

## Precision guided mechanical weed control

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**Summary** Increasing impact of herbicide resistant and hard-to-kill weeds, together with environmental and safety concerns, have led to renewed interest in mechanical weed control. With availability of high precision guidance systems ( $\pm 2$  cm accuracy), it is now possible to cultivate closer to the row and this results in greater weed control.

Two field experiments conducted at the University of Queensland Gatton Farm assessed effectiveness of controlling weeds in chickpea crops mechanically using a high precision guidance system (GPS). In the first experiment, mechanical treatments consisted of cultivating with tools 2 cm, 5 cm and 15 cm from the row at six weeks after emergence (6WAE). In the second experiment, mechanical treatments were carried out a week earlier (5WAE) with cultivating tools 7.5 cm and 15 cm from the row.

Weed control treatments were carried out in a randomised complete block design with four replications. Each plot was 3 m wide and 20 m long with four rows on 0.75 m spacing. Measurements were taken from the intra-row and inter-row of the two middle rows of each treatment. Percentage of weeds removed and crop damage were used to compare mechanical treatments.

Efficiency of weed removal under each mechanical treatment was determined by counting the weeds prior to cultivation and then a week after cultivation:

$$\text{Weeds removed (\%)} = \frac{WD_{bc} - WD_{ac}}{WD_{bc}} \times 100$$

$WD_{bc}$  = Weed density before cultivation

$WD_{ac}$  = Weed density after cultivation

The amount of crop damage by cultivation was determined by measuring the length of row with dead plants in the middle rows of each plot (2 rows  $\times$  20 m row<sup>-1</sup>) a week after the cultivation:

$$\text{Crop damage (\%)} = \frac{\text{Row length of dead plants (m)}}{40 \text{ m}} \times 100$$

Crop and weed biomass (dry weight), seed production of dominant weed species, plant canopy height at full flowering, and crop yield from each mechanical treatment were compared with the control treatments. Untreated and weed-free treatments were comparison treatments for experiment 1 whereas untreated and post-sowing pre-emergence (PSPE) simazine treatments were comparison treatments for experiment 2.

For experiment 1, overall percentage of weed control increased with increase in width of inter-row cultivation and a maximum of 59% weeds was removed by the 2 cm treatment. However, this treatment caused unacceptable damage (20%) to plants, primarily due to random errors in the accuracy of GPS. Cultivating 5 cm and 15 cm from the row caused negligible crop damage and the weeds removed were 55% and 49%, respectively. Biomass and seed production of weeds did not follow a clear trend because of large spatial variability of weed density among treatments.

Weeds removal rates for experiment 2 were much higher than those observed for experiment 1, primarily due to lower weed density and timing of cultivation. Average weed density in the second experiment was one quarter to one third of that in the first experiment. Cultivating 7.5 cm and 15 cm from the row resulted in 77% and 54% weed removal, respectively. No crop damage was observed for these two treatments.

Weed biomass at flowering was significantly different among cultivation treatments – 72 g m<sup>-2</sup> for 7.5 cm, and 247 g m<sup>-2</sup> for 15 cm cultivation treatment. Weed biomass for PSPE simazine treatment (77 g m<sup>-2</sup>) was significantly lower than the non-weeded treatment (306 g m<sup>-2</sup>).

Crop yield from the 5 cm treatment approached that of the weed free treatment; this treatment would help farmers control herbicide escapes, and slow development of herbicide-tolerant species.

**Keywords** Precision guidance, GPS, chickpea, cultivation, weed density, biomass.

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