CHICKPEA TIME OF SOWING TRIAL, Trangie 2011

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Key words

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GRDC codes

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Take home message

- early sowing of chickpeas may not result in higher yields, despite earlier flowering, due to the increased risk of disease and the impact of low temperatures on flowering.
- later sown chickpeas can compensate through shortening their vegetative phase and flowering at temperatures more conducive to subsequent pod development.

Introduction

Chickpeas are a popular and profitable winter pulse crop option for the northern grains region. They are adapted to the heavier alkaline soil types of the region, and are able to tolerate relatively high temperatures during the flowering-grain fill period. They contribute to the profitability of northern farming systems through the ability to fix nitrogen and provide weed and disease breaks for both winter and summer cereal crops.

The two major constraints to chickpea production in the northern cropping region are disease and frost damage (Whish *et al*, 2007). In both cases, sowing date can be used as a strategy to influence yield through avoidance of cold temperatures during flowering, and to reduce the effect of disease.

The optimal time to sow chickpea will depend on the interaction between the environment and the available varietal germplasm. Current chickpea genotypes have excellent frost tolerance whilst in the vegetative state, but conversely display one of the highest temperature thresholds for seed set among cool season (winter) pulse crops. Mean daily temperature of less than 15℃ has been shown to cau se flower abortion (Clarke & Siddique, 1998). Flowering initiation in chickpeas has been described as a photo-thermal response, but in most environments temperature is the main determinant. The optimum sowing date results in flowering occurring when the risk of cold temperatures is low, and it is especially important to avoid frost during flowering, which can kill chickpea plants (Whish *et al*, 2007).

Choosing an optimum sowing time can also be a compromise between maximising yield potential and minimising disease levels. Earlier sowing can expose the crop to more rain events which can increase the risk of Ascochyta disease. It will also increase crop biomass, increasing the risk of Botrytis grey mould (BGM), lodging, and soil moisture deficit during grain fill. Later sowing can result in shorter plants (harvesting difficulties) and increased heliothis pressure, but may reduce vegetative water use and reduce the exposure to Ascochyta and Phytophthora infection events and lessen the risk of BGM (Matthews & McCaffery, 2011).

Chickpea time of sowing trials were conducted in 2010 and 2011 by NSW DPI at Trangie Agricultural Research Centre, to evaluate the impact of sowing date on phenology and yield of current and potential release cultivars. The 2010 trial succumbed to in-crop waterlogging and wet weather at harvest and was not harvested. This paper reports on the results of the 2011 trial.

2011 Site Details

Location:	Trangie Agricultural Research Centre
Soil type:	grey vertosol (pH_{CaCl} 7.5)
Previous crop:	wheat
Fertiliser:	100 kg/ha Granulock 12Z
Plant available water:	180 mm (stored) at sowing to a depth of 1.5 m, with 230 mm of rain from May-October

2011 Trial Treatments

Sowing dates:	TOS 1: 5 May TOS 2: 18 May TOS 3: 9 June TOS 4: 27 June
Varieties:	CICA 0511 (Jimbour® maturity, since released as PBA Boundary®) CICA 0912 (potential release, Jimbour® maturity) Genesis™ 425 (long season maturity, kabuli type) Flipper® (long season maturity, ascochyta tolerance) PBA HatTrick® (Jimbour® maturity, ascochyta tolerance) Sonali® (short season variety released in WA for chilling tolerance)

Methods

Crop establishment – Sowing rate was calculated individually for each variety based on a 100-seed weight and assumption of 90% germination. Target plant population was 60 plants/m^2. All seed was inoculated with Group N inoculant prior to sowing. All TOS seed was moisture-seeked into good moisture but there was no follow-up rainfall during June or July 2011. Row spacing was 66 cm. Actual plant counts (trial mean) averaged 26 plants/m^2 (range 20 to 37) with no apparent differences (not statistically analysed) between variety or sowing times.

Crop management – Current district practice was used to manage the trial as a chickpea crop. Standard herbicide products were used (PSPE and in-crop) to control weeds. Fungicide treatments were applied as a preventative strategy prior to rain events (including both mancozeb and chlorothalonil products). Note that the earlier sowing times (TOS 1 and 2) received extra fungicide applications during the establishment phase than later sowing times (TOS 3 and 4). The trial was also sprayed for heliothis with standard practice insecticide.

Data collection – Crop phenology data was collected through weekly plant mapping from 1st August on, to record date of first flower, date of first pod, and subsequent podding development. Whilst Phytophthora root rot was identified as having a significant impact, no disease scoring data was collected. Ascochyta and botrytis grey mould disease pressure was much lower in 2011 than 2010 and with the fungicide strategy used in the 2011 trial there was no evidence of these foliar diseases being present.

Harvesting – The trial was harvested on 28 November 2011, following one week of wet weather (76 mm at TARC from 20/11 to 25/11) but prior to the subsequent rainfall events at the end of November and through December 2011.

Climate data – Meteorological data was used from Trangie ARC weather station (approx. 2 km from trial site). Manual records (read daily) were used due to gaps and discrepancies in the BOM automatic weather station records. This data was used to assess the link between mean daily temperature and flowering/podding, as well as low temperature/frost impacts.

Results: Impact of time of sowing on phenology

Meteorological data from Trangie ARC shows that the mean daily temperature fluctuated and was frequently below the critical value of 15℃ right through August until 3 September, followed by another week of low temperatures from 8 to 14 September. This is consistent with analysis of Trangie temperature data for the last four years (2008-2011) showing that the mean daily temperature averages below 15℃ until 2 September.

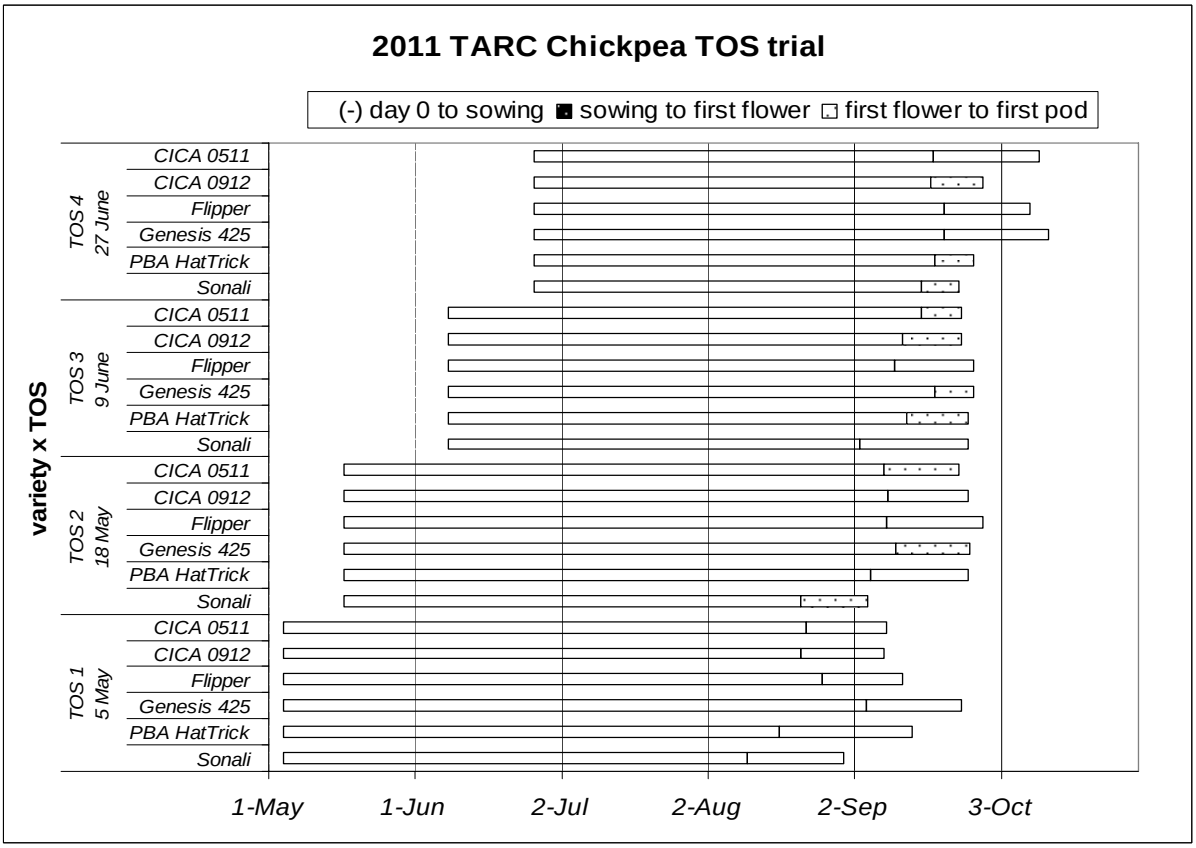

Figure 1. First flower and first pod dates for six chickpea varieties sown on four dates at Trangie ARC, 2011.

At low temperatures below 15℃, floral initiation (flower production) can commence (in response to both temperature and daylength), but any advantage from early flowering is often negated by increased flower abortion due to either infertile pollen being produced during pollen development, or lack of fertilisation during the pollination process.

Frost (sub-zero temperatures) can have additional effects to low temperatures by causing the complete loss of reproductive structures at any stage, i.e. flower, pod and/or seed abortion. Maturity can also be delayed as plants compensate by regenerating new branches. In 2011 only two actual frosts (below 0℃) were recorded on 13 and 14 September.

The phenology data graphed above (Figure 1) shows the flowering and first pod-set response of six chickpea varieties as an interaction of both sowing time and temperature. As a general rule, the actual date of first flower is delayed as sowing time is delayed, but the time taken from sowing to first flower is reduced. The period from sowing to flowering for TOS 1 and TOS 2 averaged across all six varieties was roughly the same (110-111 days to flower), whereas TOS 3 averaged 96 days and TOS 4 averaged 85 days to first flower, showing that the vegetative period before flowering is reduced as sowing time is delayed. All TOS 1 varieties had commenced flowering by 2 September, with the exception of Genesis™

425, whereas no varieties sown at TOS 2, 3 or 4 had commenced flowering until after 2 September, with the exception of Sonali().

The data in Figure 1 (above) shows that as a general summation of all six varieties:

- date of first flower (or length of vegetative phase) was progressively delayed as sowing was delayed
- date of first pod was delayed between TOS 1 and TOS 2, similar between TOS 2 and TOS 3, but further delayed between TOS 3 and TOS 4.
- the length of time between date of first flower and date of first pod shortened as sowing was delayed, especially for TOS 3, then lengthened again for TOS 4.

The variety Sonali() is a separate case. It was released in 2004 by the Department of Agriculture Western Australia and CLIMA, and bred specifically for chilling tolerance. As an early maturing (Tyson cross) line, Sonali() has been reported to start flowering 10-15 days earlier than other varieties that were current at the time of release (Sona and Howzat()), with podding commencing when the mean daily temperature is 10℃, compared to 14-15℃ for other varieties. The 2011 trial was consistent with this description, with Sonali() flowering 7-10 days earlier than any other variety, and the only variety to set and hold pod before 2 September. Unfortunately Sonali() showed poor disease tolerance in NSW and was never recommended for northern NSW conditions. Later results will show it has since been out-classed in yield.

Table 1 (below) provides a summary of mean phenology data grouped for all varieties at each of the four times of sowing. Note that this represents one year's trial observations only and the phenology data was not statistically analysed for significance.

	date sown (2011)	mean date of first flower	mean number of days to first flower	mean date of first pod	mean number of days to first pod
TOS 1	5 May	23 Aug	110	12 Sept	20
TOS 2	18 May	6 Sept	111	23 Sept	17
TOS 3	9 June	13 Sept	96	26 Sept	14
TOS 4	27 June	19 Sept	85	4 Oct	15

Table 1. Mean phenology data of six chickpea varieties sown on four dates at Trangie ARC, 2011.

Results: Impact of time of sowing on yield

Yield results are presented in Figure 2 below. Analysis of these results showed that there are significant differences between varieties in their overall performance, and also between the four times of sowing, but that there is no interaction between sow time and variety, since each variety behaved relatively the same at each sow time.

General response to sowing time

- TOS 1 (5 May) proved to be too early for the six varieties in this trial, with a mean yield penalty of 400-500 kg/ha below TOS 2 and TOS 3.
- There was no significant yield difference between TOS 2 (18 May) and TOS 3 (9 June). In this trial yield was optimal at either of these sowing times.
- TOS 4 (27 June) was too late with an associated yield penalty for all varieties when compared to TOS 2 and TOS 3 (mean yield 300 kg less), but still yielded higher (mean yield 170 kg/ha more) than TOS 1.

These differences could be explained by the climatic conditions post-sowing for each time of sowing. Chickpeas sown on the 5 May into warmer soils had emerged within 10 days, but at

about the two-leaf stage there was heavy rainfall (41 mm) on 23 May. This rainfall event was conducive to the development of Phytophthora root rot (PRR) in TOS 1 (*Kevin Moore, pers. comm.*). TOS 2 had only just been sown on 18 May and although PRR was evident, it did not have the same impact as TOS 1. The June sowings TOS 3 and TOS 4, although sown into good moisture, had minimal post-sowing rainfall events through June and July, with their first major rainfall event (28 mm) not until 18 August. There appeared to be far less development of PRR in TOS 3 and TOS 4 than the two earlier sowings, although actual disease levels were not objectively assessed. The dry period of June-July, in combination with a preventative fungicide strategy prior to predicted rainfall events, meant that there was no obvious development of the foliar disease Ascochyta and Botrytis grey mould in any of the four sowing times.

The differences could also be explained in relation to temperatures during the early part of flowering and pod development. Whilst plants sown at TOS 1 flowered earlier and set pod earlier (mean date 12 September), there was a week of low temperatures from 8 September culminating in two frost events on 13 and 14 September. Any flowers/pods up to this point would have been aborted (with the exception perhaps of Sonali). This effect would be reduced with subsequent sowing dates, to the point where plants sown at TOS 4 did not begin to flower until 19 September (mean date) after those particular frost events had occurred.

It is a poorly communicated fact that whilst chickpea plants generally produce many flowers, a large proportion (50-80 %) do not develop into pods, depending upon the variety, sowing date and other environmental conditions (Clarke & Siddique, 1998). Pod development in terms of actual pods produced vs. total number of flowering sites and pods aborted was recorded via weekly plant mapping in this trial, but has not yet been analysed to be reported here.

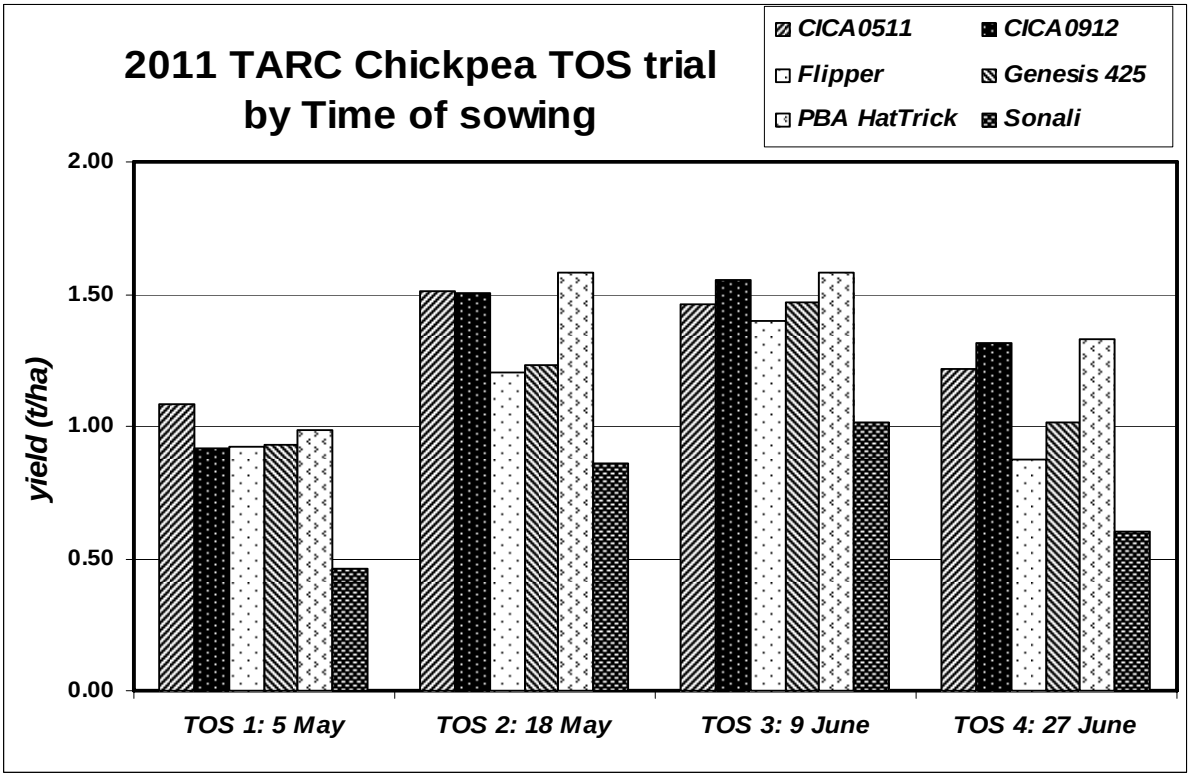

Figure 2. Yield response of six chickpea varieties sown on four dates at Trangie ARC, 2011 (average variety l.s.d. = 0.124; average TOS l.s.d. = 0.116)

General response of varieties

- PBA HatTrick® was the highest overall yielding variety (mean yield 1.37 t/ha), with significant yield differences to Flipper®, Genesis™ 425 and Sonali®, but not to CICA 0511 or CICA 0912.
- There was no significant difference between the yields of CICA 0511 (since released as PBA Boundary®) and CICA 0912.
- There was no significant difference between any of the varieties sown at TOS 3, with the exception of Sonali®.
- The longer maturing lines Flipper® and Genesis™ 425 appeared to incur greater yield penalties from TOS 4 but these differences are not statistically significant.
- Despite it's chilling tolerance, the early flowering habit of Sonali® did not translate into yield and was significantly lower yielding (360–630 kg/ha less) than all other varieties.

Conclusion

Chickpea time of sowing has been a debateable issue through several previous Northern Update sessions in recent times. The development and release of new chickpea varieties with high yielding attributes (largely due to greater regional adaptation and improved disease tolerance) has led to the belief that early sowing (early May) would be the key to optimising water use, through the development of increased biomass and hence earlier flowering. This trial has shown that earlier flowering does not necessarily translate into higher yield, due to the impact of lower temperatures during early flowering and a greater potential risk of disease. Conversely there is also a yield penalty from later sowing (late June) but chickpea plants are able to compensate to some effect when compared to very early sowing. Further research will be conducted over several seasons to develop sound recommendations for the region.

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