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Faba bean phenology and yield responses to sowing date and water treatment – Wagga Wagga 2021

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Key findings

- Early sowing and water treatment increased grain yield.
- PBA Marne$^{\Phi}$ and PBA Nasma$^{\Phi}$ were the highest yielding varieties, while PBA Amberley$^{\Phi}$ and PBA Samira$^{\Phi}$ were the lowest yielding.
- PBA Nasma$^{\Phi}$ was the earliest maturing variety.
- Early sowing and water treatment prolonged the growth duration.
- More biomass was accumulated in early sowing and under the water treatment.

Keywords faba bean, phenology, sowing date, water, Wagga Wagga, yield, southern

Introduction

In southern NSW, abiotic stresses such as heat and moisture stress late in the season combined with cold temperatures and frost damage early in the season can limit faba bean yield potential. To maximise yield, it is important to optimise sowing and water treatment timing to ensure that critical growth phases do not coincide with the high risks from abiotic stress. This paper presents results from the Wagga Wagga site (southern NSW) in 2021 and discusses the influence of water treatment (WT) and/or sowing date (SD) on faba bean phenology and grain yield response.

Site details

Location	Wagga Wagga, NSW
Soil type	Red kandosol
Previous crop	Wheat
Sowing	Target plant density: 25 plants/m^2
Soil pH_{Ca}	6.4 (0–10 cm); 4.9 (10–20 cm)
Fertiliser	100 kg/ha, 50% mono-ammonium phosphate (MAP) and 50% single super phosphate (SSP) (nitrogen [N]:5, phosphorus [P]:15.4, potassium [K]:0, sulfur [S]:6.25) blend
Weed control	Knockdown (8 April 2021): Expedient® (adjuvant) 500 mL/100 L + Panzer 450 (herbicide; mode of action (MOA) group 9) 2 L/ha + Striker® (herbicide; MOA group 14) 100 mL/ha Pre-emergent SD1 (29 April 2021): Simagen 900 WG (herbicide; MOA group 5) 1.4 kg/ha + TriflurX® (herbicide; MOA group 3) 1.2 L/ha Pre-emergent SD2 (23 May 2021): Panzer 450 (herbicide; MOA group 9) 2 L/ha + Simagen 900 WG (herbicide; MOA group 5) 1.4 kg/ha + TriflurX® (herbicide; MOA group 3) 1.2 L/ha

This research paper is an extract from the publication *Southern NSW Research Results 2022*, available at https://www.dpi.nsw.gov.au/agriculture/broadacre-crops/guides/publications/southern-nsw-research-results

Disease management	• Dithane™ Rainshield™ NeoTec™ (fungicide; MOA group M3) 1 kg/ha (23 June 2021) • Veritas® Opti (fungicide; MOA groups 3 and 11) 500 mL/ha (23 June 2021) • Veritas® Opti (fungicide; MOA groups 3 and 11) 500 mL/ha (21 July 2021) • Dithane™ Rainshield™ NeoTec™ (fungicide; MOA group M3) 2 kg/ha (20 August 2021)
Pest management	• Trojan® (insecticide; MOA group 3A) 8 mL/ha (21 June 2021) • Karate Zeon®(insecticide; MOA group 3A) 36 mL/ha (22 October 2021) • Karate Zeon® (insecticide; MOA group 3A) 36 mL/ha (11 November 2021)
Desiccation	• Reglone® Non-residual (herbicide; MOA group 22) 1.2 L/ha (14 December 2021) • Spraytop® 250 SL (herbicide; MOA group 22) 0.8 L/ha (14 December 2021)
In-crop rainfall (April–October)	204 mm
Harvest date	SD1: 3 December 2021 SD2: 14 December 2021

Treatments

Variety

PBA Amberley$^{\phi}$, PBA Marne$^{\phi}$, PBA Nasma$^{\phi}$ and PBA Samira$^{\phi}$

Sowing date (SD)

SD1: 29 April 2021

SD2: 21 May 2021

Water treatment (overhead irrigation)

Total 94.8 mm

- 13.3 mm on 18 August
- 8.4 mm on 23 August
- 14.8 mm on 26 August
- 14.2 mm on 10 September
- 12.1 mm on 21 September
- 16 mm on 7 October
- 16 mm on 28 October

Results

Phasic development

Variety, sowing date and the interaction between the two influenced phase development, time to flower and pod initiation. Generally, the growing season was longer in SD1. This might be due to the influence from a slower accumulation of growing degree days (GDD), shorter daylength and water treatment (Figure 1).

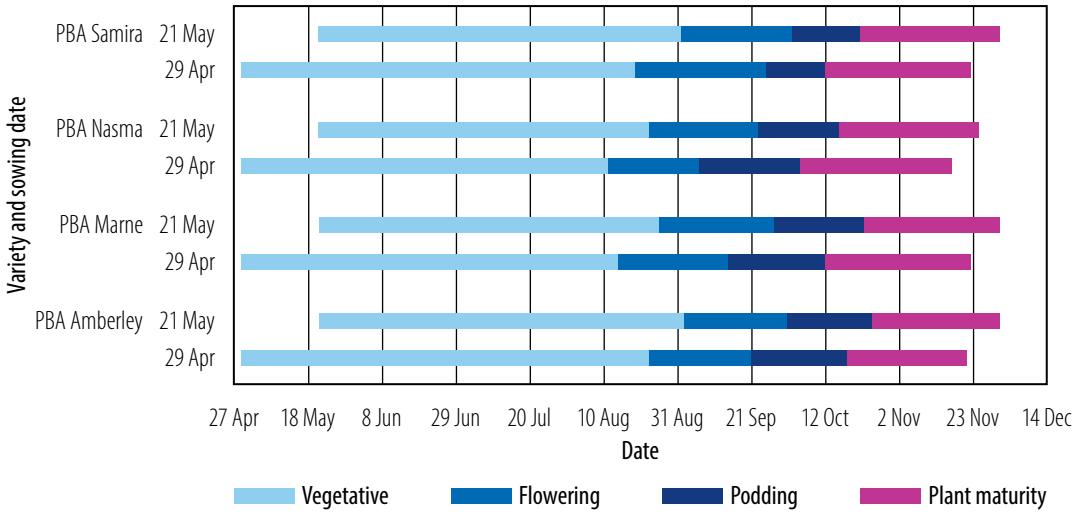

Figure 1 Influence of sowing date at Wagga Wagga on start and duration of key faba bean growth phases.

Days to plant establishment was affected by sowing date, which was longer in SD2 by 2.5 days due to cooler air and soil temperatures. Phenological traits (flowering and podding) were similarly affected by variety and sowing date, and their interaction. PBA Amberley$^{\Phi}$ was late flowering (50%) and podding (50%), with early sowing. However, the growth duration as measured by days to physiological maturity (Figure 1; Table 1) was influenced by all the main treatments (variety, sowing date and water treatment) and showed variety × sowing date; sowing date × water treatment; and variety × sowing date × water treatment interactions.

Table 1 Phenological response to sowing date for 4 faba bean varieties at Wagga Wagga, 2021.
DTEst = days to establishment; DT50F = days to 50% flowering; DT50P = days to 50% podding; DTPM = days to physiological maturity; Dry = dryland treatment, Wet = water treatment.

Variety	SD	DTEst		DT50F		DT50P		DTPM	
		Dry	Wet	Dry	Wet	Dry	Wet	Dry	Wet
PBA Amberley	29 Apr	6.43	6.27	115.8	116.2	144.4	145.7	198.7	214.0
	21 May	8.33	7.76	104.0	104.1	134.2	132.7	192.0	196.0
PBA Marne	29 Apr	6.12	6.46	107.1	107.3	139.0	138.3	201.2	214.0
	21 May	8.15	9.76	97.0	96.6	129.5	130.0	192.0	196.0
PBA Nasma	29 Apr	7.60	5.70	104.3	104.3	130.6	129.8	197.0	207.0
	21 May	8.13	9.27	94.0	94.1	125.1	125.3	183.8	192.0
PBA Samira	29 Apr	6.19	4.88	112.0	112.2	148.8	149.8	200.7	214.0
	21 May	9.05	8.87	103.1	103.2	134.6	134.9	192.0	196.0
Variety	l.s.d.	n.s.		0.17		1.14		0.54	
SD	l.s.d.	0.91		0.30		0.94		0.38	
Water treatment	l.s.d.	n.s.		n.s.		n.s.		0.38	
Variety × SD	l.s.d.	n.s.		0.31		2.24		0.76	
Variety × water treatment	l.s.d.	n.s.		n.s.		n.s.		n.s.	
SD × water treatment	l.s.d.	n.s.		n.s.		n.s.		0.53	
Variety × SD × water treatment	l.s.d.	n.s.		n.s.		n.s.		1.07	

l.s.d. = least significant difference; n.s. = not significant.

Grain yield

The main treatments (variety, sowing date and water treatment) affected grain yield, biomass, harvest index, hundred seed weight and lodging scores (Table 2). For biomass accumulation, variety × sowing date and sowing date × water treatment interactions were also observed. Late sowing and dry treatment also resulted in lower biomass accumulation. Seed weight showed variety × sowing date; variety × water treatment; and sowing date × water treatment interactions. Variety × sowing date interactions were observed for grain yield.

PBA Marne$^{\Phi}$ and PBA Nasma$^{\Phi}$ had the highest grain yield (5.40 t/ha and 5.38 t/ha, respectively) when averaged over sowing date and water treatments, significantly more than PBA Amberley$^{\Phi}$ and PBA Samira$^{\Phi}$ (Table 2). Sowing on 29 April (SD1) in the optimum window achieved a grain yield of 5.19 t/ha with an increase of 13% compared with 4.6 t/ha when sowing was delayed until 21 May (SD2) (Table 2). The 95 mm of water applied in the water treatment increased grain yield across all varieties by 22%, from 4.42 t/ha to 5.38 t/ha (Table 2).

Harvest index, the ratio of grain yield to total biomass, displayed both variety × sowing date and water treatment interactions. Both PBA Nasma$^{\Phi}$ (0.48) and PBA Marne$^{\Phi}$ (0.48) had a significantly higher harvest index than either PBA Amberley$^{\Phi}$ or PBA Samira$^{\Phi}$ (both at 0.41) (Table 2). Harvest index increased significantly with delayed sowing, from 0.41 to 0.48 (Table 2).

PBA Samira$^{\Phi}$ lodged more than the other varieties, it was also more pronounced in the water treatment and SD1. All the two-way and three-way interactions were observed for lodging.

Table 2 Biomass, grain yield and lodging response of 4 faba bean varieties for different sowing dates and water treatments at Wagga Wagga, 2021. *Dry = dryland treatment, Wet = water treatment.*

Variety	SD	Biomass (t/ha)		Hundred seed weight (g)		Grain yield (t/ha)		Harvest Index		Lodging score*	
		Dry	Wet	Dry	Wet	Dry	Wet	Dry	Wet	Dry	Wet
PBA Amberley	29 Apr	11.88	12.70	56.76	56.18	4.17	5.04	0.35	0.40	1.30	5.47
	21 May	8.46	9.98	61.64	62.65	3.60	4.53	0.43	0.45	1.19	3.50
PBA Marne	29 Apr	13.04	13.76	55.39	56.00	5.37	6.50	0.41	0.47	2.11	5.73
	21 May	8.49	10.60	54.32	58.85	4.15	5.58	0.49	0.53	1.15	2.32
PBA Nasma	29 Apr	12.39	12.58	59.56	65.77	5.58	5.89	0.45	0.47	1.65	3.24
	21 May	8.46	11.21	55.91	62.35	4.34	5.69	0.51	0.51	1.13	1.65
PBA Samira	29 Apr	12.21	12.08	57.25	56.65	4.35	4.63	0.35	0.38	2.40	7.58
	21 May	8.40	11.46	57.90	63.70	3.81	5.13	0.45	0.45	2.55	3.55
Variety	l.s.d	0.49		1.21		0.26		0.011		0.46	
SD	l.s.d	0.98		1.16		0.45		0.013		0.99	
Water treatment	l.s.d	0.99		1.27		0.44		0.020		0.87	
Variety × SD	l.s.d	0.93		1.75		0.46		0.016		0.85	
Variety × water treatment	l.s.d	n.s.		1.69		n.s.		0.019		0.80	
SD × water treatment	l.s.d	1.39		1.33		n.s.		0.02		1.23	
Variety × SD × water treatment	l.s.d	n.s.		n.s.		n.s.		n.s.		1.24	

l.s.d. = least significant difference; n.s. = not significant; * lodging score: 1 = low, 9 = high.

Summary

Seasonal conditions significantly influenced phenology and grain yield quality responses to sowing date and water treatment in 2021. Mild temperatures combined with above average soil moisture throughout the growing season masked the management practices, although varietal differences were evident. The increased biomass due to early sowing and water addition increased lodging incidence. While this is unusual it is probably due to the favourable end-of-season conditions, which did not present the abiotic stresses such as heat and moisture stress, commonly encountered at this site.

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