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Published by NSW Department of Primary Industries,
a part of the Department of Regional New South Wales.

Albus lupin, lentil, chickpea, field pea, vetch and faba bean variety experiments – Wagga Wagga 2021

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Key findings

Lupin

- Rosetta[Φ] was the highest yielding variety with 3.39 t/ha, with a later start and finish date to flowering as well as a longer flowering duration, than either Luxor[Φ] or Murringo[Φ].
- Luxor[Φ] and Murringo[Φ] were similar for grain yield, days to flowering and flowering duration in 2021.

Lentil

- PBA Jumbo2[Φ] was the highest yielding variety in 2021 with 2.46 t/ha, more than 0.5 t/ha higher than all other varieties.
- PBA Bolt[Φ] and PBA Kelpie XT[Φ] were first to flower, with all varieties flowering within 6 days of each other.

Chickpea

- PBA Slasher[Φ] was the highest yielding variety with 2.93 t/ha, with CBA Captain[Φ] and PBA Boundary[Φ] having similar yields.
- There was 5 days difference between the varieties in time to the start of flowering.

Field pea

- Grain yield was similar for all the field pea varieties at Wagga Wagga in 2021.
- Early flowering was seen in PBA Percy[Φ] and Sturt[Φ] at 101 to 103 days after sowing, and late flowering in PBA Butler[Φ] at 130 days after sowing.
- Flowering duration ranged from 30 to 49 days across all varieties. PBA Butler[Φ] had a very short flowering duration of 30 days while PBA Percy[Φ] and Sturt[Φ] flowered for over 48 days.

Vetch

- Timok[Φ] grain yield was 2.14 t/ha, similar to Volga[Φ] at 1.85 t/ha yet higher than the other varieties.
- Sixteen days separated the earliest flowering variety from the latest. Early flowering Studenica[Φ] flowered 111 days after sowing, 16 days earlier than Morava[Φ].
- Flowering duration ranged from 30 to 43 days, for Timok[Φ] and Studenica[Φ], respectively.

Faba bean

- Cairo[Φ] was the highest yielding variety with 5.7 t/ha, with PBA Marne[Φ], PBA Nanu[Φ] and PBA Nasma[Φ] having similar yields.
- There was 12 days difference between the first variety to flower, Doza[Φ] at 96.7 days after sowing, and the last variety to flower, Nura[Φ] at 109 days after sowing.

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

Key words Wagga Wagga, 2021, pulses, legumes, variety

Introduction

Varietal experiments were conducted to investigate establishment, crop phenology, days to flowering, flowering duration, and grain yield responses of commercially available pulse and legume varieties. All species were sown in the optimal sowing window. This paper reports the findings from these experiments.

Site details

Location	Wagga Wagga Agricultural Institute
Soil type	Red kandosol
Previous crop	Wheat
Rainfall	• Fallow (December–March): 306 mm • Fallow long-term average (LTA): 157 mm • In-crop (April–October): 204 mm • In-crop LTA: 329 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 the sowing and harvest dates for each crop.

Table 1 Sowing and harvest dates for the 6 species used in variety experiments at Wagga Wagga Agricultural Institute in 2021.

Species	Sowing date	Harvest date
Lupin	14 May 2021	4 December 2021
Lentil	14 May 2021	8 December 2021
Chickpea	14 May 2021	19 January 2022
Field pea	1 June 2021	7 December 2021
Faba bean	5 May 2021	4 December 2021
Vetch	15 May 2021	6 December 2021

Treatments

Varieties

Lupin: Rosetta$^{\Phi}$, Luxor$^{\Phi}$ and Murringo$^{\Phi}$

Lentil: PBA Ace$^{\Phi}$, PBA Bolt$^{\Phi}$, PBA Hallmark XT$^{\Phi}$, PBA Jumbo2$^{\Phi}$and PBA Kelpie XT$^{\Phi}$ (red) and PBA Greenfield$^{\Phi}$ (green)

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

Faba bean: Cairo$^{\Phi}$, Doza$^{\Phi}$, Farah$^{\Phi}$, PBA Amberley$^{\Phi}$, PBA Bendoc$^{\Phi}$, PBA Marne$^{\Phi}$, PBA Nanu$^{\Phi}$, PBA Nasma$^{\Phi}$, PBA Samira$^{\Phi}$, PBA Warda$^{\Phi}$ and PBA Zahra$^{\Phi}$

Vetch: Morava$^{\Phi}$, Studencia$^{\Phi}$, Timok$^{\Phi}$ and Volga$^{\Phi}$

Results

Seasonal conditions

Above average rainfall from January to March provided adequate soil moisture for sowing on 14 May, 15 May and 1 June sowing dates. Mild environmental conditions extended throughout the growing season, which led to large crop biomass and extended flowering windows and resulted in later than usual harvest timings.

Lupin

Grain yield was significantly higher for Rosetta$^{\Phi}$ (3.39 t/ha), when compared with Luxor$^{\Phi}$ (3.02 t/ha) and Murringo$^{\Phi}$ (3.01 t/ha) (Table 2). Rosetta$^{\Phi}$ also had a higher hundred seed weight (43.9 g), than Luxor$^{\Phi}$ and Murringo$^{\Phi}$ (both under 41.0 g) (Table 2).

There were significant differences between varieties in the number of days after sowing (DAS) to the start and end of flowering. Murringo$^{\Phi}$ was first to flower (113 DAS) followed by Luxor$^{\Phi}$ (114 DAS) and Rosetta$^{\Phi}$ (117 DAS) which were both significantly later than Murringo$^{\Phi}$ (Table 2). Rosetta$^{\Phi}$ finished flowering significantly later (177 DAS) than Murringo$^{\Phi}$ and Luxor$^{\Phi}$ (172 and 173 DAS, respectively) (Table 2). This resulted in a longer flowering duration for Rosetta$^{\Phi}$ (60.5 days) compared with Luxor$^{\Phi}$ and Murringo$^{\Phi}$ (both 59 days) (Table 2).

Table 2 Albus lupin variety experiment results, Wagga Wagga Agricultural Institute, 2021.

Variety	Establishment (plants/m^2)	Days to flowering (DAS)		Flowering duration (days)	Grain yield (t/ha)	Hundred seed weight (g)
		Start	End			
Luxor	34.4	114.0	173.0	59.0	3.02	40.14
Murringo	28.0	113.0	172.0	59.0	3.01	40.68
Rosetta	35.5	117.0	177.5	60.5	3.39	43.87
Site mean	32.6	114.0	174.2	59.5	3.10	41.56
l.s.d. (P<0.05)	5.7	0.5	1.0	1.3	0.12	1.6

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

Lentil

PBA Jumbo2$^{\Phi}$ was the highest yielding variety (2.46 t/ha), out yielding all the other varieties by over 0.5 t/ha (Table 3). Lentil grain yields were lower than expected as pre harvest storms caused some pod drop and shattering. PBA Greenfield$^{\Phi}$ had the highest hundred seed weight (4.21 g/100 seeds), PBA Ace$^{\Phi}$ had a similar hundred seed weight (4.01 g/100 seeds) and PBA Hallmark XT$^{\Phi}$ had the lowest hundred seed weight (3.52 g/100 seeds) (Table 3).

There were significant differences in days to flowering and flowering duration between lentil varieties. PBA Bolt$^{\Phi}$ and PBA Kelpie XT$^{\Phi}$ began flowering 146 DAS, which was significantly earlier than the site average of 150 days. PBA Ace$^{\Phi}$ and PBA Greenfield$^{\Phi}$ began flowering 153 and 152 DAS respectively (Table 3). There were varietal differences in flowering duration. PBA Ace$^{\Phi}$ had the shortest flowering duration (42 days) followed by PBA Greenfield$^{\Phi}$ (43 days), PBA Hallmark XT$^{\Phi}$ (44 days) and PBA Jumbo2$^{\Phi}$ (44 days). PBA Bolt$^{\Phi}$ and PBA Kelpie XT$^{\Phi}$ both had a significantly longer flowering duration (47 days), when compared with all the other varieties (Table 3).

Table 3 Lentil variety experiment results, Wagga Wagga Agricultural Institute, 2021.

Variety	Establishment (plants/m^2)	Days to flowering (DAS)		Flowering duration (days)	Grain yield (t/ha)	Hundred seed weight (g)
		Start	End			
PBA Ace	127.0	152.7	165.0	42.3	1.89	4.01
PBA Bolt	122.7	146.3	164.0	47.7	1.82	3.84
PBA Greenfield	129.3	152.3	165.3	43.0	1.76	4.21
PBA Hallmark XT	122.3	150.7	164.7	44.0	1.88	3.52
PBA Jumbo2	124.3	150.3	165.0	44.7	2.46	3.91
PBA Kelpie XT	118.0	146.3	164.0	47.7	1.88	3.92
Site mean	123.9	149.8	164.7	44.9	1.95	3.90
l.s.d. (P<0.05)	n.s.	1.1	n.s.	1.8	0.40	0.23

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

Chickpea

PBA Slasher$^{\Phi}$ had the highest grain yield (2.93 t/ha), which was significantly higher than all other varieties except CBA Captain$^{\Phi}$ (2.68 t/ha). All other varieties, including the kabuli type, had similar yield (Table 4).

CBA Captain$^{\Phi}$ was first to flower (140 DAS) and PBA Slasher$^{\Phi}$ was last to start flowering (145 DAS) (Table 4). Mild temperatures during spring combined with adequate soil moisture led to extended flowering and pod set duration. The experiment was not harvested until mid January with flowering continuing until 2 weeks before harvest.

Table 4 Chickpea variety experiment results, Wagga Wagga Agricultural Institute, 2021.

Variety	Establishment (plants/m^2)	Days to flowering (DAS)	Grain yield (t/ha)	Hundred seed weight (g)
CBA Captain	46.1	140.0	2.68	22.78
Genesis090	43.8	142.3	2.10	31.27
PBA Boundary	44.2	143.3	2.43	21.00
PBA Royal	46.6	143.0	2.10	30.76
PBA Slasher	45.1	145.3	2.93	21.29
PBA Striker	44.6	140.7	2.29	23.40
Site mean	45.1	142.4	2.42	25.08
l.s.d. (P<0.05)	n.s.	2.3	0.47	1.46

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

Field pea

All varieties had similar yields. PBA Butler$^{\Phi}$ had the highest yield (2.79 t/ha) and PBA Oura$^{\Phi}$ had the lowest yield (2.21 t/ha) (Table 5). There were significant differences in days to flowering. PBA Percy$^{\Phi}$ and Sturt$^{\Phi}$ were the first varieties to flower (101 and 103 DAS respectively). PBA Butler$^{\Phi}$ flowered significantly later than all the other varieties (130 DAS) (Table 5).

PBA Butler$^{\Phi}$ had a significantly shorter flowering duration (29 days) when compared with all the other varieties and PBA Percy$^{\Phi}$ and Sturt$^{\Phi}$ had a significantly longer flowering duration (48 days) (Table 5). Hundred seed weight varied across the varieties. PBA Percy$^{\Phi}$ had the highest hundred seed weight (19.53 g/100 seeds) and Sturt$^{\Phi}$ had the lowest (15.33 g/100 seeds) (Table 5).

Table 5 Field pea variety experiment results, Wagga Wagga Agricultural Institute, 2021.

Variety	Establishment count (plants/m^2)	Days to flowering (DAS)		Flowering duration (days)	Grain yield (t/ha)	Hundred seed weight (g)
		Start	End			
PBA Butler	43.0	130.0	149.7	29.7	2.79	17.22
PBA Noosa	41.0	111.0	150.7	39.7	2.44	17.87
PBA Oura	37.3	109.0	150.7	41.7	2.21	17.75
PBA Pearl	43.7	109.0	149.3	40.3	2.38	18.55
PBA Percy	42.7	101.3	150.0	48.7	2.37	19.53
PBA Taylor	39.3	114.7	150.3	35.7	2.35	17.46
PBA Wharton	46.3	112.7	150.7	38.0	2.59	16.84
Sturt	41.7	103.3	151.7	48.3	2.35	15.33
Site mean	41.9	113.9	150.4	36.5	2.43	17.57
l.s.d. (P<0.05)	n.s.	2.0	n.s.	3.0	n.s.	0.8

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

Vetch

Timok$^{\Phi}$ had the highest grain yield (2.14 t/ha) of the 4 varieties, Morava$^{\Phi}$ had the lowest (1.5 t/ha) (Table 6). Vetch grain yields were lower than expected with pre harvest storms causing some pod drop and shattering, combined with lodging and the resultant harvest difficulties.

There were significant differences in days to flowering for all commercial varieties, Studenica$^{\Phi}$ was first to flower (111 DAS), followed by Volga$^{\Phi}$, Timok$^{\Phi}$ and Morava$^{\Phi}$ (115, 120 and 127 DAS respectively) (Table 6). Differences in days to end of flowering were also observed as Timok$^{\Phi}$ (149 days) and Volga$^{\Phi}$ (150 days) ended flowering significantly earlier than Studenica$^{\Phi}$ and Morava$^{\Phi}$ (154 and 163 days respectively) (Table 6). Flowering duration for Timok$^{\Phi}$ was significantly shorter than the other varieties, ending after 29 days after starting flowering while Studenica$^{\Phi}$ had a significantly longer flowering duration of 43 days (Table 6).

Table 6 Vetch variety experiment results, Wagga Wagga Agricultural Institute, 2021.

Variety	Days to flowering (DAS)		Flowering duration (days)	Dry matter (t/ha)	Maturity score*	Grain yield (t/ha)
	Start	End				
Morava	127.3	163.7	36.3	6.2	8.7	1.50
Studenica	111.3	154.7	43.3	5.5	3.3	1.75
Timok	120.0	149.7	29.7	6.2	5.0	2.14
Volga	115.0	150.3	35.3	5.9	5.7	1.85
Site mean	119.2	154.6	35.4	6.1	5.5	1.84
l.s.d. (P<0.05)	2.0	1.9	2.4	n.s.	0.80	0.25

l.s.d. = least significant difference; DAS = days after sowing; n.s. = not significant; * Maturity score: 1 = early, 9 = late.

Faba bean

Cairo$^{\Phi}$ was the highest yielding variety (5.70 t/ha), with PBA Nanu$^{\Phi}$ (5.49 t/ha) and PBA Nasma$^{\Phi}$ (5.43 t/ha) having similar grain yields. These 3 faba bean varieties had yields significantly higher yielding than Doza$^{\Phi}$ (4.90 t/ha), PBA Amberley$^{\Phi}$ (4.88 t/ha), PBA Bendoc$^{\Phi}$ (4.86 t/ha), PBA Samira$^{\Phi}$ (4.73 t/ha) and Nura$^{\Phi}$ (4.65 t/ha) (Table 7).

Significant differences were observed in days to flowering with Doza$^{\Phi}$ and Cairo$^{\Phi}$ being first to flower after 97 days, followed by PBA Nasma$^{\Phi}$ (98 days), PBA Nanu$^{\Phi}$ (98 days), PBA Warda$^{\Phi}$ (99 days) and PBA Marne$^{\Phi}$ (100 days) (Table 7). Nura$^{\Phi}$ took 109 days to flower, significantly later than all other varieties

and the site mean (Table 7). Other later flowering varieties also included, PBA Samira$^{\Phi}$ (106 days), PBA Amberley$^{\Phi}$ (105 days), PBA Zahra$^{\Phi}$ (104 days) and PBA Bendoc$^{\Phi}$ (104 days) which all flowered significantly later than the site average (Table 7).

There were significant varietal differences in flowering duration with Nura$^{\Phi}$ and PBA Nasma$^{\Phi}$ having the shortest flowering duration of 52 days and PBA Marne$^{\Phi}$ the longest with 63 days (Table 7).

Table 7 Faba bean variety experiment results, at Wagga Wagga Agricultural Institute, 2021.

Variety	Establishment score (21/7/2021)	NDVI	Vigour score† (23/8/21)	Days to flowering (DAS)	Flower duration (days)	Maturity score* (10/11/21)	Grain yield (t/ha)	Harvest score+ (29/11/21)
Cairo	8.0	0.53	9.0	97.7	59.7	3.0	5.70	7.7
Doza	8.0	0.47	8.3	96.7	60.3	4.3	4.90	8.0
Farah	7.7	0.51	8.7	102.0	60.0	4.3	4.99	6.7
Nura	7.3	0.44	8.0	109.0	51.7	5.7	4.65	7.3
PBA Amberley	7.7	0.49	8.3	105.0	54.3	6.3	4.88	9.0
PBA Bendoc	6.7	0.42	7.3	104.3	56.0	7.7	4.86	5.7
PBA Marne	7.0	0.45	8.3	100.0	62.7	2.7	5.22	8.3
PBA Nanu	7.7	0.53	8.7	98.7	56.7	3.7	5.49	7.3
PBA Nasma	7.7	0.51	9.0	98.3	51.7	2.0	5.43	7.3
PBA Samira	7.3	0.49	8.3	106.7	53.3	5.7	4.73	7.7
PBA Warda	7.3	0.48	8.7	99.3	55.7	1.7	5.04	7.7
PBA Zahra	7.0	0.53	8.0	104.7	58.7	8.3	5.18	7.3
Site mean	7.7	0.49	8.4	102.3	56.1	4.5	5.09	7.5
l.s.d. (P<0.05)	n.s.	0.07	0.8	1.4	3.2	1.5	0.45	1.7

l.s.d. = least significant difference; DAS = days after sowing; n.s. = not significant; NDVI: normalised difference vegetation index; † Vigour score 1 = low, 9 = high; * Maturity score: 1 = early, 9 = late; + Harvest score: 1 = severe lodging, 9 = erect plants.

Summary

The 2021 winter growing season was favourable for growing pulse and legume crops. Temperatures were mild and the soil moisture adequate during the crops vegetative stage, which resulted in high biomass accumulation during winter and early spring. Mild to optimal temperatures and lack of moisture stress during the reproductive period extended the grain filling duration resulting in above average yields for southern NSW. Ideal environmental conditions combined with a proactive fungicide program resulted in large crop biomass and near perfect flowering and pod fill conditions which contributed to above average yields. Seed quality was affected by several wetting and drying cycles in November prior to harvest, which is likely to reduce seed germination and the resulting plant establishment in the following crop.

Acknowledgements

Thanks to Scott Clark and Nelson West for technical assistance.

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