CANOLA (*BRASSICA NAPUS*) COMPETITION FOR WEED MANAGEMENT

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ABSTRACT

Canola (*Brassica napus*) is an important break crop in the temperate cropping zone of southern Australia. Although a wide range of herbicide-tolerant cultivars are now available, weeds can still significantly reduce grain yield and quality. Crop competition is a useful tool for reducing weed impacts and suppressing weed growth and spread. A field experiment in 2009 studied the impact of two canola genotypes and four crop densities on the competitive ability of canola with wheat, an important volunteer weed in canola. Significant effects of competition on the suppression of the weed and grain yield were recorded. Manipulation of crop agronomy by choice of genotype and increasing crop density to reduce weed impacts is a cost-effective and simple way for famers to improve weed control, increase herbicide efficacy and prolong the life of useful chemicals by reducing the rate of development of herbicide resistance.

Keywords: weed competition, cultivars, herbicide resistance, weed interference, hybrid, seed rate

INTRODUCTION

In recent years weed control options for canola in Australia have improved considerably with the development of a wide range of herbicide–tolerant cultivars with resistance to glyphosate, triazine, or imidazinolinone herbicides. However, the widespread incidence of weed resistance to many herbicide groups requires the inclusion of non-chemical control tactics in management strategies to reduce weed costs and dependence on herbicides. Volunteer wheat can be a significant weed in canola even in herbicide-tolerant crops (Lemerle *et al*. 2001). Crop competition is an important tactic to facilitate herbicide performance and integrated weed management.

Previous studies in Canada indicate that more competitive canola cultivars and higher seeding rates increased the ability of crops to compete with weeds (Harker *et al*. 2003, Beckie *et al*. 2008). F_1 hybrids are taller, more vigorous, and establish a denser canopy than the open-pollinated types (Zand and Beckie 2002). In Australia, triazine–tolerant cultivars were poorly competitive against weeds compared to the vigorous hybrids (Lemerle *et al.* 2010). We hypothesise that a combination of cultivar and seeding rate will increase weed suppression and optimise grain yield and quality in the presence of weeds. This study compared the effects of canola genotype and seeding rate on crop grain yield in the presence and absence of volunteer wheat.

MATERIALS AND METHODS

The experiment was conducted at Wagga Wagga, New South Wales, Australia (Latitude 35^0 05 S, Longitude147^0 35 E) in 2009 in a silty clay loam with pH 4.6 and organic matter of 1.8%. Treatments were arranged in a split-split plot design with three replicates. Main

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plots were two genotypes, split-plots were four crop densities and sub-plots were weedy and weed-free conditions. Genotypes were a low vigour, conventional triazine-tolerant cultivar (ATR-409) and a vigorous commercial F_1 hybrid (46Y78). Four canola seeding rates (15, 30, 60, 120 seeds/m^2) were used to target crop densities of 10, 20, 40 and 80 plants/m^2 (assuming emergence rate at about 60%) as recommended by McCaffery *et al*. (2009). Plot size was 1.8 m (eight 22 cm rows) wide by 10 m long. The experimental area was cultivated and harrowed on 4 June and treated with Trifluralin applied at 1.8 L/ha in 100 L water/ha) and incorporated on 15th June to control broadleaf weeds. The canola treatments densities were sown on 16th June, plus and minus cv. Ellison at 15 kg/ha as the surrogate weed. DAP fertiliser was applied at sowing, equivalent to 20 kg/ha P and 18 kg/ha N.

Crop establishment was estimated by counting plant numbers using a 0.5 m ruler between 2 crop rows at five random locations per plot. Weed numbers were recorded using 50 cm X 50 cm quadrats in six random locations per plot. In-crop growing-season (1 April – 31 October) rainfall was only 230 mm about half the annual average of 460 mm.

Destructive hand harvests for biomass were taken at flowering on 16th September using one randomly placed 1m^2 quadrat per plot. Crop and weeds were separated and weighed. After drying at 70 ^{0}C for three days, dry weights were recorded. Plots were harvested for grain yield using a Kingaroy small-plot harvester on 20th November. The samples were cleaned and sub-samples taken for quality assessment by NIR (moisture, oil, protein and glucosinolate contents – data not reported here).

Data were analysed using AS-REML in R version 2.12.2.

RESULTS AND DISCUSSION

Plant densities

For the three lower seeding rates, the achieved crop (canola) plant density was very close to the targeted number. However, for the highest rate (80 plants/m^2) the results varied from 67 to 88 plants/m^2 on average for the two cultivars. In this environment the farmers' target is around 40-60 plants/m^2 for all genotypes (McCaffery *et al*. 2009), while lower densities are recommended in drier areas. Poor establishment is a common problem in canola due to dry conditions at sowing, where residues from the previous crop are present, and from insect, bird or mouse damage.

The weed (volunteer wheat) plant density was much more variable and ranged from 49 to 100 plants/m^2, due to sowing difficulties and poor establishment. Weed density varied from 61 to 87 plants/m^2 (averaged across the seeding rate by genotype combinations).

Grain Yield

Grain yield was affected by a significant interaction between canola genotype, canola density and the presence or absence of volunteer wheat. Yields were low due to drought and ranged from 0.05 to 0.25 t/ha depending on the treatment combination (Figure 1). There was no indication in these low-yielding conditions that the hybrid 46Y78 was higher yielding than ATR-409, in fact it was lower yielding at higher densities possible due to greater early vigour and water use. Weed-free plots yielded much more than weedy ones (Figures 1 A and B).

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The weed-free yield response to canola density reached a plateau at about 40 plants/m^2 in the hybrid 46Y78 but continued to increase with crop density in ATR-409 (Figure 1A).

However, the reduction in yield in the face of weed competition was somewhat smaller for the hybrid than ATR-409 (Figure 1C), that is about 25% of the weed-free controls for the hybrid and 40-45% for ATR-409, especially at the higher densities. This is expected and is a similar result to the Canadian experience (Harker *et al*. 2003, Beckie *et al*. 2008). Further studies will confirm this in another contrasting season.

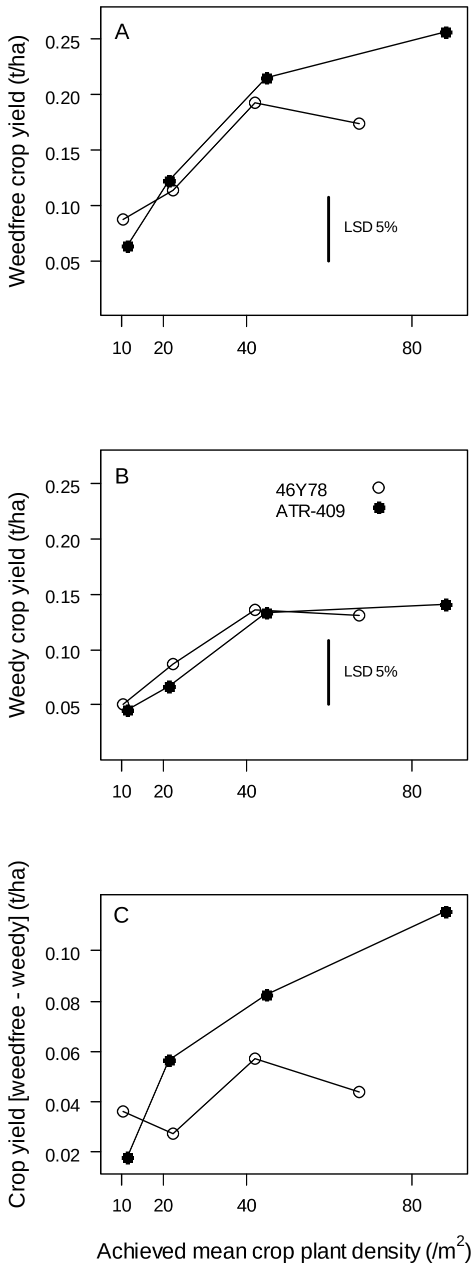

Figure 1. Grain yield (t/ha) for two canola cultivars, low vigour, conventional triazine-tolerant cultivar ATR-409 (closed symbol), and vigorous F_1 hybrid - 46Y78 (open symbol) in A) weed-free plots, and B) in weedy plots. Panel C) shows the reduction in yield (t/ha).

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X-axis tick marks show the targeted crop plant densities (plants/m^2), while the data is plotted at the achieved densities.

Dry Matter (Biomass)

Crop and weed dry matter (biomass) at the end of flowering were negatively correlated (Figure 2) as was found with 15 canola hybrids and annual ryegrass (Lemerle *et al.* 2010), confirming the importance of crop vigour and high biomass accumulation for weed suppression. The impact of canola allelopathy in suppression of weeds also requires further investigation.

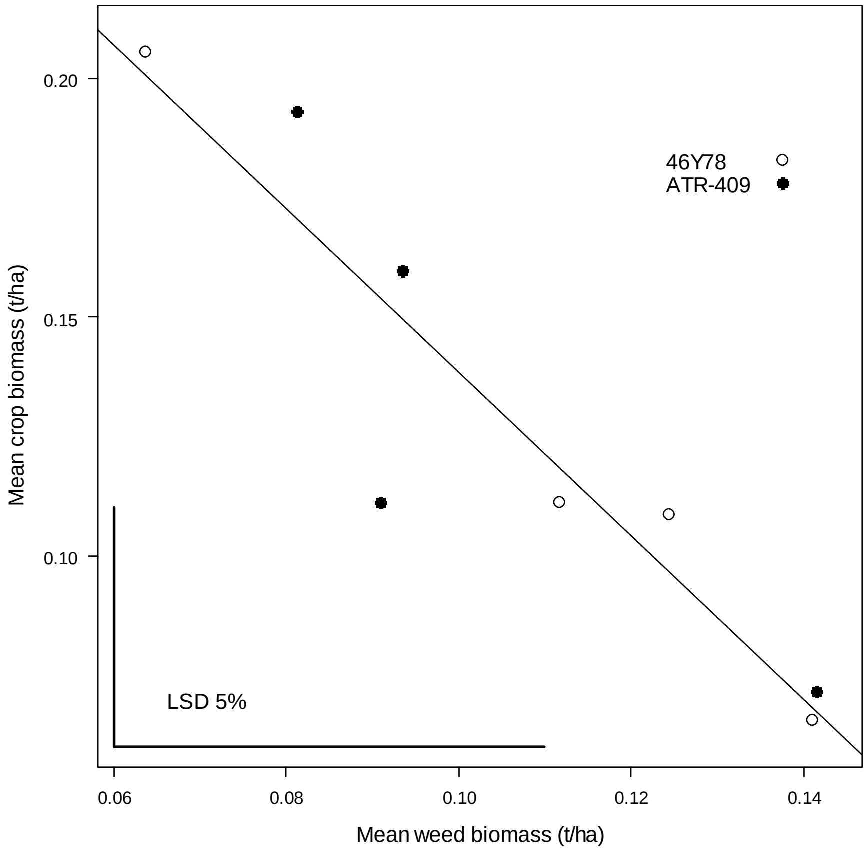

Figure 2. Relationship between crop and weed dry matter (t/ha) at late flowering for two canola cultivars grown in weedy plots in competition with volunteer wheat. The LSDs (5%) are large and show the inherent variability in this type of data. The plotted regression line illustrates the overall negative relationship.

In conclusion, these preliminary results show an important interaction between canola genotype and seeding rate on crop grain yield in the presence and absence of volunteer wheat. Higher seeding rates will be useful low-cost technique for reducing weed impact.

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