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FarmLink Research Report 2015

Field Evaluation of Allelopathy in Canola

Project Partners

Project Partners

Trial Site Location

Temora Agricultural Innovation Centre and CSU Wagga Wagga

Report Authors

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Introduction

Research undertaken at the Graham Centre over many years has clearly indicated that there are differences between crop varieties in their abilities to 'control' associated weeds through both competitive ability and allelopathic capability. Laboratory and field trials have demonstrated proof of concept that some varieties can deliver weed free seedbeds without assistance from herbicides.

In 2015 field trials were established at two sites, Temora and Wagga Wagga to provide a wider geographic base for the evaluation of canola allelopathy. Varieties were chosen for their known positive and negative allelopathic capabilities and apart from glyphosate application to create the seedbed before sowing, no herbicides were applied during the growing season.

The trials experienced erratic weed behaviour with poor weed populations and late emergence. Nevertheless varieties performed to their expectations with allelopathic varieties inhibiting weeds and non-allelopathic varieties allowing weeds to flourish. The characteristics of allelopathy ought to be considered in crop breeding programs to reduce dependence on herbicides.

Background

Crop plant interference against weeds involves the combined effects of plant competition and allelopathy. Allelopathy is the exudation of compound by plants that can suppress the growth of neighbouring plants. This exudation occurs from the roots and affects seeds and seedlings of other species located within a limited range (Rice, 1984). Although most plants species, including crops, are capable of producing and releasing biologically active root exudates (allelochemicals), relatively few have strong allelopathic properties. Recent research at Charles Sturt University has shown a large variation in the allelopathic potential of canola (Brassica napus) genotypes against weeds both in the laboratory and in the field (Asaduzzaman et al. 2014a; 2014b). In addition, several allelochemicals (sinapyl alcohol, p-hydroxybenzoic acid and 3,5,6,7,8-pentahydroxy flavone) have been isolated solely from the strongly-allelopathic canola genotypes (Asaduzzaman et al. 2014c). These phytotoxic or signalling chemicals presumably resulted in the observed inhibitory effects on annual ryegrass (Lolium rigidum) in the laboratory, and may also be responsible for the significant suppression of other weed species in the field (Asaduzzaman et al. 2014b). Despite the reports on genetic variability of allelopathy in several crops including canola, research on understanding the genetic control of allelopathy is still in its infancy. However, the reported variation in allelopathic strength in canola (Asaduzzaman et al. 2014a; 2014b) indicates that strong genetic control is involved.

Research at Charles Sturt University in seasons 2012 and 2013 clearly indicated that there is strong allelopathic capability within the available germplasm. The task therefore was to establish a series of trial sites where strongly and weakly allelopathic varieties could be tested, together with two current lines from Pacific Seeds for evaluation.

Experimental

The objective of the field experiments was to evaluate the capability of the chosen varieties to suppress weeds in crop. Six sites were chosen, three at Wagga Wagga and three at Temora in southern NSW. The purpose of the range of trials was to canvas the responses in different environments and to ensure that at least some sites had weed burdens.

Choice of variety was based on known attributes for allelopathy and competitiveness. Two Pacific Seeds varieties of unknown allelopathy capability were included to evaluate their field performance against the varieties so classified. Details of variety inclusions are given in Table 1. It needs to be noted that Av-Opal, the most allelopathic variety, was only sown at two sites due to seed shortages, it being replaced at the other sites by PAK388-502, the next highest allelopathic variety as determined by ECAM. It should be noted that PAK388-502 is not a Pacific Seeds line.

Seedbed preparation involved a seedbed knockdown spray, glyphosate, but no other herbicides were used during the experiment. Seed was treated with Jockey®. Sowing occurred in early May with all plots receiving common fertiliser rates and common seeding rates (1500 seeds per plot). Weeds were allowed to emerge and develop and be monitored with weed free and weedy controls. All plots were sprayed twice with Prosaro® at 4-leaf and 8-leaf stages for protection against blackleg. The trials were destroyed in early October so as not to allow weed seed set. Six replicates were employed to account for variability of responses. with small plots.

Two quad measurements were made per plot (except at Temora experiments for emergence data where only one quad was recorded). Quads were placed at 'random' but obvious patches were avoided. One Temora site had many volunteer narrow-leaf lupins which were included in weed counts and biomass cuts.

Entry	Wagga-1	Wagga-2	Wagga-3	Temora-4	Temora-5	Temora-6
1	AV-OPAL	PAK85388-502	PAK85388-502	AV-OPAL	PAK85388-502	PAK85388-502
2	ATR-409	ATR-409	ATR-409	ATR-409	ATR-409	ATR-409
3	AV-GARNET	AV-GARNET	AV-GARNET	AV-GARNET	AV-GARNET	AV-GARNET
4	RIVETTE	RIVETTE	RIVETTE	RIVETTE	RIVETTE	RIVETTE
5	BAROSSA	BAROSSA	BAROSSA	BAROSSA	BAROSSA	BAROSSA
6	ATR-BONITO	ATR-BONITO	ATR-BONITO	ATR-BONITO	ATR-BONITO	ATR-BONITO
7	HYOLA-600RR	HYOLA-600RR	HYOLA-600RR	HYOLA-600RR	HYOLA-600RR	HYOLA-600RR
8	HYOLA-725RT	HYOLA-725RT	HYOLA-725RT	HYOLA-725RT	HYOLA-725RT	HYOLA-725RT
9	CONTROL	CONTROL	CONTROL	CONTROL	CONTROL	CONTROL

Variety		Allelopathic capability	Competitiveness
Av Opal	Superseded OP	✓	×
Av-Garnet	Superseded OP	×	✓
Barossa	Superseded OP	×	×
Rivette	TT	✓	✓
ATR Bonito	Current OPTT	?	✓
ATR-409		×	×

Table 1. Variety inclusions at each of the experimental sites at Wagga Wagga and Temora and their categorisation on the basis of allelopathy and competitiveness

Results

The seasonal conditions of 2015 were difficult for experimental activities. There was variability in canola emergence which is a challenge with sowing small quantities of small seed. This however did not unduly effect experimental outcomes. The lack of weed germinations, despite annual ryegrass being sown in some trials, was a widespread phenomenon on south-eastern Australian trials this season. Our decision to sow on six sites to spread such risk paid off and we were able to continue with four of the six sites, two at Wagga (GC2 and GC3) and two at Temora (T4 and T6). The abandoned trial site at Wagga (DPI1) was used to grow Av-Opal seed for future experiments. At both Wagga and Temora there was a low weed site and a heavy weed site.

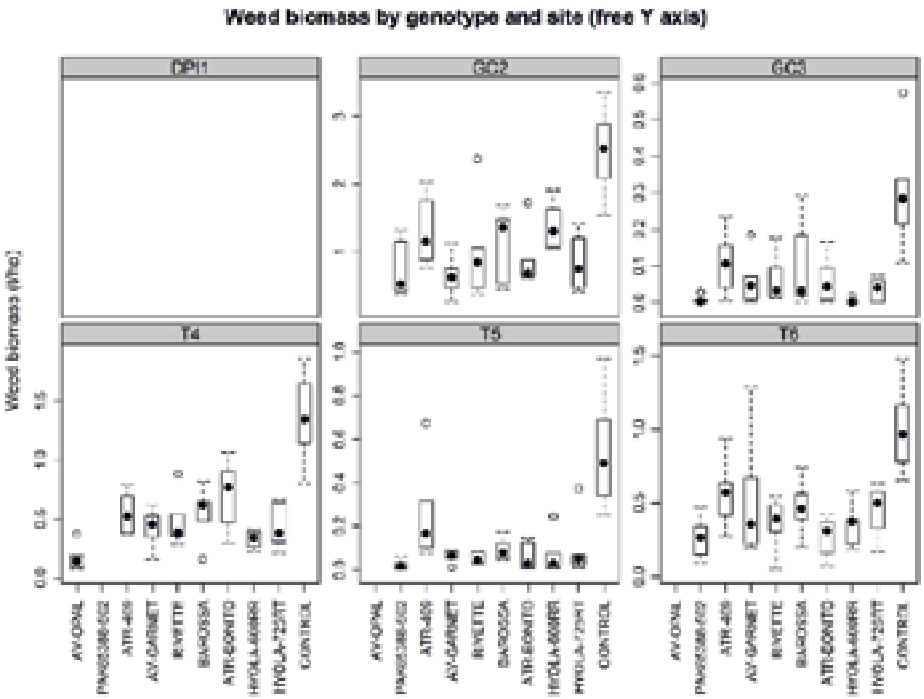

Figure 1. Weed biomass (t/ha) using raw plot data. Crop free controls are at the right of each panel. Please note that the Y axes are on different scales.

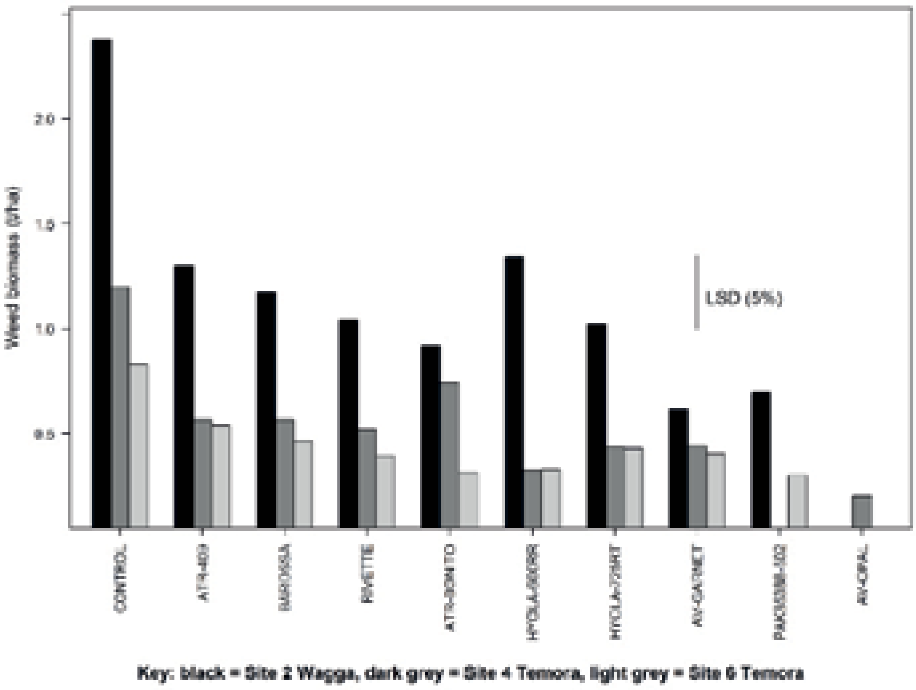

Figure 1. Weed biomass (t/ha) using raw plot data. Crop free controls are at the right of each panel. Please note that the Y axes are on different scales.

Figure 1 shows the weed biomass data against variety in September. All varieties reduced weed biomass relative to the crop-free controls as would be expected but the allelopathic varieties (Av-Opal, Pak85388-502) had reduced weed biomass burden at all sites relative to other varieties, in some cases near zero. Hyola varieties were generally at the lower end of weed biomass burdens except for Hyola 600RR in GC2 at Wagga Wagga.

Figure 2 dissects these data for individual sites including the crop free controls. This reveals the relative weediness of the sites.

Conclusions

Despite a challenging season for weed studies, given the poor early germination of weeds, this research has provided confirmation of earlier studies showing the beneficial weed control capabilities of the allelopathic varieties Av-Opal and PAK85388-502. It also showed the poor impact of ATR-409 and Barossa. Other varieties were intermediate in response including the Pacific Seeds varieties Hyola-600RR and Hyola725RT.

The experiments re-enforce the need for the preservation of the older varieties like Av-Opal and PAK85388-502 (highly allelopathic) and Av-Garnett (highly competitive) so that these benefits can be incorporated into new cultivars. It also re-enforces the need for new varieties to be evaluated for their capabilities in the field without herbicides so that producers can broaden their armoury against herbicide resistance by choosing effective weed-inhibitive varieties

Plate 1 The capability of AvOpal (left) to provide weed free conditions without herbicide in contrast to non-allelopathic variety (right)