Lentil sowing date – Wagga Wagga 2016

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Key findings

- A favourable growing season in 2016 produced results that supported previous work showing the importance of sowing within the recommended sowing window.
- No significant yield difference was found when lentil was sown on 6 May and 17 May, when averaged across varieties.
- Delay in sowing from 6 May to 2 June resulted in a 34% yield reduction and from 17 May to 2 June a 26% yield reduction across varieties.
- PBA Hurricane XT$^{(\phi)}$, PBA Jumbo2$^{(\phi)}$ and PBA Ace$^{(\phi)}$ were the highest yielding commercial varieties, when averaged across sowing times.
- The results from this experiment indicate the importance of sowing within the recommended sowing window to maximise the height from ground level to bottom pod to maximise the ease of harvest.

Aim

To compare growth, development and yield of current commercial lentil varieties and advanced breeding lines sown on three dates on a red–brown earth at Wagga Wagga in southern NSW. This information will be used to confirm and update current agronomic recommendations for lentil in this region.

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 block design with sowing date in the main blocks and varieties in the sub-plots; three replications
Paddock history	The previous crop was barley; the 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: 120 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 weed seed set Fallow weed control: glyphosate (450 g/L) 2 L/ha, water 100 L/ha Incorporated by sowing: Terbyne® (750 g/kg terbuthylazine) 850 g/ha, Triflur X® (480 g/L trifluralin) 1 L/ha, Boxer Gold® (800 g/L prosulfocarb + 120 g/L S-metolachlor) 2.5 L/ha, water 100 L/ha Post sowing: Select Xtra®(240 g/L clethodim) 500 mL/ha, Factor® (250 g/kg butroxydim) 180 g/ha, Supercharge® 100 mL/100 L (16 June), water 100 L/ha Brodal Options® (500 g/L diflufenican) 150 mL/ha (10 August), water 100 L/ha

Insect management	Targeting Heliothis (*Helicoverpa* sp.), Fastac Duo® (100 g/L alpha-cypermethrin) 200 mL/ha, water 100 L/ha (24 October)
Disease management	Targeting: Ascochyta blight (*Ascochyta lentis*) and grey mould (*Botrytis fabae B. cinerea*) Penncozeb® 750DF (750 g/kg mancozeb) 2 kg/ha, water 100 L/ha (4 August) Howzat® (500 g/L carbendazim) 500 mL/ha, water 100 L/ha (26 August) Howzat® (500 g/L carbendazim) 500 mL/ha, water 100 L/ha (20 September)
Harvest date	7 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 an exceptional growing season, with abundant rainfall combined with mild temperatures. Growing season rainfall recorded was 525 mm (April–October) 60% higher than the long-term average of 328 mm. Marginal moisture was recorded at the first sowing date as only 11 mm of rain fell during April (Figure 1). This is in contrast to the rainfall that fell during May and June, where double the long-term average with 102 mm and 100 mm, respectively was recorded (Figure 1). June through to October received well above the long-term average rainfall leading to a full soil moisture profile for sustained spring growth.

Air temperatures from June to August were higher than the long-term average values (Figure 1). This was in part due to the higher atmospheric moisture levels during May to August, which resulted in the average daily minimum temperatures being higher than average. This might have contributed to high levels of plant growth across the winter. The period from August to October, when flowering and grain fill occur, also received favourable environmental conditions with fewer frosts than the long-term average.

Treatments

Varieties (8)

PBA Ace$^{\phi}$, PBA Bolt$^{\phi}$, PBA Hurricane XT$^{\phi}$, PBA Jumbo2$^{\phi}$, Nipper, CIPAL 1301, CIPAL 1422, CIPAL 1522

Sowing date (SD)

SD1: 6 May
SD2: 17 May
SD3: 2 June

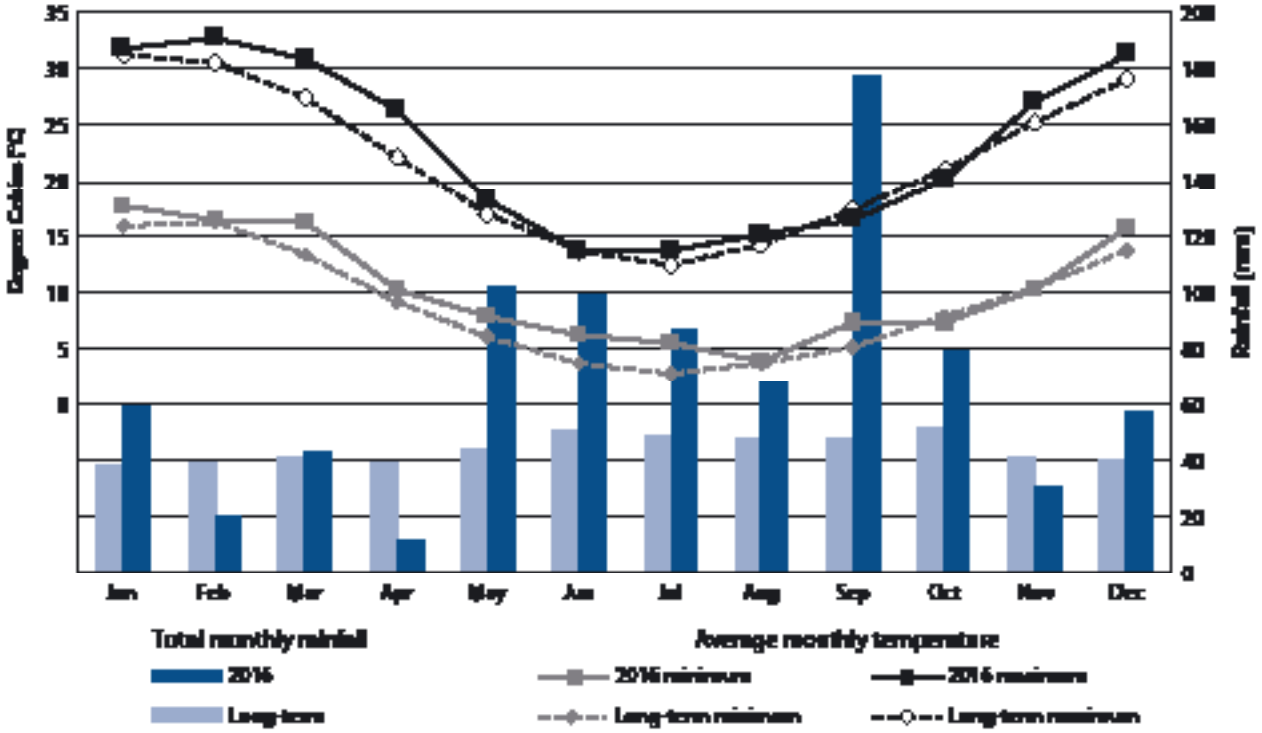

Figure 1. Monthly rainfall and temperature for Wagga Wagga Agricultural Institute in 2016 and the long-term average.

Results

Establishment

Lentil in southern NSW has a recommended target plant density of 110–130 plant/m^2. Therefore, sowing rates are adjusted according to seed size and germination percentages. For small-seeded lentil varieties such as PBA Hurricane XT$^{(\phi)}$, this approximates to 45–55 kg/ha; for medium-sized varieties such as PBA Ace$^{(\phi)}$ the sowing rate is approximately 55–70 kg/ha; for the large-seeded varieties such as PBA Jumbo2$^{(\phi)}$ and PBA Giant$^{(\phi)}$, the sowing rate is about 75–90 kg/ha.

A target density of 120 plants/m^2 was intended for each of the three sowing dates. Plant establishment of 127.6 plants/m^2 was achieved at the 17 May sowing date, similar to the targeted density when averaged over all varieties. Establishment at 6 May and 2 June sowing dates was significantly lower than the targeted plant population, with 89.5 plants/m^2 and 98.4 plants/m^2 respectively. It could not be determined if the establishment response to sowing time was due to herbicide damage, sowing depth, soil moisture, or an interaction between these factors.

There was a significant difference between varieties for plant establishment when averaged over the three sowing dates. Nipper and PBA Jumbo2$^{(\phi)}$ had significantly lower plant establishment rates, with 93.5 plants/m^2 and 101.7 plants/m^2, respectively, lower than the other six lentil varieties or advanced breeding lines (Table 2).

Table 2. Established plant populations (plants/m^2) for eight lentil varieties averaged across sowing dates at Wagga Wagga in 2016; l.s.d. (P = 0.05) = 11.3 plants/m^2.

Variety	Establishment (plants/m^2)
CIPAL 1301	114.0
CIPAL 1422	104.3
CIPAL 1522	101.7
Nipper	93.5
PBA Ace	110.4
PBA Bolt	108.6
PBA Hurricane XT	107.0
PBA Jumbo2	101.7

Grain yield

The delay in sowing from 6 May until 2 June resulted in a 34% yield reduction from 3.16 t/ha to 2.08 t/ha (data not shown); the delay in sowing from 17 May until 2 June resulted in a 26% yield reduction across varieties – a 0.74 t/ha drop from 2.82 t/ha (data not shown).

The reduction in yield was greatest between the second and third sowing dates, indicating that timely sowing was essential to maximise yield potential within the recommended sowing window. Even ideal grain filling conditions could not compensate for the delayed sowing effect.

PBA Hurricane XT$^{(\phi)}$ was the highest yielding variety with 3.03 t/ha when averaged over the three sowing dates, which was similar to PBA Jumbo2$^{(\phi)}$ (2.90 t/ha) and CIPAL 1422 (2.78 t/ha). Nipper had the lowest average yield over the three sowing dates with 2.26 t/ha, similar to CIPAL 1301 with 2.51 t/ha (data not shown).

There were significantly differing varietal responses to the three sowing dates within the eight lentil varieties. All varieties showed a reduction in grain yield when sowing was delayed. PBA Jumbo2$^{(\phi)}$ had stable grain yield across the three sowing dates, with only a 15% reduction when sowing was delayed from 6 May until 2 June (Figure 2). This stability indicated that there is minimal potential yield loss with delayed sowing for PBA Jumbo2$^{(\phi)}$. In contrast, Nipper had a reduced yield of over 33 % when sowing was delayed by two weeks from 6 May until 17 May, and 48% reduction when sowing was delayed until 2 June (Figure 2).

For all varieties except Nipper and PBA Bolt$^{(\phi)}$, there was no significant difference in grain yield when sown on 6 May or 17 May. The reduction in yield between the 17 May sowing and the 2 June sowing was significant (Figure 2) for all varieties except Nipper and PBA Jumbo2$^{(\phi)}$.

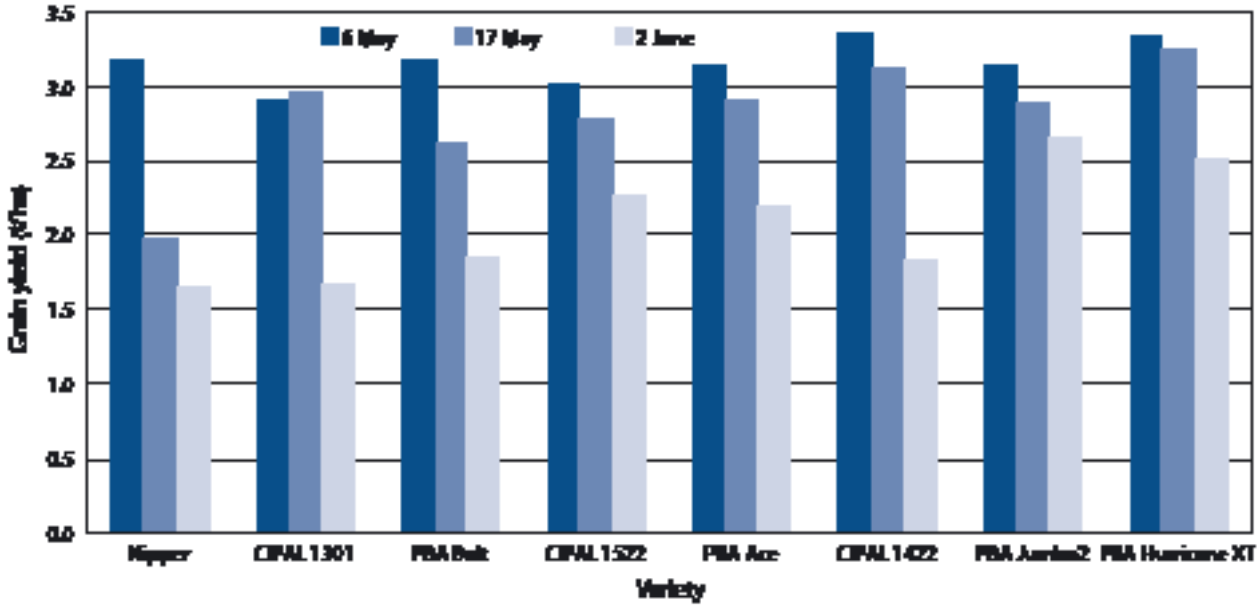

Figure 2. Grain yield for eight lentil varieties sown on three sowing dates at Wagga Wagga in 2016; l.s.d. ($P = 0.05$) = 0.50 t/ha.

Bottom pod height

The height of the lowest pod from the ground is important as it affects harvest effectiveness and efficiency. The height from bottom pod to ground decreased as sowing date was delayed. There was a 3 cm or 10% reduction in height when sowing was delayed by two weeks to 17 May and an 11 cm or 36% reduction when sowing was delayed a further two weeks until 2 June, when compared to 35.2 cm for the 6 May sow date (data not shown).

Two varieties and two advanced breeding lines had heights to bottom pods that were over 30 cm, they included CIPAL 1422 (35.1 cm) CIPAL 1522 (30.0 cm) PBA Ace$^{(\phi)}$ (34.2 cm) and PBA Jumbo2$^{(\phi)}$ (34.2 cm).

Height to bottom pods was affected by variety and sowing date interaction. PBA Hurricane XT$^{(\phi)}$ had no difference in height to bottom pod irrespective of sowing date (Figure 3), but its overall height was lower when compared with other varieties. Most

lentil varieties showed no significant reduction in height to bottom pod when sowing date was delayed until 17 May, including CIPAL 1301, PBA Hurricane XT$^{\phi}$, CIPAL 1522, PBA Jumbo2$^{\phi}$, PBA Ace$^{\phi}$ and CIPAL 1422 (Figure 3), yet reduction in height to bottom pod was significant when sowing was delayed until 2 June (Figure 3). Nipper had high height to bottom pod for the 6 May sowing date, but a more than 10 cm reduction for the 17 May and 14 cm for the 2 June sowing date (Figure 3).

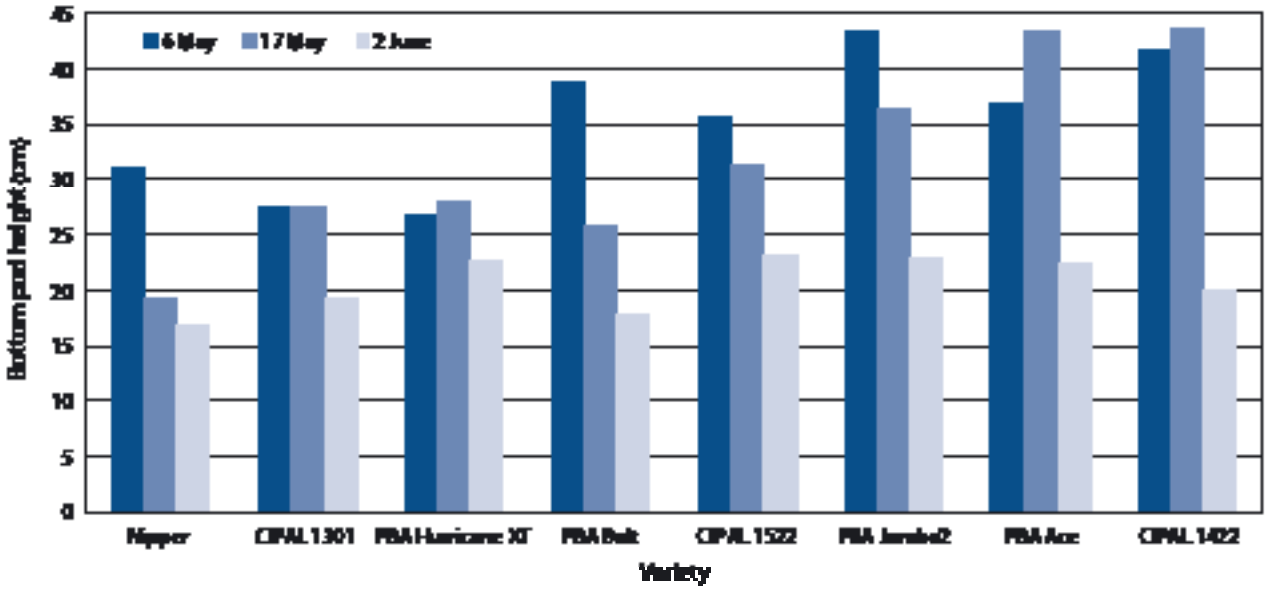

Figure 3. Bottom pod height from ground level for eight lentil varieties sown on three sowing dates at Wagga Wagga in 2016; l.s.d. ($P = 0.05$) = 7.2 cm.

Dry matter production

Ideal growing conditions across the 2016 growing season were conducive to producing high above-ground biomass. High biomass averaged across the eight varieties of 9.05 t/ha was accumulated at the 6 May sowing date, but was reduced by 19% or 1.7 t/ha when sown on 17 May and by 51% or 4.4 t/ha when sown on 2 June. Varietal differences in dry matter accumulation were also recorded. The highest biomass accumulator was PBA Ace$^{\phi}$ with 8.1 t/ha while PBA Bolt$^{\phi}$ was the lowest with 5.9 t/ha. Most varieties accumulated similar levels of biomass at the 6 May and 17 May sowing dates with significant reduction for the delayed sowing on 2 June (Figure 4).

Dry matter accumulation for individual varieties varied across the three sowing dates. For seven of the eight varieties, (the exception being Nipper), there was little difference in dry matter when sown at the beginning and in the middle of the sowing window (Figure 4). There was another marked reduction in accumulation when sowing was delayed until 2 June. However, in contrast, for Nipper there was a significant loss of dry matter accumulation between the 6 May and 17 May sowing dates (Figure 4).

Seed size

Seed size and colour (red and green) are the major determinants of market suitability for lentil. In this experiment, variety significantly affected seed weight with a range from 2.7 g/100 seeds for Nipper to 4.4 g/100 seeds for PBA Jumbo2$^{\phi}$.

There were significant differences across the varieties by sowing date interaction. PBA Hurricane XT$^{\phi}$, CIPAL 1522 and PBA Jumbo2$^{\phi}$ had significantly higher seed weight at the 6 May sowing date, while the 17 May and 2 June seed weights were lower yet similar (Figure 5). In contrast, CIPAL 1422 and PBA Bolt$^{\phi}$ had a slightly higher seed weight when sown later at the 2 June sowing date than the 6 May and 17 May sowing dates (Figure 5).

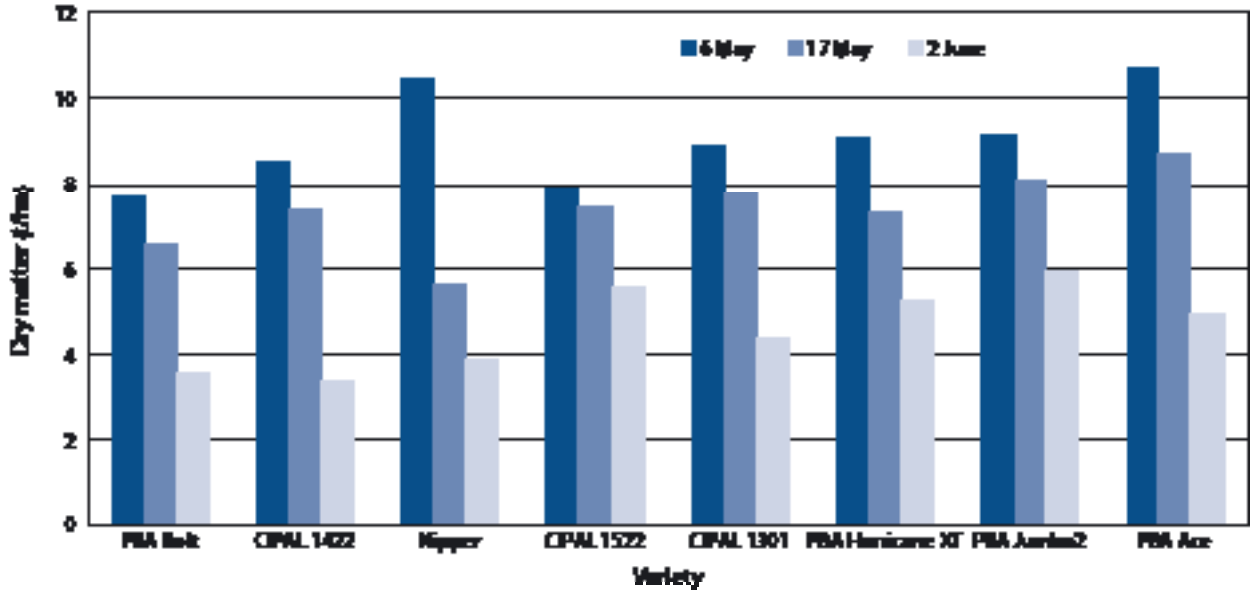

Figure 4. Dry matter production for eight lentil varieties sown on three sowing dates at Wagga Wagga in 2016; l.s.d. ($P = 0.05$) = 1.8 t/ha.

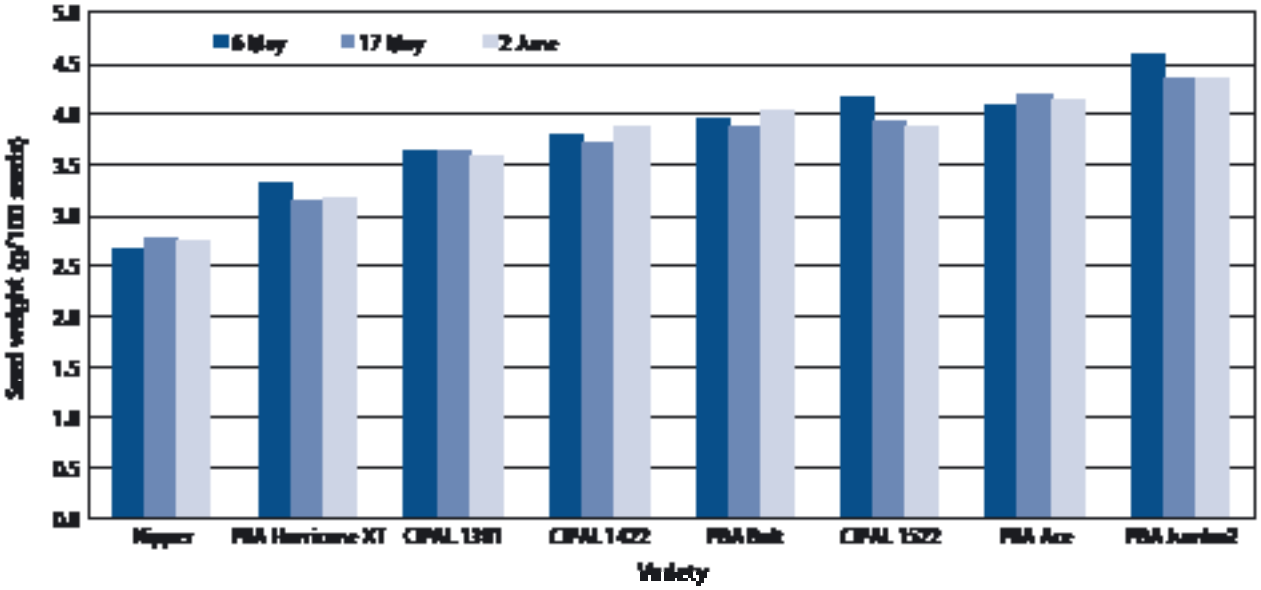

Figure 5. Seed weight for eight lentil varieties sown on three sowing dates at Wagga Wagga in 2016; l.s.d. ($P = 0.05$) = 0.1 g/100 seeds.

Summary

Paddock selection, sowing date and varietal selection are critical management factors for lentil production in southern NSW. Sowing early within the recommended planting window determines plant growth, grain yield and profit for these lentil crops. Results from recent agronomy experiments based in southern NSW indicate the optimum time to sow lentil in the western cropping region of southern NSW is late April through to mid May (later than lupin and faba bean, but earlier than field pea). In the eastern cropping region, the optimal time to sow lentils is early to late May (7–10 days later than the south-western region). Sowing beyond these dates severely compromises growth, production and yield.

Reduced grain yields were recorded when sowing was delayed. There was a 0.34 t/ha yield reduction when sowing was delayed from 6 May to 17 May (within the recommended sowing window), with a sharp reduction of 0.74 t/ha when sowing was further delayed to outside the sowing window. PBA Hurricane XT$^{\Phi}$ and PBA Jumbo2$^{\Phi}$ had the highest yields with 3.03 t/ha and 2.90 t/ha, respectively.

Some varieties showed more stability than others when sown over the sowing window with respect to grain yield. PBA Jumbo2(ϕ had only a 15% reduction when sowing was delayed to outside the sowing window (Figure 2).

Higher yield potential needs to be combined with improved height to bottom pod to enable more efficient harvesting. Timely sowing increased height to bottom pod with improvements of up to 11 cm when crops were sown at an appropriate time. Several varieties and advanced breeding lines showed high height to bottom pod, irrespective of sowing date, including PBA Jumbo2(ϕ, PBA Ace(ϕ and CIPAL 1422 with heights close to or exceeding 40 cm (Figure 3).

Seed size is a determinant of market and price received by primary producers; two varieties PBA Jumbo2(ϕ and PBA Ace(ϕ had seed weight higher than 3.5 g/100 seeds.

Sowing date is critical for maximum grain yield, dry matter, height to bottom pod, and seed size. In addition to sowing within the planting window, varietal selection for specific farming practices and location need to be assessed for maximum profitability for lentils within southern NSW.

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