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Annual ryegrass control affected by choice of management system

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Summary Annual ryegrass is the most challenging weed of winter crop production through its ability to evolve herbicide resistance to most chemical modes of action. This ability to adapt to changes in management regimes means that no one control measure is likely to effect control for any length of time.

In order to understand this phenomenon better an experiment was undertaken at Wagga Wagga, NSW first to evaluate the relative importance of cultural and chemical control options in the absence of a competing crop. The treatments were then imposed for ryegrass control within a wheat system.

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Keywords glyphosate, canola, transgenic

INTRODUCTION

Annual ryegrass (*Lolium rigidum*) remains one of the major weed challenges in winter crop production in Australia. There have been several studies (eg Gramshaw 1972, Pearce and Holmes 1976, Davidson 1994 and Gill and Holmes 1997) to evaluate control strategies for annual ryegrass but most have not focused on the integration of options related to more recent conservation farming methods, namely the use of an "autumn tickle" in combination with knockdown herbicide, level of seedbed disturbance at sowing and the impact of pre-emergent and post-emergent herbicides. These control techniques have their own effects but such effects are likely to be altered by the presence of a crop.

The following experiment reports an investigation of the effects of control options available in a conservation farming system in both a crop free situation and with a crop imposed.

MATERIALS AND METHODS

A field site was established at Charles Sturt University in June 1997, with an annual ryegrass pasture sown at 2 kg ha^{-1}. The ryegrass was allowed to set seed to generate a natural seedbank for the following season when an experiment was established to compare the relative effect of cultivation level and herbicide regime on control of annual ryegrass in the absence of crop competition. A total of 24 treatments were imposed using combinations of three factors:

- cultivation, with half the plots being lightly cultivated in autumn ("autumn tickle") (AT) to stimulate weed seed germination.
- sowing method, with a simulated sowing operation using either wide points providing full soil disturbance (FD) or narrow points to emulate a direct drilling operation (DD). Glyphosate was applied pre-sowing at 360 g a.i ha^{-1} (FD1) for the FD treatment and both 360 g a.i ha^{-1} (DD1) and 540 g a.i. ha^{-1} (DD2) for the DD treatment to reflect farmer practices. A control treatment (C) with neither glyphosate nor soil disturbance was also included.
- selective herbicides application, with herbicides selected to emulate typical herbicide control practices in wheat. Four selective herbicide regimes were used: pre-emergent herbicide only (15 g a.i. ha^{-1} chlorsulfuron) (Pre); post-emergent herbicide only (375 g a.i. ha^{-1} diclofop-methyl) (Post); both pre-emergent and post-emergent herbicides (P&P); and a control treatment with no selective herbicides (C). Pre-emergent herbicides were applied and incorporated at the time of cultivation, while post-emergent herbicides were applied when the annual ryegrass was at the 2-4 leaf growth stage.

Individual plots were 4 x 4 m, with three replicates of all treatments arranged as a split-split plot design, with treatments randomised within blocks. Final plant counts were obtained in September 1998 from five 0.1 m^2 random quadrats in central 4 m^2 of each plot, with numbers of each species present recorded.

In the following year, annual ryegrass seed was broadcast at 15 kg ha^{-1} at a second site prior to the autumn break. Treatments as per year one were again undertaken, except for the control treatment (CD1) which was cultivated, and a fifth treatment with glyphosate applied pre-sowing at 540 g a.i ha^{-1} prior to full soil disturbance sowing (FD2). Wheat (cv Diamondbird) was sown at 80 kg ha^{-1} in 10 x 1.8 m plots.

Plant counts were obtained from five 0.1 m^2 quadrats randomly placed along the centre of each plot. Weeds were assigned to one of three categories; i.e. annual ryegrass, broadleaf weed and other grass weeds. Counts were undertaken prior to sowing and six weeks after application of post-emergent herbicides.

Fertilisers were applied in line with advice for regional best practice as obtained from the local NSW Department of Primary Industries District Agronomist. Methidathion insecticide was applied at 80 g a.i. ha^{-1} post sowing, pre emergence to control red legged earth mite.

In both experiments, weed count means for each plot were obtained by averaging quadrat counts per plot and then expressing the result in the form of plants m^{-2}. Data were transformed using ln(plants m^{-2} + 1) to normalise variances prior to analyses of variance being conducted. Initial annual ryegrass density was included as a covariate in the analysis of subsequent annual ryegrass data due to some variations in initial annual ryegrass densities. Post hoc Fisher's protected LSD tests were used to separate significantly different means. Data were back-transformed into plants m^{-2} for presentation.

RESULTS

In the absence of a crop in the first year, an autumn tickle significantly decreased annual ryegrass density ($P < 0.01$), with an average of 595 plants m^{-2} compared to 945 plants m^{-2} for treatments that did not include an autumn tickle (Figure 1).

Soil disturbance at sowing significantly decreased annual ryegrass numbers ($P < 0.01$), with full soil disturbance at sowing providing better annual ryegrass control than direct drilling combined with either rate of glyphosate. In this experiment the pre-emergent herbicide did not improve ryegrass control compared to the untreated control, whereas the post-emergent herbicide treatment significantly decreased the annual ryegrass burden ($P < 0.01$).

In the presence of the wheat crop, differences were evident but the competition of the crop reduced the annual ryegrass density, particularly in the untreated controls. The use of an autumn cultivation to stimulate annual ryegrass germination did not have a significant effect on ryegrass density. Significantly more ryegrass was present when cultivation (CD1) was used instead of a knockdown herbicide ($P < 0.05$), except when a low rate of glyphosate was used in conjunction with direct drilling at sowing.

The herbicide regime used had a significant effect on annual ryegrass levels ($P<0.001$), but there was no significant interaction between herbicide and cultivation. Use of either a pre-emergent or a post emergent herbicide provided similar levels of improved annual ryegrass control compared to the untreated control. Using both herbicides significantly increased annual ryegrass control in the presence of the wheat crop.

Direct drilling with the recommended glyphosate rate prior to sowing gave better results than when a lower glyphosate rate was used, or no glyphosate at all. This suggests that it is critical to use the correct glyphosate rate when using direct drilling techniques. Effective selective herbicides can provide significant reductions in annual ryegrass levels singularly, or can further reduce annual ryegrass levels if used in conjunction.

DISCUSSION

Shallow autumn cultivation has been reported to increase annual ryegrass germination (Pearce and Holmes 1976 and Heap 1988). Davidson (1994), however, reported no effect of an autumn 'tickle' on annual ryegrass germination and concluded that seasonal conditions, particularly rainfall events, may be more important than cultivation. The use of an autumn 'tickle' did not significantly increase the level of annual ryegrass emergence in the second year of this trial. The high seeding rate and the broadcasting of the seed just prior to the autumn tickle being imposed may have influenced this outcome.

The rate of glyphosate used and the degree of soil disturbance are factors of influence as demonstrated in the absence of crop, but these effects were generally negated in the presence of the wheat. Selective herbicide regime however remained influential in the presence of the crop, with the pre-emergent herbicides assisted by the presence of a crop.

This experiment demonstrated that the presence of a crop has a strong influence in determining the impact of management techniques on the weed burden. In this case wheat was chosen and it is not clear whether there would have been the same influence in the presence of other crops or under different seasonal conditions. However it is known that different varieties have differential effects on particular weeds. This has been demonstrated with wheat on annual ryegrass (Lemerle *et al*. 2001) for example. It is suggested that such capability between crop species and variety should be utilised more diligently.

ACKNOWLEDGMENTS

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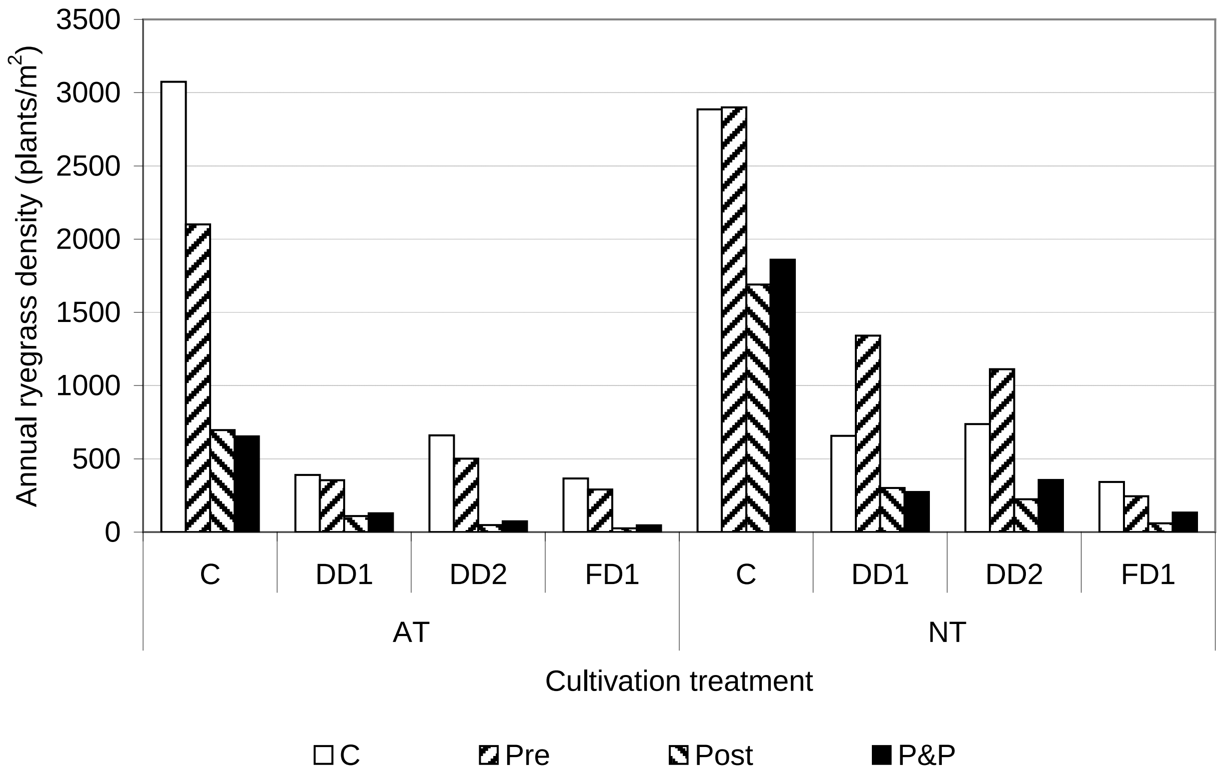

Figure 1. The effect of autumn tickle, sowing practice and herbicide treatment on annual ryegrass populations in August, in the absence of crop.

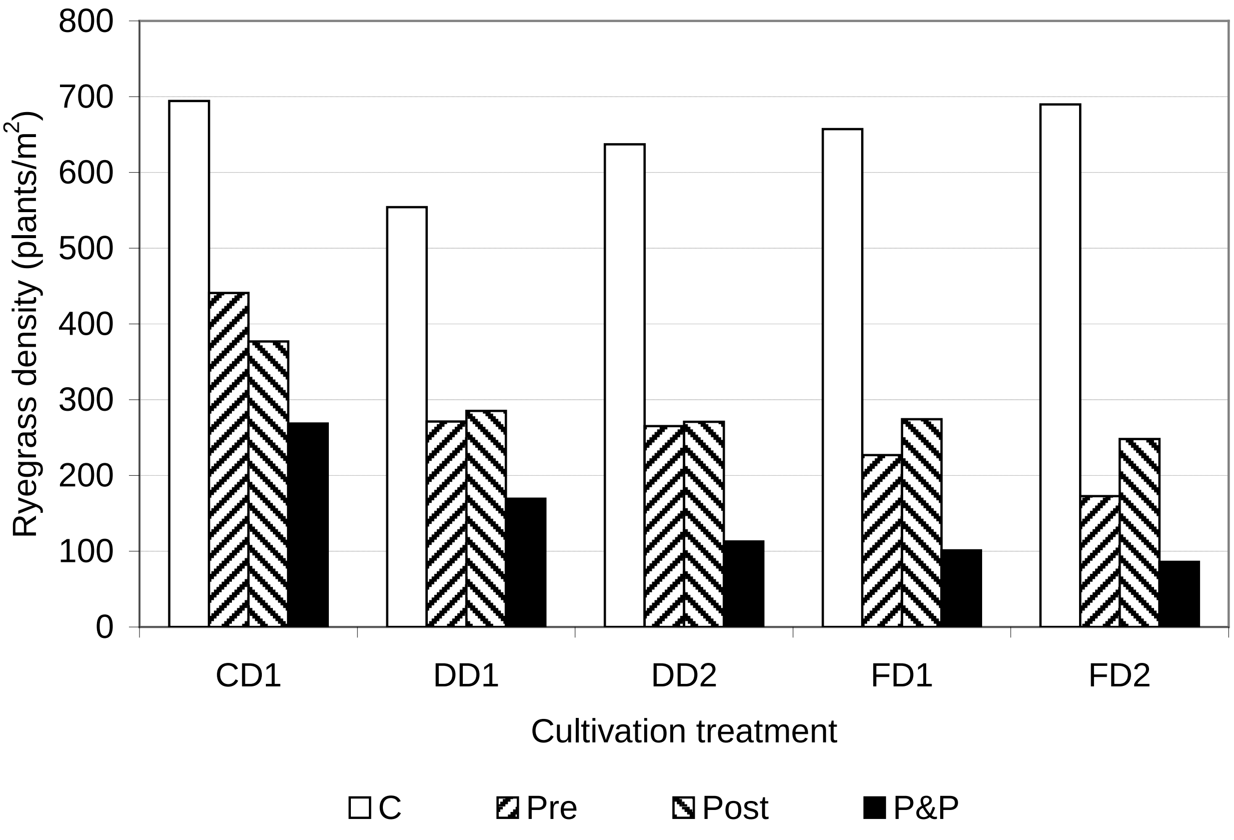

Figure 2. The effect of sowing method and herbicide treatment on the density of annual ryegrass in the presence of a wheat crop.