COMPETITIVE INTERACTIONS BETWEEN WEEDS AND CHICKPEA (*CICER ARIETINUM* L.): TOWARDS THE DEVELOPMENT OF AN INTEGRATED WEED MANAGEMENT SYSTEM

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Abstract

The production of chickpea (*Cicer arietinum* L.) in the northern grains region of eastern Australia has great potential for breaking grass disease cycles, improving soil nutritional status, and alternating herbicides within crop rotations. However, the susceptibility of chickpea to weed competition has hindered its adoption in rotations. This thesis investigates the agronomic production of chickpea by examining how manipulations of sowing pattern, timing of herbicide applications, and selection of varietal material affect its competitive interaction with weeds.

It was found that the manipulation of chickpea sowing pattern from narrow (32 cm rows) to wide (64 cm rows) had no detrimental effect on chickpea yield when grown in competition with varying densities of *Rapistrum rugosum* (l.) All. (turnip weed) or *Avena sterilis* ssp. *ludoviciana* (Durieu) Nyman (wild oat). Increasing the weed (wild oat, turnip weed) density was found to reduce the chickpea yield in a manner best described by a rectangular hyperbolic model. From the model, weed densities of 8 turnip weeds m^{-2} or 10 wild oats m^{-2} reduced chickpea yield by more than 50% compared with a weed-free control.

Only a few herbicides are available for use in chickpea crops and many of these pose high risk for the development of herbicide resistance. To improve weed control in chickpea crops and to reduce the risk of developing herbicide resistance, herbicides should be applied at strategic times to maximise their effectiveness and minimise the need for repeat applications. Chickpea and weed (wild oat, turnip weed) growth studies were combined with time of weed removal studies, and the results correlated with degree-day measurements to identify the optimum time for weed control. For the two experimental sites examined in this thesis, Tamworth and Warialda in northern New South Wales, a heat sum of 444 degree-days was considered the optimum time for controlling weeds, because it maximised crop yield and minimised weed seed return to the seed bank.

The selection of varietal material with greater early vigour and ability to shade is often seen as a means of improving the competitive ability of a crop. The low stature and relatively open canopy of current chickpea varieties suggest that this is an area for potential improvement. Comparisons between existing varieties and new breeding lines showed that current breeding objectives are improving the competitive ability of chickpea. In my opinion, however, chickpea weed

management would be improved more effectively by concentrating on the agronomic areas of chickpea production.

The effects of the position of weeds in relation to the chickpea crop and shading by weeds were also examined. The position of the weeds in relation to the crop row had no effect on chickpea yield. However, yield was increased if the weed distribution was clumped in high density patches compared with being evenly distributed throughout the crop.

Increased shading at the time of chickpea flowering (as in the case of turnip weed growth) by 50% significantly reduced yield and could partially explain some of the yield loss from the weed density experiments.

It is hoped that these areas of investigation will form the foundation of an integrated weed management package; however, further work (as discussed in Chapter 10) is required to relate crop and weed growth to environmental parameters. Understanding the weed and crop growth under particular environmental conditions would enable the development of simulation models which could be used for forecasting experimental outcomes and eventually assist farm management decisions.

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