Triazine resistant canola in southern Australia

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Summary. In commercial canola crops cruciferous weeds can reduce seed yield by competition and seed quality by contamination. Charlock and Buchan weed in particular have affected yield and seed quality of canola grown in the south-east of South Australia. Although hand-weeded triazine resistant canola yielded on average 26% less than hand-weeded Barossa the yield penalty was reduced when the commercial treatment of Dicamba was used on Barossa compared to simazine applied to triazine resistant lines. In a separate experiment, post-emergence herbicides failed to increase yields of triazine resistant canola, but simazine was effective when applied either pre-emergence or as a split application. The use of triazine resistant canola with triazine herbicides provides a means of growing acceptable yields of canola-quality seed where cruciferous weeds currently preclude canola from crop rotations.

Introduction

Canola is rapeseed containing less than 2% erucic acid in the oil and less than 30 ptM/g of glucosinolates in air dry, oil free meal. Canola has become an important crop in Australia with about 100,000 hectares grown in 1992; however, problems exist in some areas because of competition from cruciferous weeds and also contamination of canola seed samples with seed of cruciferous weeds. For example, in trials near Millicent in the south-east of South Australia unacceptably high erucic acid and glucosinolate levels were found in seed samples (3). These trials were contaminated by charlock *(Sinapis arvensis),* seed of which contains about 30% oil, 39% erucic acid and total glucosinolates of about 200 1.tM /g (5). Charlock seed is very similar in appearance and size to canola seed and it is virtually impossible to separate seed of the two species. Commercial problems with the quality of canola oil from this area due to high levels of erucic acid have occurred, while the presence of cruciferous weeds throughout southern Australia has discouraged many farmers from growing canola. Triazine herbicides control charlock and other weeds, including Buchan weed *(Hirschfeldia incana),* and allow the use of triazine resistant canola lines which results in acceptable yields of canola-quality seed (4). The experiments reported here were designed to: (i) evaluate triazine resistant canola compared to normal canola; (ii) investigate alternative methods for controlling charlock and other cruciferous weeds, and (iii) determine the effect of a range of triazine herbicides on triazine resistant canola.

Methods

Experiment I

Trials were sown on a peat soil near Millicent in the south-east of South Australia on 12 September 1991 and 9 September 1992. Plot size was 8 m by 8 rows at 15 cm row spacing and trial design was a randomised complete block with four replications. Canola was sown at 6 kg/ha and Simazine (simazine 500g/L w/v) was applied at 3 L/ha three days after sowing. The variety Barossa was used as the normal canola, while TRI7-2 and TR25- I were the triazine resistant lines used in 1991 and 1992 respectively. The hand-weeded control plots were weeded early in 1991 but weeding was delayed in 1992 until weeds were relatively large. Dicamba (dicamba 200g/L w/v), at IL/ha, was applied 6-7 weeks after sowing, which is the district practice. In 1991 Muster (DPX A7881), at 45g/ha, was applied about 3 weeks after sowing. The 1991 trial was direct-headed while the 1992 trial was windrowed prior to harvest. Grain yields were determined and oil content was measured by near infrared reflectance (NIR).

Experiment 2

This trial was sown near Bordertown in the south-east of South Australia on 3 June 1992. Plot size was 8m by 8 rows at 15cm row spacing and the trial design was a randomised complete block with four replications. A triazine resistant canola line (TR17-2) was sown at 6 kg/ha. Pre-emergence herbicides were applied on 15 June 1992 while post-emergence herbicides were applied on 24 July 1992. Plots were direct headed to determine seed yields and oil content was measured by NIR.

Results and discussion

Weeds were present in both years of experiment 1 with Buchan weed being the main problem in 1992 and some charlock occurring, particularly in 1991. Over the two years hand-weeded Barossa canola produced 18% higher seed yield than untreated Barossa, indicating the level of weed competition that occurred. TRI7-2 and TR25- I yielded poorly when grown without a triazine herbicide, averaging 29% less than when treated with simazine (Table 1). This is probably caused by the lower competitive ability of triazine resistant plants which is associated with their reduced photosynthetic efficiency and slow early growth (1). The hand-weeded treatments and the use of simazine controlled nearly all the weeds in the plots although the late hand weeding in 1992 allowed some competition to occur early.

The other treatments which controlled charlock in Barossa were post-emergence sprays of Muster in 1991 and Dicamba in both years. However these herbicides only controlled charlock and seed yields were no better than untreated Barossa (Table I). Dicamba significantly decreased the oil content of Barossa in both years (Table 1). While Dicamba controlled charlock, it allowed other weeds to compete with the canola. It would therefore seem to be a last resort for growers who only have a charlock problem which might preclude their crop from being accepted as canola. due to seed contamination. Although Muster has been shown to control charlock in Canada (2), it is unlikely to be released in Australia (D. McQuinn. pers. comm.)

The triazinc resistant lines, when hand-weeded, produced a seed yield 26% lower than hand-weeded Barossa, a similar yield penalty as was determined in Canada (I). However. under commercial-like conditions, where Barossa was treated with Dicamba and the triazinc resistant lines were treated with simazine, the average yield penalty was reduced, particularly as a result of the Buchan weed infestation in 1992. In both years the oil content of Barossa treated with Dicamba was significantly lower than that of the triazine resistant lines (Table 1). Although two different triazine resistant lines were used in 1991 and 1992, no significant difference in seed yield was measured between these triazine resistant lines in variety trials (T. Potter, unpublished data). Therefore, at least in spring sowings, there is little yield or oil penalty associated with growing triazine resistant canola and using triazine herbicides to control charlock and other cruciferous weeds when compared to commercial control measures currently used in normal canola in southern Australia.

Table I. Seed yield and oil content of triazine resistant and normal canola at Millicent, 1991 and 1992

Treatment	1991		1992		Mean	
	Seed yield (kg/ha)	Oil content (%)	Seed yield (kg/ha)	Oil content (%)	Seed yield (kg/ha)	Oil content (%)
Barossa hand-weeded	4609	44.6	2382	39.0	3496	41.8
Barossa nil	4143	45.2	1792	38.6	2968	41.9
Barossa and Dicamba (1L/ha)	4038	42.3	1842	37.1	2940	39.7
Barossa and Muster (45g/ha)	3991	44.4	-	-	-	-
Triazine Resistant[a] hand-weeded	3682	44.8	1505	39.6	2594	42.2
Triazine Resistant[a] nil	3126	43.3	1318	39.1	2222	41.2
Triazine Resistant[a] and Simazine (3 L/ha)	3608	44.4	2115	39.6	2862	42.0
l.s.d.	464	0.56	537	1.07		
significance	P<0.001	P<0.001	P<0.05	P<0.001		
c.v. (%)	8.3	1.8	21.3	1.9		

[a]lines TR17-2 in 1991 and TR25-1 in 1992

In experiment 2 a range of triazine herbicides was applied either pre-emergence or post-emergence. None of the herbicides caused any visual damage to the triazine resistant canola. None of the herbicides applied post-emergence resulted in increased seed yields over the nil treatment (Table 2), indicating that early weed control is essential in triazine resistant canola; this was shown also in experiment I. Both pre-emergence application and a split application of simazine resulted in increased seed yield over the nil treatment (Table 2). The split application of simazine may help to control later germinating cruciferous weeds. Oil content of canola treated with metribuzin was significantly lower than the nil treatment but all other herbicides had no effect on oil content (Table 2).

Triazine resistant canola will allow canola to be grown where cruciferous weeds are likely to reduce seed yields by competition or reduce seed quality by contamination. There is no likelihood of weeds inheriting the triazine resistance from the canola because triazine resistance is cytoplasmically inherited (1) but the continued use of triazine herbicides may select for triazine resistance in weed populations. Triazine resistant canola varieties have been released in Canada since 1984 (I) and it is likely that a triazine resistant canola will be released in Australia (K. White, pers. comm.). This resistance will allow canola quality seed to be produced in areas where at present weed competition and contamination cause problems.

Table 2. Effect of a range of triazine herbicides on the seed yield and oil content of a triazine resistant canola (TR 17-2) at Bordertown 1992.

Treatment	Active ingredient (g/L)	Rate of product(/ha)	Application date	Seed yield (kg/ha)	Oil content (%)
Nil			-	2031	37.0
Sencor	Metribuzin (480)	600 mL	24.7	1924	35.0
Bladex	Cyanazine (500)	3 L	24.7	2113	37.4
Igran	Terbutryn (500)	1 L	24.7	2146	36.8
Simazine	Simazine (500)	4 L	24.7	2290	37.2
Simazine	Simazine (500)	4 L	15.6	2410	35.7
Simazine	Simazine (500)	3 L pre	15.6	2641	37.2
		2 Lpost	24.7		
l.s.d.				328	1.36
significance				P<0.01	P<0.05
c.v.%				10.1	2.5

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