

Exploring novel management and delayed sowing to improve and expand southern region chickpea production

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Key findings

- Opportunities to expand chickpea production into frost prone environments can be explored through delayed sowing.
- Gibberellic acid and companion crop species were not beneficial to improving chickpea plant height or podding height.

Why do the trial?

Chickpea production area in South Australia has expanded by 18,800 hectares in the last decade, with 44,000 tonnes of grain produced in 2021 (PIRSA 2022). High grain prices for chickpea in recent years has driven this production expansion, despite the high level of disease management required due to a break down in ascochyta blight resistance (Blake, Kimber et al. 2017, GRDC 2017). However, local chickpea agronomic research, including novel management approaches and variety evaluation, is limited and growers are seeking opportunities to improve and expand their production. Opportunities to improve chickpea harvestability through improving crop and podding height, and a pilot study to expand chickpea production in frost prone environments through delayed sowing was explored in 2021.

How was it done?

Plot size	1.75 m x 10.0 m	Fertiliser	80 kg/ha MAP
Seeding date	May 17, 2021		
Location	Condowie, SA		

Delayed sowing for frost avoidance

A pilot time of sowing (TOS) experiment was undertaken at the Farrell Flat Frost Learning Centre in 2021 to investigate agronomic opportunities in expanding pulse production into frost prone environments through delayed sowing. Three varieties of chickpea and faba bean were included with varying phenology characteristics, however, only chickpea results will be discussed for the purpose of this report.

PBA Royal is a medium size kabuli that is well adapted to medium rainfall growing regions of south eastern Australia, with early-mid flowering and mid maturity traits. PBA Drummond is a desi chickpea bred for Central Queensland with mid-flowering and early-mid maturity traits. Chill 1 is a breeding line with a chilling tolerance gene, giving the chickpea the ability to flower and set pod/seeds under suboptimal temperatures.

The first TOS was completed on May 20, followed by the second TOS on August 17. The trial was sown in a split-plot design, with crop type and TOS randomly assigned to the main plot and variety randomly assigned to the sub plot to ensure each crop received appropriate agronomic management. Data was analysed using a split-plot ANOVA model in GenStat 21st Edition.

Novel management to improve chickpea harvestability

With the aim of improving plant height and harvestability of chickpea, four treatments and two varieties were evaluated at Condownie, 2021. Two varieties were selected with contrasting plant height and growth habit characteristics.

PBA Slasher is a desi seed type with short-medium plant height and semi-spreading growth habit, while CBA Captain is a medium-tall desi type with an erect growth habit. To improve podding and plant height, four treatments were applied to each variety; 1. chickpea was sown with a companion species (canola), and gibberellic acid was applied at either 2. early flowering, or 3. early pod set, compared to 4. untreated control. Measurements included plant height and grain yield. Plant height was measured prior to and following the gibberellic acid applications by recording the height of five randomly selected plants within each plot, excluding the edge rows. Data was analysed using a two-way ANOVA in GenStat 21st Edition.

Results and discussion

Delayed sowing for frost avoidance

Rainfall at Farrell Flat was slightly below average with 436 mm annual rainfall, compared to the long-term average of 472 mm. However, several months during the growing season received above average rainfall, including June (+11 mm), July (+58 mm) and November (+58 mm). Temperatures recorded at the site included frost events, most frequent during the spring months of September and October (Table 1). The September and October frosts coincided with all chickpea varieties from the first TOS entering the full flowering growth phase. Whereas all chickpea varieties from the second TOS were entering the flowering growth phase towards the end of October, thereby having less exposure to frost events during this critical reproductive growth phase.

It is estimated from phenological assessments that the flowering growth phase (before the commencement of podding) of the first TOS lasted approximately six weeks, compared to four weeks for the second TOS. This resulted in pod formation of the first TOS chickpeas occurring in mid-November, and early-December for the second TOS. During the pod formation periods there was increased temperatures, however, there was sufficient available soil moisture to complete grain maturity in both TOS.

PBA Drummond had no grain yield penalty from a delayed TOS in 2021, with an average grain yield of 2.68 t/ha across TOS (Figure 1). In contrast, Chill 1 and PBA Royal experienced grain yield reductions with delayed sowing. It is hypothesised the different germplasm groups responded differently to the delayed sowing conditions. This is similar to chickpea TOS experimental findings from Riverton in 2020.

Table 1. Number of events where temperatures reached equal to or less than 0°C at the Farrell Flat Frost Learning Centre in 2021. Temperature sensors were placed at 90 cm above the ground.

	May	Jun	Jul	Aug	Sept	Oct	Nov	Dec	Jan
No. Days $\leq 0^{\circ}\text{C}$	1	1	3	5	14	12	4	2	0

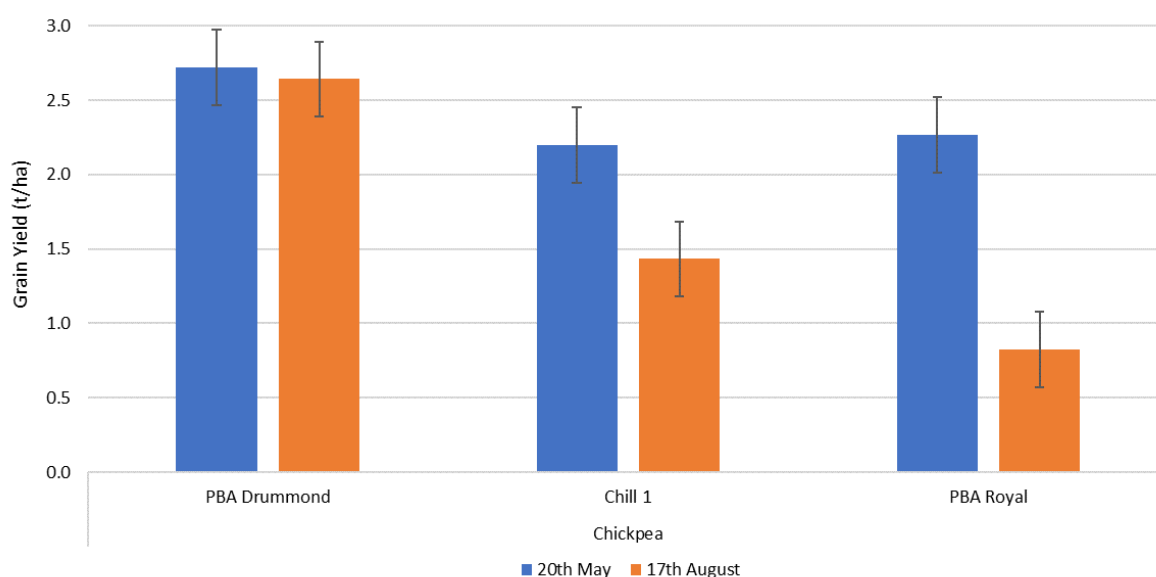


Figure 1. Grain Yield (t/ha) response of chickpea varieties to different times of sowing at Farrell Flat, 2021. Error bars represent standard error ($P \leq 0.05$).

Novel management to improve chickpea harvestability

The use of gibberellic acid applied at early flowering or early podding, or the use of canola as a companion crop species, were not beneficial to improving harvestability through increasing plant height or pod height in 2021. The use of the companion species resulted in interspecies competition that reduced resource availability for the chickpea crop and in turn the chickpea had reduced plant height and pod set. However, chickpea and canola intercropping combinations have been successful in previous seasons and other environments (Roberts and Day 2021).

CBA Captain is a taller desi chickpea variety and had a 4 cm average height advantage over PBA Slasher throughout the growing season (Table 2). CBA Captain control and gibberellic acid treatments plots were the highest yielding, but no higher than PBA Slasher that received gibberellic acid at early podding (Figure 2).

Table 2. Plant height (cm) of chickpea varieties sown at Condowie, 2021.

Variety	Date			
	18 Aug	31 Aug	5 Oct	22 Oct
CBA Captain	34.42	46.6	49.2	48.2
PBA Slasher	29.83	42.5	45.3	44.4
LSD ($P \leq 0.05$)	1.06	1.75	2.81	3.12

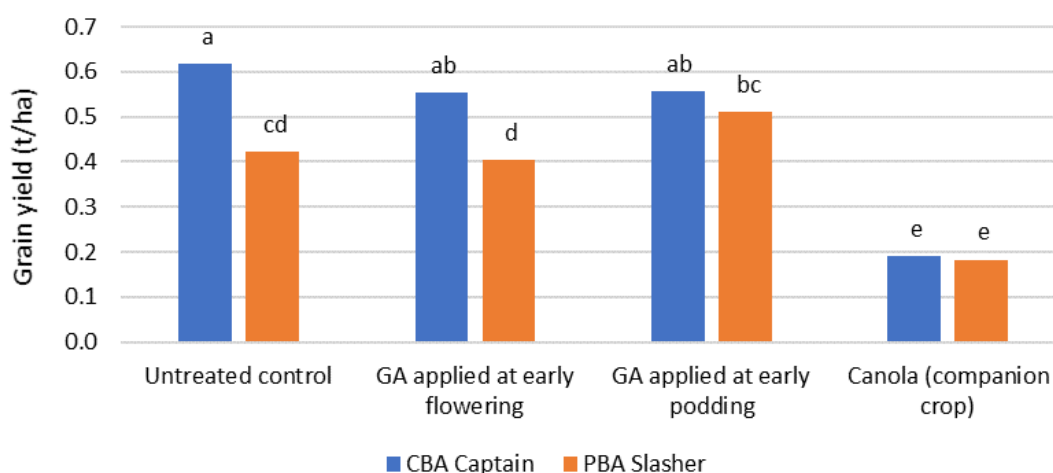


Figure 2. Grain yield (t/ha) in response to the interaction between variety and treatment applied to improve harvestability, at Condowie 2021. Bars labelled with the same letters are not significantly different ($P \leq 0.05$).

Conclusion

The results from chickpea delayed sowing pilot experimentation suggests this strategy could be a useful reproductive frost avoidance strategy. Further research is needed in this space to validate early results and determine a suitable germplasm for delayed sowing within this environment, while determining sowing window limits to avoid frost incidence, and the quantity of plant available soil moisture required for podding and grain fill growth phases when temperatures increase.

Opportunities remain to further explore novel management to improve harvestability of chickpea. Earlier gibberellic acid applications need further exploration, to improve early plant vigour rather than improving plant height during reproductive growth stages. Further validation of improving chickpea production with canola as a companion species warrants further evaluated, with the option of terminating the canola at early flowering to reduce competition for resources.

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