Department of Primary Industries
Department of Regional NSW

NSW research results

RESEARCH & DEVELOPMENT – INDEPENDENT RESEARCH FOR INDUSTRY

The following paper is from an edition of the Northern or Southern New South Wales research results book.

Published annually since 2012, these books contain a collection of papers that provide an insight into selected research and development activities undertaken by NSW DPI in northern and southern NSW.

Not all papers will be accessible to readers with limited vision.
For help, please contact: Carey Martin at carey.martin@dpi.nsw.gov.au

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

Department of Primary Industries
and Regional Development

SOUTHERN NSW RESEARCH RESULTS 2024

Pulse variety experiments – faba bean, lentil, lupin, field pea, chickpea and vetch – Wagga Wagga 2023

Mark Richards and Dr Neroli Graham

NSW DPIRD, Wagga Wagga Agricultural Institute, Private Mail Bag, Wagga Wagga NSW 2650

Key findings

- Unfavourable seasonal conditions restricted yield potential at Wagga Wagga with terminal drought limiting yield potential of all pulse species. Despite these conditions, some species and varieties performed well, particularly those that flowered earlier.
- Despite unfavourable spring conditions, average grain yield across the 5 pulse species was 3.1 t/ha.
- The highest yielding faba bean varieties were the early flowering PBA Nasma$^{\Phi}$, FBA Ayla$^{\Phi}$ and PBA Warda$^{\Phi}$. Flowering started in early August and continued until the end of September. In 2023, higher grain yield was associated with an earlier and longer flowering period.
- The highest yielding lentil varieties were PBA Jumbo2$^{\Phi}$, PBA Kelpie XT$^{\Phi}$, GIA Thunder$^{\Phi}$, PBA Ace$^{\Phi}$, GIA Lightning$^{\Phi}$, PBA Hallmark XT$^{\Phi}$ and ALB Terrier$^{\Phi}$. Most varieties started flowering in early September and finished in mid October.
- Grain yields for the 6 narrow-leaf lupin varieties ranged from 2.83 t/ha to 2.54 t/ha and were all statistically equal.
- The highest yielding field pea varieties were PBA Taylor$^{\Phi}$, PBA Percy, PBA Wharton$^{\Phi}$, PBA Noosa$^{\Phi}$ and APB Bondi$^{\Phi}$. PBA Percy was the first to flower in late August and all varieties finished flowering in October.
- Volga$^{\Phi}$ was the highest yielding vetch variety at 1.91 t/ha, significantly higher than all other varieties. Studencia$^{\Phi}$ was first to flower in early September, 6 days before the next.

- **Important note:** while all seasons are unique, it is important to consider long-term phenology and yield data to determine varietal responses and adaptation to the growing environment.

Keywords Wagga Wagga, 2023, pulses, variety, phenology, faba bean, field pea, lupin, chickpea, lentil, vetch, grain yield, seed weight

Introduction

Pulse variety experiments were conducted at Wagga Wagga in 2023 to support southern NSW pulse growers with additional local variety information at our key research sites. Experiments were conducted on a range of varieties to investigate crop phenology and grain yield responses for a range of commercially available faba bean, lentil, lupin, field pea, chickpea and vetch varieties.

This research paper is an extract from the publication *Southern NSW research results 2024*, available at https://www.dpi.nsw.gov.au/agriculture/broadacre-crops/guides/publications/southern-nsw-research-results

Some of the commercial variety results presented in this paper have been extracted from experiments conducted by the National Faba Bean Breeding program, Chickpea Breeding Australia program and National Vetch Breeding program.

Site details

Location	Wagga Wagga Agricultural Institute, Wagga Wagga
Soil type	Red kandosol
Soil pH_{Ca}	6.5 (0–5 cm), 5.5 (5–10 cm), 4.9 (10–15 cm), 5.2 (15–20 cm), 5.6 (20–25 cm), 5.8 (25–30 cm)
Paddock history	Wheat (2022), oats (2021), wheat (2020)
Fertiliser	100 kg/ha, SuPerfect® Grain Legume (N5:P15:S7:Ca11)
Rainfall	• Annual – 2023: 454 mm – Long-term average (LTA): 536 mm • In-crop (April–October) – 2023: 205 mm – LTA: 331 mm

Sowing and harvest dates

Table 1 shows the sowing and harvest dates for the experiments.

Table 1 Sowing and harvest dates for pulse variety experiments at Wagga Wagga in 2023.

Species	Sowing date	Harvest date
Faba bean	8 May	27 November
Lentil	17 May	19 November
Narrow leaf lupin	17 May	23 November
Field pea	17 May	14 November
Chickpea	17 May	6 December
Vetch	22 May	13 December

Treatments

Variety

Table 2 lists the pulse species and varieties evaluated.

Table 2 Pulse species and varieties evaluated at Wagga Wagga in 2023.

Species	Variety
Faba bean	FBA Ayla$^{\Phi}$, Cairo, Doza, PBA Amberley$^{\Phi}$, PBA Bendoc$^{\Phi}$, PBA Marne$^{\Phi}$, PBA Nanu$^{\Phi}$, PBA Nasma$^{\Phi}$, PBA Samira$^{\Phi}$, PBA Warda$^{\Phi}$
Lentil	ALB Terrier$^{\Phi}$, GIA Leader$^{\Phi}$, GIA Lightning$^{\Phi}$, GIA Thunder$^{\Phi}$, PBA Ace$^{\Phi}$, PBA Bolt$^{\Phi}$, PBA Hallmark XT$^{\Phi}$, PBA Highland XT$^{\Phi}$, PBA Jumbo2$^{\Phi}$, PBA Kelpie XT$^{\Phi}$, Nipper$^{\Phi}$
Narrow-leaf lupin	Coyote$^{\Phi}$, Lawler$^{\Phi}$, Mandelup$^{\Phi}$, PBA Bateman$^{\Phi}$, PBA Jurien$^{\Phi}$, Wonga
Field pea	APB Bondi$^{\Phi}$, PBA Butler$^{\Phi}$, PBA Noosa$^{\Phi}$, PBA Oura$^{\Phi}$, PBA Pearl, PBA Percy, PBA Taylor$^{\Phi}$, PBA Wharton$^{\Phi}$, Sturt
Desi chickpea	CBA Captain$^{\Phi}$, PBA Slasher$^{\Phi}$
Vetch	Morava, Studencia$^{\Phi}$, Timok$^{\Phi}$, Volga$^{\Phi}$

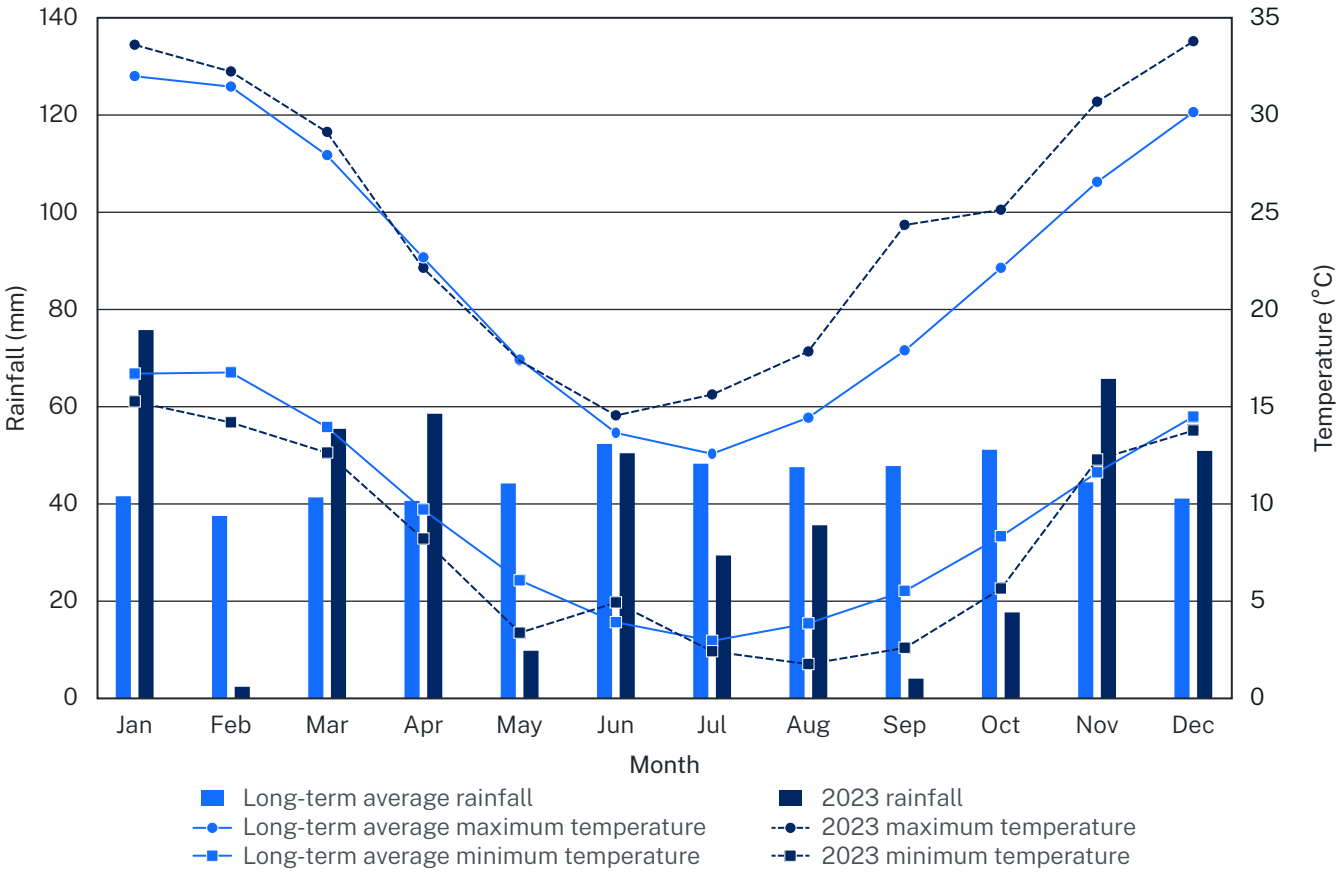
Seasonal conditions

Significant soil water reserves were carried over from the very wet 2022 fallow season. Following above average rainfall in January, March and April, starting soil moisture at sowing was adequate for optimal crop establishment within the recommended sowing windows (Figure 1). Rain from May to October, 146 mm, was lower than the LTA (291 mm).

Wagga Wagga recorded 32 frosts during the growing season, with 17 frosts between August and mid October. Following several frosts in early September, there were 3 hot days above 30 °C from 16 to 18 September, reaching a high of 34 °C on 17 September. Daily maximum temperatures were regularly above 30 °C from 20 October.

Low soil moisture levels in spring, coupled with frequent frost and high temperatures during the grain-filling phase, reduced the yield potential in all crop types.

There were no significant disease issues at this site in 2023.



Monthly temperature and rainfall data for 2023 taken from on-site weather station.
Long-term data extracted from SILO.

Figure 1 Monthly minimum and maximum temperature, and total monthly rainfall in 2023, and long-term averages at Wagga Wagga.

Results

Faba bean

The average faba bean yield was 4.41 t/ha, varying between 4.97 t/ha (PBA Nasma$^{\Phi}$) and 4.02 t/ha (PBA Samira$^{\Phi}$ and PBA Amberley$^{\Phi}$) (Table 3). The highest yielding varieties, PBA Nasma$^{\Phi}$, FBA Ayla$^{\Phi}$ and PBA Warda$^{\Phi}$ were statistically similar. These varieties were bred for the northern growing region but significantly out-yielded southern bred varieties in this experiment. This is likely due to their early and longer flowering window and earlier maturity.

Table 3 Growing region, crop phenology and grain yield responses for faba bean varieties at Wagga Wagga in 2023.

Experiment conducted by NSW DPI as part of the National Faba Bean Breeding program.

Variety	Proposed NSW growing region	50% flowering (date)*	End of flowering (date)†	Yield (t/ha)‡	100 seed weight (g)
PBA Nasma	Northern	4 Aug	29 Sep	4.97 [a]	59.4
FBA Ayla		4 Aug	30 Sep	4.81 [abcde]	58.3
PBA Warda		2 Aug	28 Sep	4.54 [abcdef]	53.3
PBA Nanu		4 Aug	29 Sept	4.50 [bcdefg]	62.4
Cairo		3 Aug	1 Oct	4.41 [defg]	57.9
Doza		3 Aug	30 Sep	4.32 [efg]	52.2
PBA Bendoc	Southern	12 Aug	1 Oct	4.32 [efg]	57.4
PBA Marne		9 Aug	30 Sep	4.26 [efg]	63.2
PBA Amberley		16 Aug	1 Oct	4.02 [fg]	62.9
PBA Samira		17 Aug	1 Oct	4.02 [g]	67.7
Mean		9 Aug	30 Sep	4.41	61.7
l.s.d. (*P*<0.05)		2.8	1.1	0.48	2.01

* 50% flowering is the date when 50% of plants had one open flower.

† End of flowering is the date when only 5% of plants have an open flower.

‡ N.B. For grain yield interpretation, varieties with the same letter are statistically similar.

l.s.d. = least significant difference.

PBA Warda$^{\Phi}$ was the first to flower (50% flowering) on 2 August (Table 3), with Cairo, Doza, PBA Nasma$^{\Phi}$, FBA Ayla$^{\Phi}$, and PBA Nanu$^{\Phi}$ flowering 1–2 days later. These early flowering varieties, bred for northern NSW, flowered at least 5 days before the first southern variety, PBA Marne$^{\Phi}$, which started flowering on 9 August. PBA Samira$^{\Phi}$ was the last to flower, 15 days after PBA Warda$^{\Phi}$, on 17 August. Flowering ended between 28 September and 1 October for all varieties. In 2023, early and longer flowering, and faster pod fill and maturity were associated with higher grain yield.

PBA Samira$^{\Phi}$ recorded the heaviest hundred seed weight (HSW) of 67.7 g (Table 3). This was significantly higher than all other varieties. HSW ranged from 67.7 g for PBA Samira$^{\Phi}$ to 52.2 g for Doza.

Lentil

The highest yielding lentil variety was PBA Jumbo2$^{\Phi}$ at 2.81 t/ha (Table 4). There was no significant difference between the yields of PBA Kelpie XT$^{\Phi}$, GIA Thunder$^{\Phi}$, PBA Ace$^{\Phi}$, GIA Lightning$^{\Phi}$, PBA Hallmark XT$^{\Phi}$ and ALB Terrier$^{\Phi}$.

Table 4 Crop phenology and grain yield responses for lentil varieties at Wagga Wagga in 2023.

Experiment conducted by NSW DPI.

Variety	Classification (seed size)	50% flowering (date)*	End of flowering (date)†	Yield (t/ha)‡	100 seed weight (g)
PBA Jumbo2	large	8 Sep	15 Oct	2.81 [a]	5.2
PBA Kelpie XT	large	3 Sep	10 Oct	2.72 [ab]	5.0
GIA Thunder	small	9 Sep	15 Oct	2.71 [ab]	4.6
PBA Ace	medium	13 Sep	17 Oct	2.63 [abc]	4.6
GIA Lightning	small	14 Sep	17 Oct	2.63 [abc]	4.6
PBA Hallmark XT	medium	7 Sep	12 Oct	2.59 [abcd]	4.2
ALB Terrier	medium	7 Sep	15 Oct	2.58 [abcd]	4.4
PBA Highland XT	small	3 Sep	11 Oct	2.47 [bcd]	4.4
PBA Bolt	medium	10 Sep	9 Oct	2.46 [bcd]	4.8
Nipper	small	16 Sep	14 Oct	2.33 [cd]	3.8
GIA Leader	medium	11 Sep	20 Oct	2.29 [d]	5.2
Mean		10 Sep	14 Oct	2.54	4.7
l.s.d. (*P*<0.05)		2.48	2.13	0.34	0.7

* 50% flowering is the date when 50% of plants had one open flower.

† End of flowering is the date when only 5% of plants have an open flower.

‡ N.B. For grain yield interpretation, varieties with the same letter are statistically similar.

l.s.d. = least significant difference.

The earliest lentil varieties to flower were PBA Kelpie XT$^{\Phi}$ and PBA Highland XT$^{\Phi}$ on 3 September (Table 4). Nipper was the last to flower on 16 September. PBA Bolt$^{\Phi}$ finished flowering first on 9 October, 11 days earlier than GIA Leader$^{\Phi}$, the final variety to finish flowering on 20 October.

Lentil varieties are grouped for marketing into small, medium, and large seed size categories. In this experiment, HSW for:

- small varieties was between 3.8 g and 4.6 g
- medium varieties was between 4.2 g and 5.2 g
- large varieties was between 5.0 g and 5.2 g.

PBA Jumbo2$^{\Phi}$ and GIA Leader$^{\Phi}$ had the heaviest HSW at 5.2 g, while Nipper$^{\Phi}$ had the lightest at 3.8 g.

Narrow-leaf lupin

There was no significant difference in the yield of all narrow-leaf lupin varieties (Table 5). Yields varied between 2.83 t/ha (PBA Jurien$^{\Phi}$) and 2.54 t/ha (Lawler$^{\Phi}$). The average site yield was 2.70 t/ha.

PBA Jurien$^{\Phi}$ and Lawler$^{\Phi}$ started flowering on 31 August, 8 days earlier than Wonga, the last variety to start flowering (Table 5). All varieties finished flowering on 4 October, except Wonga which finished on 11 October.

There was a significant difference in HSW among the varieties (Table 5) yet PBA Bateman$^{\Phi}$, Mandelup$^{\Phi}$ and PBA Jurien$^{\Phi}$, had similar HSW – significantly higher than the other varieties.

Table 5 Crop phenology and grain yield responses for narrow-leaf lupin varieties at Wagga Wagga in 2023.

Experiment conducted by NSW DPI.

Variety	50% flowering (date)*	End of flowering (date)†	Yield (t/ha)	100 seed weight (g)
PBA Jurien	31 Aug	4 Oct	2.83	16.7
Mandelup	1 Sep	4 Oct	2.79	16.2
PBA Bateman	2 Sep	4 Oct	2.74	16.9
Coyote	3 Sep	4 Oct	2.66	15.6
Wonga	7 Sep	11 Oct	2.56	14.4
Lawler	31 Aug	4 Oct	2.54	15.4
Mean	2 Sep	5 Oct	2.70	15.9
l.s.d. (*P*<0.05)	2.97	0.56	n.s.	0.72

* 50% flowering is the date when 50% of plants had one open flower.

† End of flowering is the date when only 5% of plants have an open flower.

l.s.d. = least significant difference

n.s. = not significant.

Field pea

The average site yield was 3.22 t/ha (Table 6). PBA Taylor$^{\phi}$ was the highest yielding variety at 3.61 t/ha. The yields of PBA Taylor$^{\phi}$, PBA Percy, PBA Wharton$^{\phi}$, PBA Noosa$^{\phi}$ and APB Bondi$^{\phi}$ were statistically similar.

There were notable differences in flowering dates. PBA Percy was the first variety to flower on 28 August, 4 days before PBA Oura$^{\phi}$ and Sturt (Table 6). PBA Butler$^{\phi}$ was the last variety to start flowering on 12 September, 15 days after PBA Percy. All varieties finished flowering within a 6-day window, from 8 October (PBA Butler$^{\phi}$) to 14 October (Sturt).

HSW ranged from 16.1 g for PBA Butler$^{\phi}$ and APB Bondi$^{\phi}$ to 19.1 g for PBA Pearl (Table 6). There was no significant difference between varieties.

Table 6 Crop phenology and grain yield responses for field pea varieties at Wagga Wagga in 2023.

Experiment conducted by NSW DPI.

Variety	Type	50% flowering (date)*	End of flowering (date)†	Yield (t/ha)‡	100 seed weight (g)
PBA Taylor	kaspa	9 Sep	10 Oct	3.61 ^{a}	17.1
PBA Percy	dimpled dun	28 Aug	13 Oct	3.51 ^{ab}	17.5
PBA Wharton	kaspa	6 Sep	9 Oct	3.51 ^{ab}	17.7
PBA Noosa	blue	6 Sep	12 Oct	3.42 ^{abc}	16.5
APB Bondi	kaspa	8 Sep	12 Oct	3.39 ^{abc}	16.1
PBA Pearl	white	4 Sep	11 Oct	3.29 ^{bcd}	19.1
PBA Oura	dimpled dun	2 Sep	10 Oct	3.03 ^{def}	16.5
PBA Butler	kaspa	12 Sep	8 Oct	2.87 ^{ef}	16.1
Sturt	white	2 Sep	14 Oct	2.81 ^{f}	16.4
Mean		6 Sep	11 Oct	3.22	17.1
l.s.d (*P*<0.05)		1.24	1.04	0.35	n.s.

* 50% flowering is the date when 50% of plants had one open flower.

† End of flowering is the date when only 5% of plants have an open flower.

‡ N.B. For grain yield interpretation, varieties with the same letter are statistically similar.

l.s.d. = least significant difference.

n.s. = not significant.

Chickpea

The average site yield was 2.41 t/ha (Table 7). There was no significant difference in yield, flowering window, or HSW between CBA Captain$^{\Phi}$ and PBA Slasher$^{\Phi}$.

Table 7 Crop phenology and grain yield responses for chickpea varieties at Wagga Wagga in 2023.

Experiment conducted by NSW DPI as part of the Chickpea Breeding Australia program.

Variety	50% flowering (date)*	End of flowering (date)†	Yield (t/ha)‡	100 seed weight (g)
CBA Captain	15 Sep	17 Oct	2.57	18.5
PBA Slasher	15 Sep	18 Oct	2.40	17.6
Mean	15 Sep	18 Oct	2.41	19.4
l.s.d. (*P*<0.05)	n.s.	n.s.	n.s.	n.s.

* 50% flowering is the date when 50% of plants had one open flower.

† End of flowering is the date when only 5% of plants have an open flower.

l.s.d. = least significant difference.

n.s. = not significant.

Vetch

Volga$^{\Phi}$ recorded a yield of 1.91 t/ha, significantly higher than all other varieties (Table 8). Morava was the lowest yielding variety yielding at 1.15 t/ha, the equivalent of 39% less than Volga$^{\Phi}$.

Studencia$^{\Phi}$ was first to flower on 5 September; Morava was the last, flowering 15 days later, on 20 September (Table 8). The delayed flowering exposed Morava to heat and moisture stress, reducing its yield potential. All varieties finished flowering with a 3-day period, between 1 October and 3 October.

Table 8 Crop phenology and grain yield responses for vetch varieties at Wagga Wagga in 2023.

Experiment conducted by NSW DPI as part of the National Vetch Breeding program.

Variety	50% flowering (date)*	End of flowering (date)†	Biomass (t/ha) (9/10/2024)	Yield (t/ha)‡
Volga	11 Sep	1 Oct	8.0	1.91 [a]
Studencia	5 Sep	2 Oct	7.1	1.54 [b]
Timok	16 Sep	2 Oct	7.9	1.51 [b]
Morava	20 Sep	3 Oct	5.9	1.15 [c]
Mean	14 Sep	2 Oct	7.3	1.65
l.s.d. (*P*<0.05)	0.73	0.69	n.s.	0.17

* 50% flowering is the date when 50% of plants had one open flower.

† End of flowering is the date when only 5% of plants have an open flower.

‡ N.B. For grain yield interpretation, varieties with the same letter are statistically similar.

l.s.d. = least significant difference.

n.s. = not significant.

Conclusion

The results of these experiments need to be considered in the context of unfavourable spring conditions, with severe moisture stress affecting all experiments throughout the reproductive window. The site only received 146 mm of rain from May to October inclusive, around 50% of the long-term average of 291 mm over the same period. Moisture stress, combined with some severe frosts in August to mid October, restricted yield potential for all species. Immediately following the several frosts in early September there were 3 hot days, averaging above 30 °C, from 16 to 18 September.

Species with large differences in growth phases, (e.g. the flowering window), such as faba bean, lentil, field pea, and vetch, appeared better able to take advantage of the slightly more favourable conditions earlier in the reproductive period. Early formed pods in these species were less affected by the heat and moisture stress later in the spring, enabling higher grain yield.

For contrasting species that show little phenotypic variation in the varieties tested, such as lupin and chickpea, there was little variation in yield as the main limiting factor at this site was heat and moisture stress during the grain filling period, which occurred simultaneously for all varieties.

Despite the unfavourable spring conditions, the average grain yield across the 5 species was above average at 3.1 t/ha. Significant contributing factors included a full moisture profile at the start of the season and minimal soil constraints in the experiment paddock. Considering a good liming history, the lowest pH_{Ca} in the profile was 4.9 at 10–15 cm. This had a beneficial effect on plant health, nodulation and vigour contributing to plants accessing soil water available at depth in a dry spring, which then significantly increased yield potential.

Acknowledgements

Thank you to Daniel Johnston, Karl Moore, Jess Simpson, Lily Tenhave and Gerard Ryan for their technical assistance.

We acknowledge the ongoing support for pulse research in southern NSW by NSW DPIRD.

Faba bean data presented is part of the National Faba Bean Breeding program (UOA1606-009RTX).

Chickpea data presented is part of the Chickpea Breeding Australia program (DPI2003-009OPX).

Vetch data presented is part of the National Vetch Breeding program (UOA2104-011RTX).

More information

Mark Richards
Wagga Wagga Agricultural Institute, Wagga Wagga
mark.richards@dpi.nsw.gov.au
0428 630 429

Find results from other pulse agronomy experiments in previous editions of Southern NSW research results (https://www.dpi.nsw.gov.au/agriculture/broadacre-crops/guides/publications/southern-nsw-research-results).