Albus lupin, faba bean, narrow-leaf lupin, chickpea, field pea and lentil variety experiments – Methul 2021

Jessica Simpson, Mark Richards, Dr Neroli Graham and Karl Moore
NSW DPI, Wagga Wagga

Key findings

Albus lupin

- There were no significant differences between varieties for grain yield and no trends between flowering and grain yield. The site mean for grain yield (2.7 t/ha) was above average.
- Murringo$^{\Phi}$ was the earliest flowering variety and had the longest flowering duration.
- Rosetta$^{\Phi}$ was the last variety to flower and had the highest hundred seed weight.

Faba bean

- PBA Nasma$^{\Phi}$, PBA Nanu$^{\Phi}$ and PBA Marne$^{\Phi}$ were the highest yielding varieties. PBA Amberley$^{\Phi}$, PBA Samira$^{\Phi}$ and PBA Bendoc$^{\Phi}$ yielded the lowest.
- There was a strong correlation between varieties that flowered early and had a shorter flowering duration, and higher yields.
- PBA Nanu$^{\Phi}$ and PBA Nasma$^{\Phi}$ were the earliest to flower however, they had the shortest flowering duration. PBA Amberley$^{\Phi}$ and PBA Samira$^{\Phi}$ were last to begin flowering but flowered for up to 10 days longer.
- PBA Samira$^{\Phi}$ had the highest hundred seed weight whilst PBA Bendoc$^{\Phi}$ had the lowest.

Narrow-leaf lupin

- PBA Bateman$^{\Phi}$ was the highest yielding variety and had the highest hundred seed weight.
- There was a moderately strong trend that indicated yields were higher in varieties that flowered earlier. There was a moderately strong correlation between high hundred seed weight and grain yield.
- PBA Jindalee$^{\Phi}$ was the latest to flower and had the shortest flowering duration, which resulted in the lowest yield and the lowest hundred seed weight.
- PBA Jurien$^{\Phi}$ flowered the earliest and had the longest flowering duration (8 days longer than PBA Jindalee$^{\Phi}$).

Chickpea

- PBA Slasher$^{\Phi}$ and PBA Striker$^{\Phi}$ yielded the highest, compared with PBA Royal$^{\Phi}$, Genesis™090, PBA Boundary$^{\Phi}$ and CBA Captain$^{\Phi}$, which yielded the lowest.
- Genesis™090 and PBA Royal$^{\Phi}$ (kabulis) flowered 5–6 days after desi varieties. Flowering duration was not significantly different between the varieties and there were no trends between flowering and grain yield.
- The kabuli varieties had a significantly higher hundred seed weight, compared with the desi varieties.

Field pea

- There was a moderately strong trend that indicated yields were higher in varieties that began flowering later and had a shorter flowering duration.
- PBA Percy$^{\Phi}$ was the earliest flowering variety, followed by Sturt$^{\Phi}$. PBA Butler$^{\Phi}$ was the last to begin flowering.
- PBA Butler$^{\Phi}$, PBA Pearl$^{\Phi}$, PBA Taylor$^{\Phi}$ and PBA Wharton$^{\Phi}$ were the highest yielding varieties. PBA Percy$^{\Phi}$ and Sturt$^{\Phi}$ were the lowest yielding varieties.
- PBA Percy$^{\Phi}$ had the highest hundred seed weight and Sturt$^{\Phi}$ had the lowest hundred seed weight.

Lentil

- The highest yielding varieties were PBA Kelpie XT$^{\Phi}$, PBA Jumbo2$^{\Phi}$, PBA Greenfield$^{\Phi}$ and PBA Ace$^{\Phi}$. Nipper$^{\Phi}$ was the lowest yielding variety. There were no trends between flowering and grain yield.
- PBA Blitz$^{\Phi}$ and PBA Kelpie XT$^{\Phi}$ were the earliest flowering varieties. However, varieties such as PBA Ace$^{\Phi}$, PBA Highland XT$^{\Phi}$ and PBA Hurricane XT$^{\Phi}$ flowered for a similar duration as PBA Blitz$^{\Phi}$ (53 to 54 days) despite flowering 3–6 days after PBA Blitz$^{\Phi}$.
- PBA Kelpie XT$^{\Phi}$ matured earliest and PBA Ace$^{\Phi}$, PBA Jumbo2$^{\Phi}$ and PBA Hurricane XT$^{\Phi}$ matured last.

Keywords Methul, 2021, pulses, legumes, variety

Introduction

Variety experiments were conducted at Methul in 2021 to evaluate the phenology and grain yield responses of 3 albus lupin, 6 faba bean, 6 narrow-leaf lupin, 6 chickpea, 8 field pea and 12 lentil varieties. Data was collected to assess each variety's establishment (scores and normalised vegetation index – NDVI), flowering dates, maturity score, grain yield and hundred seed weight.

Site details

Location	Methul
Soil type	Red clay loam
Soil pH_{Ca}	5.5 (0–5 cm), 5.4 (5–10 cm), 5.4 (10–15 cm), 6.1 (15–20 cm), 6.1 (20–25 cm), 6.1 (25–30 cm)
Previous crop	Wheat
Rainfall	• Fallow (November–March): 285 mm • Fallow long-term average (LTA): 181 mm • In-crop (April–October): 326 mm • In-crop LTA: 283 mm
Fertiliser	100 kg/ha, mono-ammonium phosphate (MAP) 50% and single super phosphate (SSP) 50% (blend) (nitrogen [N]: 5, phosphorus [P]: 15.4, potassium [K]: 0, sulfur [S]: 6.25)
Sowing and harvest date	Table 1 shows sowing and harvest dates for each species in the experiment.
Site climate	Figure 1 presents the climate data for the site.

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Chickpea

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- PBA Butler$^{\Phi}$, PBA Pearl$^{\Phi}$, PBA Taylor$^{\Phi}$ and PBA Wharton$^{\Phi}$ were the highest yielding varieties. PBA Percy$^{\Phi}$ and Sturt$^{\Phi}$ were the lowest yielding varieties.
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Lentil

- The highest yielding varieties were PBA Kelpie XT$^{\Phi}$, PBA Jumbo2$^{\Phi}$, PBA Greenfield$^{\Phi}$ and PBA Ace$^{\Phi}$. Nipper$^{\Phi}$ was the lowest yielding variety. There were no trends between flowering and grain yield.
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Treatments

Variety

Lupin

Luxor$^{\Phi}$, Murringo$^{\Phi}$, and Rosetta$^{\Phi}$ (albus), Mandelup$^{\Phi}$, PBA Bateman$^{\Phi}$, PBA Gunyidi$^{\Phi}$, PBA Jindalee$^{\Phi}$, PBA Jurien$^{\Phi}$ and Wonga$^{\Phi}$ (narrow-leaf or angustifolius)

Faba bean

PBA Amberley$^{\Phi}$, PBA Bendoc$^{\Phi}$, PBA Marne$^{\Phi}$, PBA Nanu$^{\Phi}$, PBA Nasma$^{\Phi}$ and PBA Samira$^{\Phi}$

Chickpea

CBA Captain$^{\Phi}$, PBA Boundary$^{\Phi}$, PBA Slasher$^{\Phi}$ and PBA Striker$^{\Phi}$ (desi), Genesis™090 and PBA Royal$^{\Phi}$ (kabuli)

Field pea

PBA Butler$^{\Phi}$, PBA Taylor$^{\Phi}$ and PBA Wharton$^{\Phi}$ (kaspa), PBA Pearl$^{\Phi}$ and Sturt$^{\Phi}$ (white), PBA Percy$^{\Phi}$ and PBA Oura$^{\Phi}$ (dun) and PBA Noosa$^{\Phi}$ (blue)

Lentil

Nipper$^{\Phi}$, PBA Ace$^{\Phi}$, PBA Blitz$^{\Phi}$, PBA Bolt$^{\Phi}$, PBA Flash$^{\Phi}$, PBA Hallmark XT$^{\Phi}$, PBA Highland XT$^{\Phi}$, PBA Hurricane XT$^{\Phi}$, PBA Jumbo2$^{\Phi}$ and PBA Kelpie XT$^{\Phi}$ (red), and PBA Greenfield$^{\Phi}$ (green)

Table 1 Sowing and harvest time of the different pulse species at Methul, 2021.

Species	Sowing date	Harvest date
Lupin – narrow-leaf	7 May	2 December
Lupin – albus	7 May	23 December
Faba bean	7 May	18 November
Chickpea	7 May	23 December
Field pea	8 June	18 November
Lentil	7 May	18 November

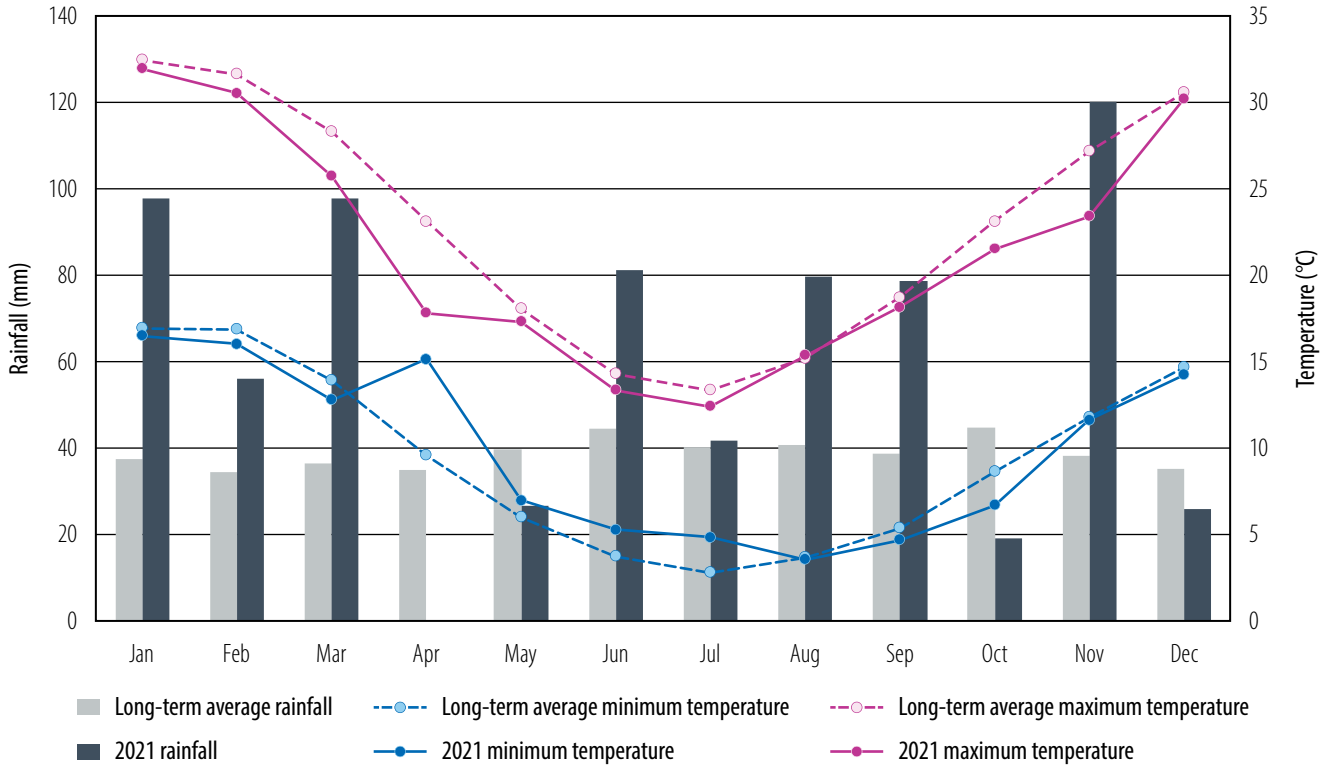

Figure 1 Monthly rainfall and temperature for Anglia, Methul and the associated long-term average.

Treatments

Variety

Lupin

Luxor$^{\Phi}$, Murringo$^{\Phi}$, and Rosetta$^{\Phi}$ (albus), Mandelup$^{\Phi}$, PBA Bateman$^{\Phi}$, PBA Gunyidi$^{\Phi}$, PBA Jindalee$^{\Phi}$, PBA Jurien$^{\Phi}$ and Wonga$^{\Phi}$ (narrow-leaf or angustifolius)

Faba bean

PBA Amberley$^{\Phi}$, PBA Bendoc$^{\Phi}$, PBA Marne$^{\Phi}$, PBA Nanu$^{\Phi}$, PBA Nasma$^{\Phi}$ and PBA Samira$^{\Phi}$

Chickpea

CBA Captain$^{\Phi}$, PBA Boundary$^{\Phi}$, PBA Slasher$^{\Phi}$ and PBA Striker$^{\Phi}$ (desi), Genesis™090 and PBA Royal$^{\Phi}$ (kabuli)

Field pea

PBA Butler$^{\Phi}$, PBA Taylor$^{\Phi}$ and PBA Wharton$^{\Phi}$ (kaspa), PBA Pearl$^{\Phi}$ and Sturt$^{\Phi}$ (white), PBA Percy$^{\Phi}$ and PBA Oura$^{\Phi}$ (dun) and PBA Noosa$^{\Phi}$ (blue)

Lentil

Nipper$^{\Phi}$, PBA Ace$^{\Phi}$, PBA Blitz$^{\Phi}$, PBA Bolt$^{\Phi}$, PBA Flash$^{\Phi}$, PBA Hallmark XT$^{\Phi}$, PBA Highland XT$^{\Phi}$, PBA Hurricane XT$^{\Phi}$, PBA Jumbo2$^{\Phi}$ and PBA Kelpie XT$^{\Phi}$ (red), and PBA Greenfield$^{\Phi}$ (green)

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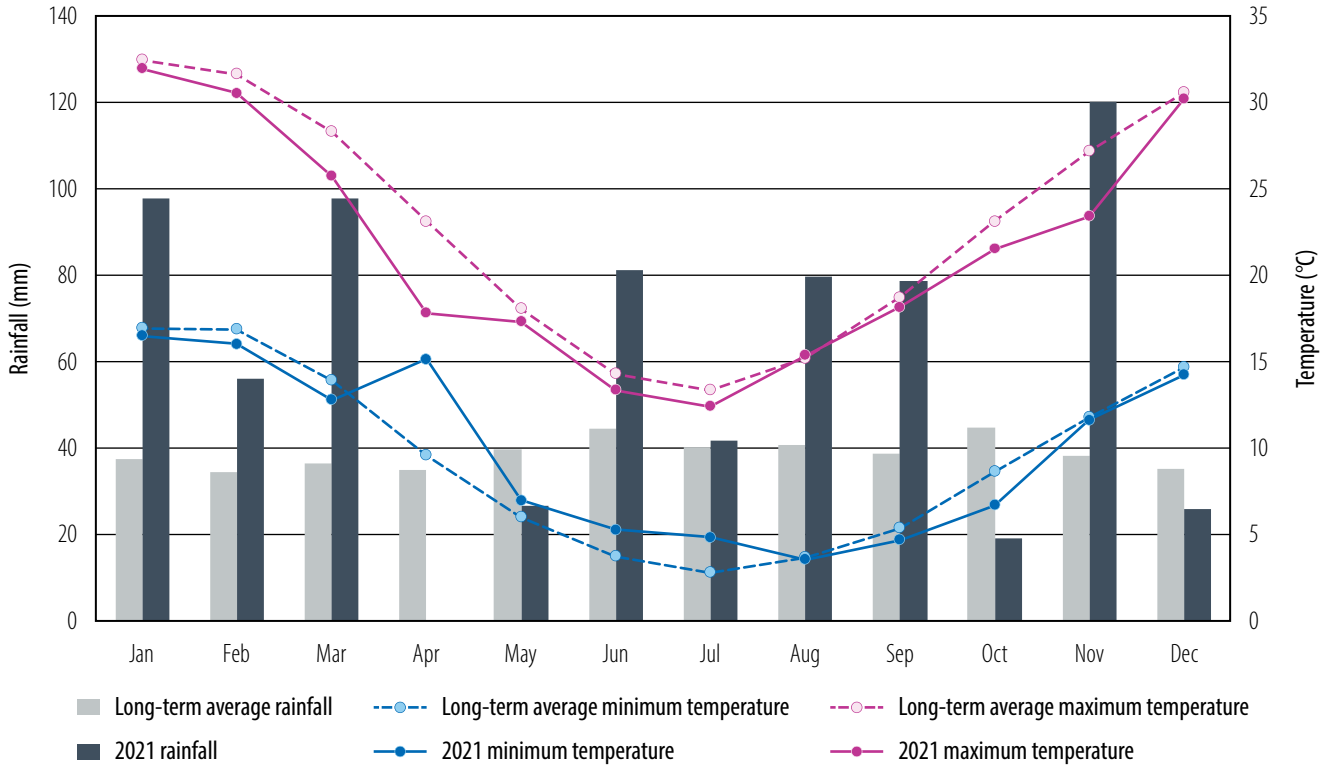

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Results

Seasonal conditions

The 2021 season at Methul was exceptional, with above average rainfall when crops were accumulating biomass and setting pods, and La Niña conditions that resulted in cooler than average temperatures. The site recorded 4 frosts (<0 °C) during the flowering period (August to September). The 2 heaviest frosts included:

1. one moderate frost on 28 August, reaching −1.4 °C and lasting 3 hours below 0 °C
2. one severe frost, on 26 September reaching −1.5 °C and lasting 5 hours below 0 °C.

With adequate soil moisture, long cool spring temperatures, and negligible moisture, temperature or disease stress, the seasonal conditions were conducive to above average grain yields across all pulse species.

Albus lupin

Murringo$^{\Phi}$ was the earliest flowering variety (106 days after sowing [DAS]) and had the longest flowering duration (55 days) (Table 2). Rosetta$^{\Phi}$ was the last variety to flower (121 DAS) and had the highest hundred seed weight (38.2 g/100 seeds). All varieties had similar grain yields, which ranged from 2.64 t/ha to 2.77 t/ha, with a site mean of 2.70 t/ha.

Table 2 Albus lupin variety evaluation experiment results, Methul 2021.

Variety	Establishment (plants/m^2)	Days to flowering (DAS)		Flowering duration (days)	Grain yield (t/ha)	Hundred seed weight (g)
		Start	End			
Luxor	41.8	116.2	161.2	45.0	2.64	35.16
Murringo	42.0	105.7	160.7	55.0	2.77	34.18
Rosetta	44.5	121.0	159.8	38.8	2.71	38.17
Site mean	42.7	114.3	160.6	46.3	2.70	35.84
l.s.d. (P>0.05)	n.s.	0.4	0.9	0.8	n.s.	1.23

l.s.d. = least significant difference; n.s. = not significant; DAS = days after sowing.

Faba bean

PBA Nasma$^{\Phi}$ was the earliest flowering variety (98 DAS), followed by PBA Nanu$^{\Phi}$ (100 DAS) (Table 3). However, they had the shortest flowering duration (43 and 42 days, respectively). PBA Amberley$^{\Phi}$ and PBA Samira$^{\Phi}$ were last to begin flowering (104 and 103 DAS, respectively), yet flowered for more than 7 days longer than either PBA Nanu$^{\Phi}$ or PBA Nasma$^{\Phi}$.

Table 3 Faba bean variety evaluation experiment results, Methul 2021.

Variety	Establishment (plants/m^2)	Days to flowering (DAS)		Flowering duration (days)	Grain yield (t/ha)	Hundred seed weight (g)
		Start	End			
PBA Amberley	28.0	103.7	155.3	51.7	4.31	65.74
PBA Bendoc	27.9	102.0	155.0	53.0	4.43	58.47
PBA Marne	29.6	101.0	150.3	49.3	4.86	64.25
PBA Nanu	30.4	100.0	142.0	42.0	4.83	63.41
PBA Nasma	24.8	98.0	141.0	43.0	4.87	69.26
PBA Samira	25.5	103.3	154.0	50.7	4.47	70.41
Site mean	28.1	100.9	148.7	47.8	4.66	64.23
l.s.d. (P>0.05)	n.s.	1.0	1.8	2.1	0.21	3.45

l.s.d. = least significant difference; n.s. = not significant; DAS = days after sowing.

PBA Nasma$^{\Phi}$ (4.87 t/ha), PBA Marne$^{\Phi}$ (4.86 t/ha) and PBA Nanu$^{\Phi}$ (4.83 t/ha) were the highest yielding varieties, significantly higher than all other varieties. PBA Amberley$^{\Phi}$ (4.31 t/ha), PBA Samira$^{\Phi}$ (4.47 t/ha) and PBA Bendoc$^{\Phi}$ (4.43 t/ha) yielded the lowest. PBA Samira$^{\Phi}$ had the highest hundred seed weight (70.4 g/100 seeds), followed by PBA Nasma$^{\Phi}$ (69.26 g/100 seeds) and PBA Amberley$^{\Phi}$ (65.7 g/100 seeds), while PBA Bendoc$^{\Phi}$ had the lowest (58.5 g/100 seeds).

Narrow-leaf lupin

There were significant differences in establishment, time of flowering, grain yield and hundred seed weight in the angustifolius experiment (Table 4). PBA Jindalee$^{\Phi}$, which has a vernalisation requirement, was significantly later to flower (120 DAS) and had a significantly shorter flowering duration (40.7 days) than all other varieties. PBA Jindalee$^{\Phi}$ was also the lowest yielding (2.39 t/ha). PBA Jurien$^{\Phi}$ flowered the earliest (105 DAS) and had the longest flowering duration (8 days longer than PBA Jindalee$^{\Phi}$).

PBA Bateman$^{\Phi}$ was the highest yielding variety (3.75 t/ha), equivalent to Mandelup$^{\Phi}$ (3.60 t/ha). In contrast, PBA Jindalee$^{\Phi}$ and Wonga were the lowest (2.93 t/ha and 3.13 t/ha respectively). PBA Bateman$^{\Phi}$ also had the highest hundred seed weight (17.7 g/100 seeds), and PBA Jindalee$^{\Phi}$ the lowest (13.1 g/100 seeds).

Table 4 Narrow-leaf lupin variety evaluation experiment results, Methul 2021.

Variety	Establishment (plants/m^2)	Days to flowering (DAS)		Flowering duration (days)	Grain yield (t/ha)	Hundred seed weight (g)
		Start	End			
Mandelup	45.7	109.0	154.0	45.0	3.60	16.29
PBA Bateman	40.2	108.0	154.7	46.7	3.75	17.72
PBA Gunyidi	41.4	107.3	155.0	47.7	3.45	14.30
PBA Jindalee	36.9	120.3	161.0	40.7	2.93	13.13
PBA Jurien	36.5	105.3	154.0	48.7	3.44	16.97
Wonga	41.6	112.7	158.0	45.3	3.13	14.99
Site mean	40.4	110.4	156.1	45.7	3.38	15.57
l.s.d. (P>0.05)	4.8	1.5	0.4	1.4	0.25	0.68

l.s.d. = least significant difference; DAS = days after sowing.

Chickpea

Genesis™090 and PBA Royal$^{\Phi}$ (kabuli varieties) flowered 5 to 6 days after the 4 desi varieties (Table 5). Flowering duration was not significantly different between all varieties. PBA Slasher$^{\Phi}$ was the highest yielding variety (2.16 t/ha), which was significantly higher than all other varieties, followed by Striker (1.95 t/ha). In comparison, PBA Royal$^{\Phi}$, Genesis™090, PBA Boundary$^{\Phi}$ and CBA Captain$^{\Phi}$ had yields that ranged from 1.58 t/ha to 1.69 t/ha, which were all similar in value. The site mean yield (1.77 t/ha) for this experiment was significantly lower than all other pulse species at this site. This is attributed to the cooler than average mean daily temperatures affecting pod set during the critical reproductive window in September and October.

The kabuli varieties had a significantly higher hundred seed weight (32.1 to 32.7 g/100 seeds) in comparison to the desi varieties, which ranged between 21.2 g/100 seeds and 23.4 g/100 seeds.

Table 5 Chickpea variety evaluation experiment results, Methul 2021.

Variety	Establishment (plants/m²)	Days to flowering (DAS)	Flowering duration (days)	Grain yield (t/ha)	Hundred seed weight (g)
CBA Captain	36.1	126.0	44.7	1.69	23.11
PBA Boundary	39.2	126.7	44.7	1.59	21.20
PBA Slasher	39.3	126.7	45.3	2.16	22.32
PBA Striker	38.3	126.0	44.3	1.95	23.38
Genesis™090	41.4	131.3	46.3	1.58	32.10
PBA Royal	39.0	133.3	46.7	1.67	32.70
Site mean	38.9	128.3	45.3	1.77	25.80
l.s.d. (*P*>0.05)	n.s.	0.8	n.s.	0.19	1.61

l.s.d. = least significant difference; n.s. = not significant; DAS = days after sowing.

Field pea

PBA Butler$^{\Phi}$, PBA Pearl$^{\Phi}$, PBA Taylor$^{\Phi}$ and PBA Wharton$^{\Phi}$ were the highest yielding varieties and, while not significantly different from one another, each had a grain yield over 3.41 t/ha (Table 6). In contrast, PBA Percy$^{\Phi}$ and Sturt$^{\Phi}$ were the lowest yielding varieties (2.70 and 2.60 t/ha, respectively) (Table 6). PBA Percy$^{\Phi}$ was the earliest flowering variety (98 DAS), followed by Sturt$^{\Phi}$ (101 DAS). PBA Butler$^{\Phi}$ was the last to begin flowering (111 DAS).

PBA Percy$^{\Phi}$ had the highest hundred seed weight (21.3 g/100 seeds), whilst Sturt had the lowest (16.8 g/100 seeds).

Table 6 Field pea variety evaluation experiment results, Methul 2021.

Variety	Establishment (plants/m2)	Days to flowering (DAS)		Flowering duration (days)	Grain yield (t/ha)	Hundred seed weight (g)
		Start	End			
PBA Butler	50.5	110.7	135.7	25.0	3.41	19.43
PBA Noosa	47.0	103.7	137.0	33.3	3.26	19.75
PBA Oura	42.9	103.0	137.3	34.3	2.94	20.97
PBA Pearl	38.7	103.7	137.3	33.7	3.48	19.36
PBA Percy	45.3	97.7	138.3	40.7	2.70	21.30
PBA Taylor	48.1	106.7	135.7	29.0	3.57	19.59
PBA Wharton	42.2	107.3	137.0	29.7	3.41	19.43
Sturt	40.6	101.3	137.7	36.3	2.60	16.82
Site mean	44.4	104.3	137.0	32.7	3.17	19.58
l.s.d. (*P*>0.05)	7.1	1.6	n.s.	2.9	0.21	0.68

l.s.d. = least significant difference; n.s. = not significant; DAS = days after sowing.

Lentil

PBA Blitz$^{\Phi}$ and PBA Kelpie XT$^{\Phi}$ were the earliest flowering varieties (111 and 112 DAS, respectively) (Table 7). However, varieties such as PBA Ace$^{\Phi}$, PBA Highland XT$^{\Phi}$ and PBA Hurricane XT$^{\Phi}$ flowered for a similar duration as PBA Blitz$^{\Phi}$ (53 to 54 days) despite flowering 3 to 6 days after PBA Blitz$^{\Phi}$. Weather conditions were conducive to flowering and, due to the indeterminate nature of lentils, they continued to flower over a long period of time. There were significant differences in the number of days until the end of flowering with PBA Kelpie XT$^{\Phi}$ finishing flowering earliest (159 DAS) and PBA Ace$^{\Phi}$, finishing flowering latest (170 DAS).

The highest yielding varieties were PBA Kelpie XT$^{\Phi}$ (4.2 t/ha), PBA Jumbo2$^{\Phi}$ (4.0 t/ha), PBA Greenfield$^{\Phi}$ (4.0 t/ha) and PBA Ace$^{\Phi}$ (3.9 t/ha). Nipper$^{\Phi}$ was the lowest yielding variety (3.1 t/ha).

Table 7 Lentil variety evaluation experiment results, Methul 2021.

Variety	NDVI+ (18/8/21)	Vigour Score* (18/8/21)	Days to flowering (DAS)		Flower duration (days)	Grain yield (t/ha)
			Start	End		
Nipper	0.49	6.5	130.5	166.0	35.5	3.09
PBA Ace	0.71	9.0	117.0	170.0	53.0	3.85
PBA Blitz	0.60	8.5	110.5	163.0	52.5	3.72
PBA Bolt	0.57	9.0	116.5	167.5	51.0	3.78
PBA Flash	0.57	9.0	123.5	163.0	39.5	3.36
PBA Greenfield	0.60	8.0	124.0	168.0	44.0	3.97
PBA Hallmark XT	0.67	9.0	117.5	167.5	50.0	3.29
PBA Highland XT	0.51	8.5	114.0	167.5	53.5	3.71
PBA Hurricane XT	0.61	9.0	115.0	169.0	54.0	3.75
PBA Jumbo2	0.60	9.0	115.5	169.0	53.5	3.97
PBA Kelpie XT	0.59	9.0	111.5	159.0	47.5	4.19
Site mean	0.60	8.6	118.2	166.6	48.4	3.63
l.s.d. (P>0.05)	0.13	1.1	2.7	3.3	3.9	0.38

l.s.d. = least significant difference; +NDVI: normalised difference vegetation index; *Vigour score: 1 = low, 9 = high; DAS = days after sowing.

Summary

The 2021 winter growing season was exceptionally favourable, particularly through the critical reproductive window, with a combination of cool temperatures, minimal frosts and adequate soil moisture resulting in all experiments producing high grain yields (overall site average of 3.2 t/ha). The lentil, chickpea and albus lupin experiments did not show any trends between flowering and yield. The field pea experiment showed a moderately strong trend that indicated yields were higher in varieties that began flowering later and had a shorter flowering duration. The narrow-leaf lupin experiment showed a moderately strong trend that indicated yields were higher in varieties that flowered early. Narrow-leaf lupins also had a moderately strong correlation between higher hundred seed weight and higher grain yield. The faba bean experiment showed a strong correlation between varieties that flowered early and had a shorter flowering duration, and higher yields.

Acknowledgements

Thank you to Greg Graham and family, Anglia, Methul for their ongoing collaboration and support of pulse research through providing the field site.

Thanks to Scott Clark and Nelson West for technical assistance.

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