CURRENT STATUS OF WEED CONTROL IN CHICKPEA IN NORTHERN NEW SOUTH WALES

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Summary The practice of using legumes in wheat rotations to improve soil nitrogen levels, break disease cycles and enable chemical control of grass weeds, is slowly being adopted by wheat farmers in the northern cropping region of eastern Australia. Pulse crops and particularly chickpea can be described as poor competitors; hence, if not grown on clean country or with herbicides, will quickly become infested with weeds, reducing quality and yield.

This paper examines a number of chemical and agronomic strategies that have been proposed to improve weed control in chickpea, and thus, identifies specific research areas that may offer long and short term control.

INTRODUCTION

Continuous cropping of grain cereals has been common practice in northern New South Wales. This form of cropping has resulted in a depletion of soil organic carbon and nitrogen and decreased crop yields, grain protein contents and financial returns to producers (Horn *et al.* 1996). Pulse crops have been incorporated into a rotation to avoid these losses while providing a disease and pest break.

Chickpea is one of the pulses suited to northern New South Wales, and is grown on a wide range of soil types, but prefers the medium to heavy clays (Knights 1991). The use of chickpea in rotations has been widely promoted after it was shown that their inclusion could raise subsequent wheat yields by up to 103% (Knights 1991).

Despite these convincing arguments, there are a number of difficulties associated with growing chickpea in the northern New South Wales grain belt. Traditionally, lucerne has been grown in the region, however, many of the pathogens and pests which are associated with lucerne production have also been found to affect chickpea (Knights 1991).

Phytophthora root rot is the major disease of chickpea in eastern Australia and has been a major impediment to widespread acceptance of the crop in northern New South Wales. However, recent breeding and selection work has identified heritable resistance, and future releases of this material should be more suited to the region. A second problem is the susceptibility of chickpea to a number of aphid-transmitted luteoviruses (Rummery *et al.* 1996), many of which originate or are associated with lucerne (Schwinghamer *et al.* 1995). Chickpea is also susceptible to foliar fungal diseases, *Botrytis* spp. and *Sclerotinia* spp., seed borne diseases, *Botrytis* and *Ascochyta rabiei* (Phoma blight), and insect attack by Heliothis species (*Helicoverpa armigera* and *H. punctigera*; Knights 1991, Schwinghamer *et al.* 1995, Rummery *et al.* 1996).

One of the major obstacles in growing chickpea successfully is their poor ability to compete with weeds. Crop losses of 90% are possible in weedy situations (Knights 1991), and the lack of registered post-emergence herbicides for broadleaf weeds reduces the options for weed management.

This paper examines the current recommendations for weed control in chickpea crops of northern New South Wales and research directions required to implement an integrated weed management system.

CURRENT WEED CONTROL SITUATION

To date there is only one post-emergence herbicide registered for broadleaf weed control in chickpea, i.e. pyridate (Tough®), but this chemical controls only a relatively narrow weed spectrum. Registered pre-emergence herbicides are available, e.g. simazine (Gesatop®) plus prometryn (Gesagard®), cyanazine (Bladex®) and metribuzin (Sencor®) (Mullen and Dellow 1994, Schwinghamer *et al.* 1995), but these are expensive and their residues may be associated with reductions in crop yield (Rummery *et al.* 1996). Chemical control of grass weeds is currently well catered for with both pre-emergence herbicides i.e. trifluralin (Treflan®, Tridan®, Trifluralin, Rival®), tri-allate (Avadex BW®) and pendimethalin (Stomp®), and post-emergence herbicides i.e. fluazifop-P (Fusilade®), haloxyfop (Verdict®), sethoxydim (Sertin®), quizalofop-p-ethyl (Targa™) and clethodim (Select®) being available. However, with the chance of developing herbicide resistance, sole reliance on chemical weed control is not recommended. The current solution with the limited number of available herbicides is to use the preceding cereal crop and fallow to chemically reduce the potential weed burden, and then only sow chickpea in areas that are considered relatively clean. Grass weeds are managed chemically with the aim of reducing their competitive effect on the chickpea crop and their ability to carry over pests and diseases to the following cereal crop (Simmons *et al.* 1991).

In order to maintain soil structure and reduce soil erosion, zero-tillage and minimal-tillage are being encouraged in northern New South Wales (Martin *et al.* 1988). Chickpeas grown with zero-tillage have also displayed a 10% yield increase over those grown with conventional cultivation (Felton *et al.* 1996). However, to avoid stubble blockages during sowing, the row spacing recommendation for chickpea has been increased to 50 cm (Rummery *et al.* 1996). Such widely spaced rows may have some advantages for weed control. Inter-row weeds may be controlled either by tillage or banding of herbicides with shielded spraying equipment (Felton *et al.* 1996). The efficiency of shielded sprays is currently being improved by use of infra-red detection systems that selectively apply herbicide to weeds (Felton *et al.* 1992) but avoid spraying bare soil. These methods of controlling weeds between rows of chickpea are potentially very useful, however, they do rely heavily on chemical control and cannot remove weeds from within the chickpea rows. Never-the-less, row-cropping of chickpea in weed-free situations has shown no reduction in crop yield (Felton *et al.* 1996).

CURRENT AND FUTURE RESEARCH GOALS

The natural ability of chickpea to resist weed competition is often considered to be poor. Winter growth is slow and the open plant canopy does not appear to impede weed germination or growth. These observations have led to the suggestion that agronomic methods may be able to be used to improve the competitive ability of chickpea, and at the same time reduce reliance on the prophylactic use of herbicides. It may be possible to manipulate rotations, plant spacing, plant density, strategic herbicide applications and the varietal vigour of chickpea to reduce the impact of weeds. A research program has commenced to address these ideas as part of a new collaborative project between NSW Agriculture, the Queensland Department of Primary Industries and the University of New England on the 'Development and promotion of integrated weed management systems for the northern grain region'.

The term 'integrated weed management' implies that weed populations can be maintained at an acceptable level that allows crop production without incurring severe financial loss and with minimal environmental impact. Such an acceptable level of weed infestation, however, is difficult to define. The economic threshold is often identified as the level of weed control for which to aim, but as Cousens (1987) outlines, many different methods are used to estimate the economic threshold. The confusion in the use of terms highlights the difficulty associated with estimating an acceptable weed level in different crops through a wide range of agricultural regions. No standard formula exists for estimating thresholds, and belief in their value is still being debated (Cousens 1987). One practical way of estimating thresholds is through visual assessment by farmers. Their threshold levels, however, are likely to be far lower than any economic threshold (Cousens 1987).

To begin the process of developing an integrated weed management system for chickpea a great deal of information is required, and initially crop development strategies need to be modified so that weeds are considered part of the equation. Current chickpea breeding is performed under weed-free situations with yield and disease resistance being the main selection criteria. If this breeding and selection work was to involve competitiveness against weeds then future varieties may suffer less from their effects. In order to achieve this result, breeding in the presence of weeds is required. The natural variability within field weed populations, however, is a major constraint on such experiments. White mustard (*Sinapis alba* L.) was used as a pseudo weed by Lotz *et al.* (1996) to overcome this type of variation. The uniform habit, vigour and drought resistance of Indian mustard (*Brassica juncea* L.) (Wright *et al.* 1995) make it another ideal candidate for competition studies with chickpea. A number of mustard varieties are currently available in Australia and these grow well in both the southern and northern chickpea regions.

The critical period of weed interference can be defined as that period in which, if weeds are not controlled, they will significantly affect yield. Experiments that are centred on this concept are often used to assess the timing of chemical applications and the length of time required for residual weed control treatments. Such experiments are well suited to chemical weed control, but do not provide sufficient information about the interaction of crop and weed growth. One experiment that is not often done, but which may enhance the results of critical period experiments, is measuring growth over time at different weed densities. This type of experiment (provided that both crop and weeds are assessed) will show how crop and weed growth are influenced by each other, thus showing when reductions in yield occur. This experiment would not show when the competition that caused the reduction in growth occurred, only when its effects are displayed. However, this information would be useful to help associate the timing of critical periods to the times when competition is believed to be most severe.

The value of rotations as a management tool for weeds is well recognised and long term research is already showing the value of chickpeas in wheat rotations (Knights 1991). Rotations can be combined with strategic spray programs to reduce weeds in following crops. However, this form of management does limit flexibility and specific crops must be planted when scheduled or residue problems may occur. Selected rotations can also target weeds in subsequent crops by using the allelopathic effects of stubble residues (Purvis 1990). However, detailed knowledge of the potential weeds in each crop and in each area is required to utilize the full potential of the selected rotational sequence.

The aim of this current project is to quantify the relationship between weed growth and chickpea yield, identify the critical period of weed interference and enhance the competitive ability of chickpea by altering the cultivar and planting pattern. Initial experiments were sown in June 1996 at Warialda and Tamworth in northern New South Wales. The competitive ability of six chickpea varieties is being assessed when grown in the presence of Indian mustard (*Brassica juncea* cv. JE13*2) and compared with wheat (cv. Hartog) and canola (cv. Hyola 42). Additional experiments are examining the effect with broadleaf (*Rapistrum rugosum*) and grass weed (*Avena ludoviciana*; *A. sterilis* subsp. *ludoviciana*) densities on chickpea grown in both narrow and wide rows.

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