

Faba bean sowing date – Wagga Wagga 2016

Mark Richards (NSW DPI, Wagga Wagga), Dr Neroli Graham (NSW DPI, Tamworth), Karl Moore, Russell Pumpa, Jon Evans and Scott Clark (NSW DPI, Wagga Wagga)

Key findings

- The optimum time to sow faba beans in southern NSW was late April–mid May.
- Even in a favourable season such as 2016 there was a 10% yield penalty when sowing was delayed from 17 May to 2 June.
- Average seed size reduced by 8% when sown outside the recommended window.
- PBA Nasma[Ⓢ], Fiesta VF, and PBA Zahra[Ⓢ] were the highest yielding commercial varieties.
- Advanced breeding lines AF10089 and AF09169 had significantly higher grain yields, particularly at the 28 April sowing date when compared to other sowing dates.
- Flowering duration for PBA Samira[Ⓢ] and PBA Zahra[Ⓢ] was stable across sowing dates, but reduced for PBA Nasma[Ⓢ] as sowing was delayed.

Aim To compare growth, development and yield of current commercial faba bean varieties and advanced breeding lines sown on three dates on a red brown–earth at Wagga Wagga in southern NSW.

Site details	Location	Wagga Wagga Agricultural Institute, Paddock 15
	Soil type	Red–brown earth, pH _{Ca} 5.7 (0–10 cm)
	Experimental design	Randomised split plot design with sowing date in the main blocks and varieties in the sub-plots; three replications
	Paddock history	The previous crop was barley; paddock was burnt before sowing to remove stubble load
	Fertiliser	75 kg/ha grain legume starter (N 0: P 13.8: K 0: S 6.1) placed 50 mm below the seed 150 g/ha sodium molybdate, 16 June
	Plant population	Target: 30 plants/m ²
	Sowing	Direct drilled using a six-row cone seeder on 300 mm row spacing using DBS tines and GPS auto-steer
	Inoculation	Group F peat inoculant was mixed directly into an onboard water tank then pumped through micro tubes into each sowing furrow
	Weed management	Commercial practices were used, aiming for weed-free experiments, eliminating both weed competition and seed set Fallow weed control: glyphosate (450 g/L) 2 L/ha, water 100 L/ha Incorporated by sowing: Terbyne [®] 850 grams/ha, Triflur X [®] 1 L/ha, Boxer Gold [®] 2.5 L/ha, water 100 L/ha Post sowing: Select Xtra [®] 500 mL/ha, Factor 180 g/ha, Super charge [®] 100 mL/100 L (16 June), water 100 L/ha Simazine 900 [®] 850 g/ha (SD1: 25 August, SD2 and SD3: 26 August), water 100 L/ha
	Insect management	Targeting <i>Heliothis</i> (<i>Helicoverpa</i> sp.) Fastac Duo [®] 200 mL/ha, water 100 L/ha (24 October)

Disease management Targeting chocolate spot (*Botrytis fabae* and *B. cinerea*) and ascochyta blight (*Ascochyta fabae*)
 Penncozeb® 750DF 2 kg/ha, water 100 L/ha (14 July)
 Penncozeb® 750DF 2 kg/ha, water 100 L/ha (4 August)
 Howzat® 500 mL/ha, water 100 L/ha (26 August)
 Howzat® 500 mL/ha, water 100 L/ha (20 September)
 Bravo® 1.5 L/ha, water rate 100 L/ha (11 October)

Harvest date 9 December

Soil analysis

Table 1. Site soil characteristics for 0–10 cm and 10–30 cm depth at Wagga Wagga in 2016.

Characteristic	Depth (0–10 cm)	Depth (10–30 cm)
pH _{Ca}	5.7	5.2
Aluminium (KCL) (cmol+/kg)	<0.10	<0.10
Nitrate N (KCL) (mg/kg)	54	20
Ammonium N (KCL) (mg/kg)	1	2
Sulphur (mg/kg)	9	9.8
Phosphorus (Colwell) (mg/kg)	60	22
Organic carbon (OC) (%)	0.79	0.47

Season

The 2016 growing season at Wagga Wagga was exceptional with growing season rainfall of 525 mm (April–October), 60% higher than the long-term average of 328 mm. April only received 11 mm of rainfall, which resulted in marginal moisture at sowing (Figure 1). Monthly rainfall for May and June was double the long-term average with 102 mm and 100 mm respectively (Figure 1). Rainfall from June to October was above the long-term average and resulted in a full soil moisture profile during spring.

Average daily maximum temperatures for June to August inclusive were slightly higher than the long-term average (Figure 1). Due to the high atmospheric moisture levels, the average daily minimum temperatures from May to August were significantly higher than average (Figure 1). Higher minimum and maximum air temperatures to August could have contributed to the higher plant growth during winter. In conjunction with the above average rainfall and milder air temperatures, there were fewer than expected frosts from August to October.

Treatments

Varieties (8)

PBA Nasma[♢], PBA Samira[♢], PBA Zahra[♢], Nura[♢], Farah[♢], Fiesta VF, AF09169, AF10089

Sowing date (SD)

SD1: 28 April

SD2: 17 May

SD3: 2 June

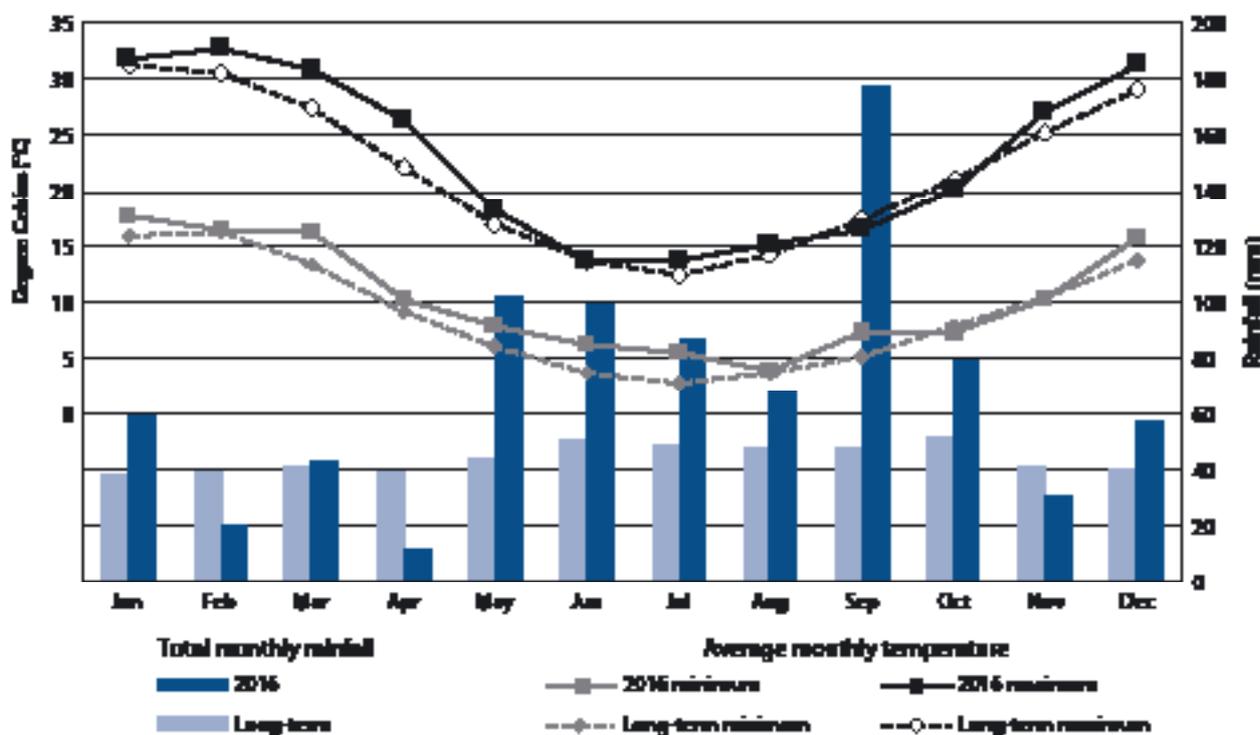


Figure 1. Monthly rainfall and temperature for Wagga Wagga Agricultural Institute in 2016 and the long-term average.

Results

Establishment

Plant establishment varied across the three sowing dates; the targeted plant population was 30 plants/m². Plant establishment for the 28 April and 17 May sowing dates were similar with 37.9 plants/m² and 37.3 plants/m² respectively, yet higher than the target population. When the sowing date was delayed until 2 June, the plant population was significantly lower with 31.2 plants/m² (Table 2), when averaged across the eight varieties. As seed for each variety was from the same source and packed at the same time, the reduced establishment at the 2 June sowing showed that delayed sowing can have a significant effect on successful plant establishment.

Table 2. Established plant counts, days to 50% flowering and flowering duration for three sowing dates averaged over eight lupin varieties at Wagga Wagga in 2016.

Plant establishment l.s.d. ($P = 0.05$) = 2.7 plants, Days to 50 % flowering l.s.d. ($P = 0.05$) = 1.0 days, Flowering duration l.s.d. ($P=0.05$) = 2.4 days.

Sowing date	Plant establishment (plants/m ²)	Days to 50% flowering	Flowering duration (days)
28 April	37.9	99.8	69.3
17 May	37.3	96.5	55.0
2 June	31.2	91.1	49.7

Flowering

Variety, sowing date and their interaction all significantly affected days to 50% flowering and flowering duration. When averaged across all varieties, there was a reduction in both days to 50% flowering, from 99.8 days to 91.1 days and flowering duration from 69.3 days to 49.7 days when sowing was delayed from 28 April to 2 June, respectively (Table 2).

PBA Nasma[®] was the quickest variety to 50% flower at 86.4 days after sowing, significantly faster than all other varieties. In contrast, Nura[®] was slowest to 50% flower at 103.5 days after sowing, a variation of approximately 18 days between the fastest and slowest variety to flower. In addition, Fiesta VF and PBA Nasma[®] had the longest flowering duration with 63.8 days and 61.4 days, respectively, compared with Nura[®] and PBA Samira[®] which flowered for the shortest time with 50.2 days and 52.5 days respectively.

There were two differing patterns of days to 50% flowering and flowering duration. The first group, Nura[Ⓛ], PBA Samira[Ⓛ] and PBA Zahra[Ⓛ] had a large and significant reduction in days to 50% flowering when sowing was delayed, whilst their flowering duration was more stable over this period as exemplified by the variety Nura[Ⓛ] (Figure 2).

In contrast, the second group, PBA Nasma[Ⓛ], Fiesta VF, Farah[Ⓛ], AF09169 and AF10089 had significantly shorter flowering duration when sowing was delayed, with a more stable number of days to 50% flowering and reduced flowering duration, as exemplified by the variety PBA Nasma[Ⓛ] (Figure 2).

Faba bean are indeterminate, continuously flowering until physiological maturity. Pod abortion and poor pod development can reduce the potential maximum yield. Pod abortion can be caused through high maximum air temperatures, frosts and low soil moisture conditions.

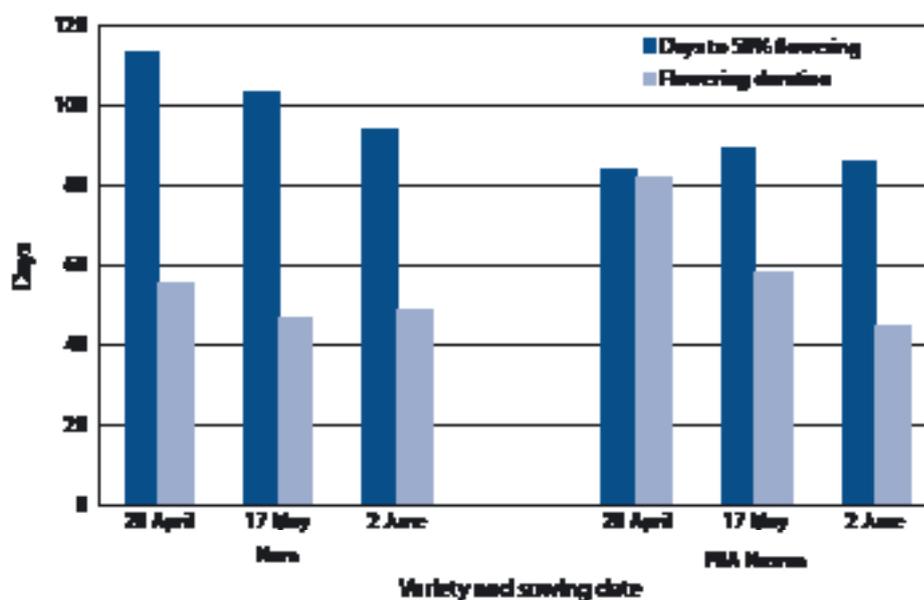


Figure 2. Days to 50% flowering and flowering duration for two faba bean varieties on three sowing dates at Wagga Wagga in 2016; days to 50% flowering l.s.d. ($P = 0.05$) = 2.6 days and flowering duration l.s.d. ($P = 0.05$) = 2.4 days.

Grain yield

There was a significant difference in grain yields across the three sowing dates. Grain yield achieved when sown on 28 April (4.11 t/ha) over all varieties was the same as the 17 May sowing date (4.13 t/ha), with both dates being within the recommended sowing window. This contrasted to the lower yield of 3.69 t/ha, a 10% reduction, when faba bean were sown outside the recommended window. The advanced breeding lines AF10089 and AF09169 had a significantly higher yield than all other varieties with 4.46 t/ha and 4.42 t/ha, respectively. PBA Samira[Ⓛ] (3.78 t/ha), Farah[Ⓛ] (3.73 t/ha) and Nura[Ⓛ] (3.54 t/ha) had the lowest grain yield of the eight varieties when averaged across the three sowing dates.

There was significant variety by sowing date variation with PBA Nasma[Ⓛ] and the two advanced breeding lines, AF09169 and AF10089, showing a reduction in grain yield with delayed sowing (Figure 3). This indicates that sowing these varieties in the earliest part of the recommended window is critical to maximise yield potential. Fiesta VF and PBA Samira[Ⓛ] showed a more flexible response to sowing date with little to no loss of yield when sowing was delayed from 28 April until 2 June (Figure 3). PBA Zahra[Ⓛ], Farah[Ⓛ] and Nura[Ⓛ] all showed a maximum grain yield when sown on 17 May with a reduction when sown earlier or later than this time (Figure 3), indicating that sowing within the middle of the window is important for optimising grain yield from these varieties.

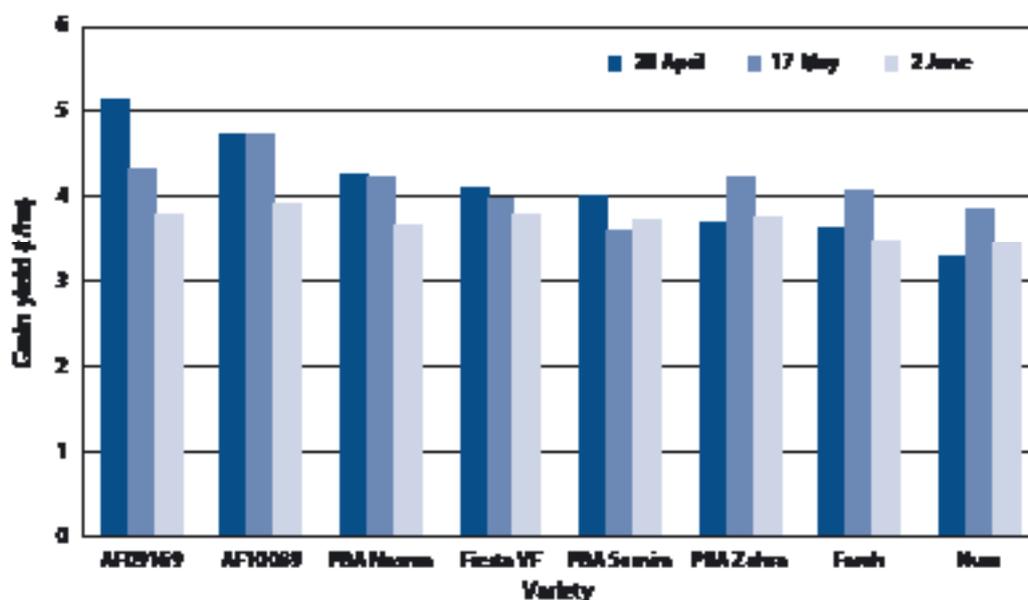


Figure 3. Grain yield for eight faba bean varieties sown on three sowing dates at Wagga Wagga in 2016; l.s.d. ($P=0.05$) = 0.57 t/ha.

Lodging

Lodging resistance is an important aspect of crop agronomy in faba bean as it confers improved harvest efficiency and enhanced fungicide penetration. Lodging in faba bean canopies contributes to fungal disease through poor airflow, which leads to higher humidity levels conducive to disease development.

There was significant reduction in lodging levels when sowing was delayed past 28 April. The average lodging score of all varieties was 7.8 for the 28 April sowing date, 4.1 for the 17 May sowing date and 1.8 for the latest sowing date of 2 June. There was genetic variation for lodging with a range from 2.4 for PBA Nasma[Ⓛ] to 6.6 for PBA Samira[Ⓛ].

Lodging varied for varieties when sown on the three sowing dates. PBA Nasma[Ⓛ] showed significantly improved lodging resistance when compared with all other varieties for the 28 April and 17 May sowing dates, except for the advanced breeding line AF09169 for the second sowing date (Figure 4). PBA Samira[Ⓛ], Fiesta VF and Farah[Ⓛ] showed high levels of lodging for both the first and second sowing dates (Figure 4). Considering that the first two sowing dates are within the recommended sowing window, the lodging score was above six, an exceptionally high value, indicating that there was a high tendency to lodge even when sown at an appropriate time.

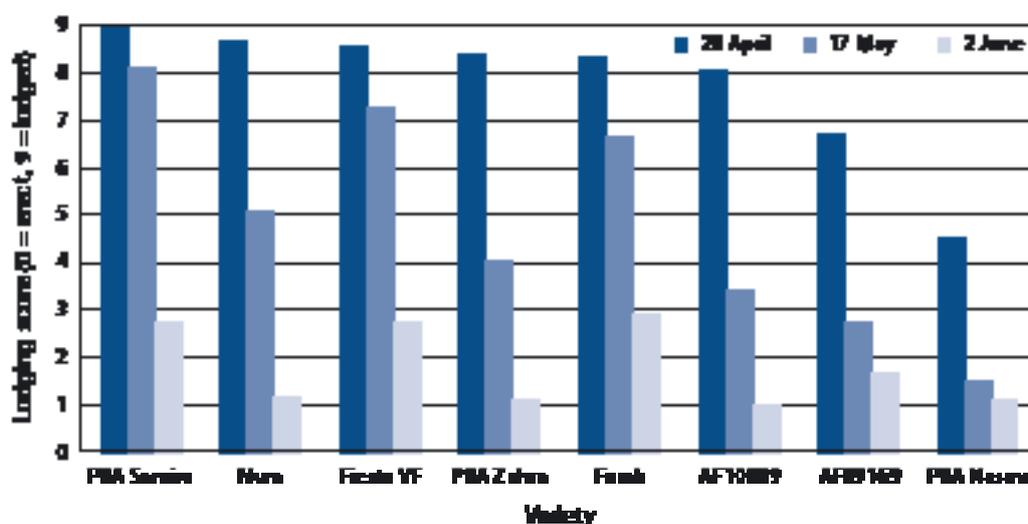


Figure 4. Lodging score for eight faba bean varieties sown on three sowing dates at Wagga Wagga in 2016; l.s.d. ($P = 0.05$) = 1.5 units.

Seed size

Across the varieties, seed weight tended to decrease with each later sowing date, from 63.6 g/100 seeds at the 28 April sowing date to 58.6 g/100 seeds at 2 June sowing date. Seed weights for 17 May and 2 June were 5.7% and 7.9% lighter than the 28 April sowing date, respectively. Farah had the lowest seed weight with 55.2 g/100 seeds, which was 14% lighter than the heaviest PBA Nasma at 65.3 g/100 seeds when averaged across three sowing dates.

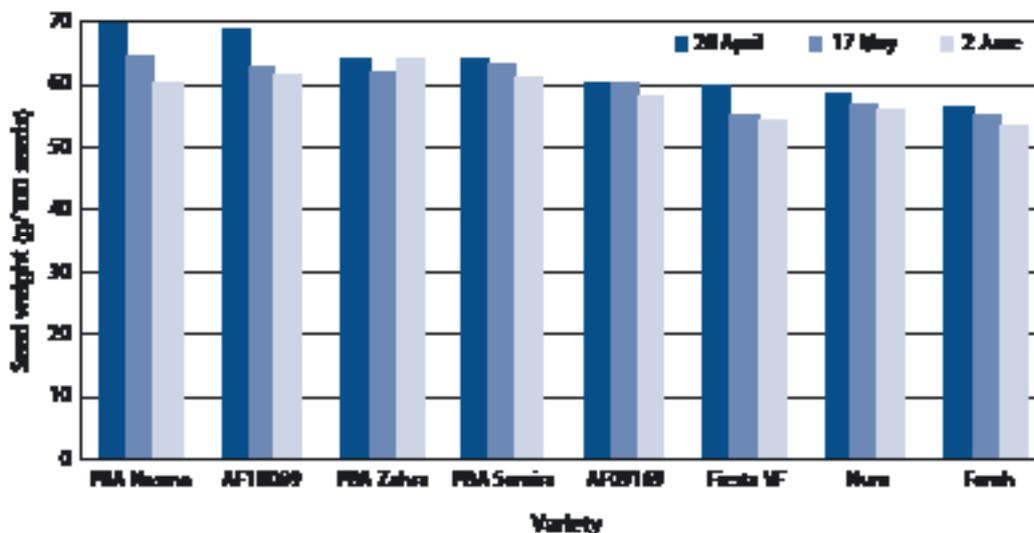


Figure 5. Seed weight for eight faba bean varieties for three sowing dates at Wagga Wagga in 2016; l.s.d. ($P = 0.05$) = 3.3 g/100 seeds.

PBA Nasma[Ⓛ], AF10089 and Fiesta VF showed significant seed size increase at the first sowing date when compared with the second sowing date (Figure 5). In addition, PBA Nasma[Ⓛ] also had a significant reduction in seed size between the second and third sowing dates (Figure 5). This could have resulted from the earlier maturity when compared with other varieties when soil moisture levels were not limiting.

For the faba bean varieties, PBA Zahra[Ⓛ], PBA Samira[Ⓛ], AF09169, Nura[Ⓛ] and Farah[Ⓛ], there was seed size stability across the three sowing dates that encompass the recommended sowing window.

Summary

Results from this experiment support previous research showing the importance of sowing faba bean within the recommended sowing window. The recommended sowing window in southern NSW is from late April until the middle of May. Crops sown before late April can result in excessive plant height, plant biomass, lodging and increased disease risk, whilst sowing after mid May can result in short plants, restricted dry matter accumulation and low grain yield potential.

A grain yield of approximately 4.1 t/ha was achieved when sown within the sowing window (28 April and 17 May). There was a 10% yield penalty when sowing was delayed from 17 May to 2 June, which is outside the recommended sowing window. The advanced breeding lines showed increased yield potential, especially when sown early within the recommended sowing window. There were variations between the varietal lines tested, showing the importance of individual varietal crop management to maximise yield potential.

Differing flowering patterns were seen between the eight faba bean varieties tested. Nura[Ⓛ], PBA Samira[Ⓛ] and PBA Zahra[Ⓛ] showed significant reduction in days to flower with the delayed sowing date, leaving the days to flower across all sowing dates similar, irrespective of actual sowing date.

This contrasted to the flowering pattern of PBA Nasma[Ⓛ], Fiesta VF, Farah[Ⓛ], AF09169 and AF10089, where the days to flowering was fairly constant over the three sowing dates, but the flowering duration reduced significantly across sowing dates. Further research into crop management and time to 50% flowering and flowering duration needs to be undertaken to illustrate if these differences are seen in other years. This sowing date × phenology interaction

is very important as it drives grain yield, especially in dry winter and spring seasons, or in highly frost-prone environments.

Mild winter and spring environmental conditions resulted in high lodging scores, with an average score at the first sowing date of 7.8, nearly twice the score at the 17 May sowing date at 4.8 and nearly four times at 1.8 for the 2 June sowing date. High lodging scores can result in complications with harvesting and harvest efficiency. All varieties except PBA Samira[®], Fiesta VF and Farah[®] had significantly lower lodging scores at the second sowing date. For each sowing date, the variety PBA Nasma[®] had the lowest lodging scores, showing resistance to lodging under southern NSW environmental conditions.

Seed size decreased with delayed sowing dates, with an approximate 5% and 8% reduction in weight from the 63.6 g/100 seeds at 28 April sowing date. Under the environmental conditions experienced in southern NSW in 2016, PBA Nasma[®] had slightly superior seed size when compared with PBA Zahra[®] and PBA Samira[®].

Timely sowing, in conjunction with appropriate varietal selection and management, can result in high yields in excess of 4 t/ha through long flowering duration and large seed size, offset against higher lodging and lodging severity when crops are sown within the recommended sowing window.

Growers also need to be aware that in cool, moist, extended springs, even late April sowings can be subject to greater disease pressure and require careful monitoring and implementation of a disease management strategy.

This experiment has also identified that PBA Nasma[®], a northern NSW varietal release, has the potential to adapt to growing within the southern NSW region, extending the available current varieties. Further research into agronomic management is required to maximise yields from PBA Nasma[®] in southern NSW as this variety exhibits contrasting phenotypic characters to the currently recommended southern varieties, PBA Samira[®] and PBA Zahra[®].

Acknowledgement

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