CHEMICAL CONTROL OF WILD RADISH IN WHEAT

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Summary. Wild radish (*Raphanus raphanistrum*) is an important weed of wheat in parts of all southern Australian states. In experiments near Rutherglen in north-eastern Victoria from 1978 to 1980, bromoxynil/MCPA ester at 0.28/0.28 kg ha^{-1} applied approximately 6 weeks after sowing gave 95% control of wild radish in wheat, metribuzin/methabenzthiazuron at 0.105/0.42 kg ha^{-1} also at 6 weeks gave 88% control, dicamba/MCPA amine at 0.08/0.34 kg ha^{-1} at 6 weeks gave 70% control but effects were slow and the resultant reduction in seed production of wild radish was often poor.

When treatment of wild radish was delayed until post-tillering, spraying with 2,4-D amine at 0.85 kg ha^{-1} or MCPA sodium salt at 0.5 kg/ha gave good control but generally no resultant increases in wheat grain yields. This was in contrast to the responses obtained from bromoxynil/MCPA, metribuzin/ methabenzthiazuron and dicamba/MCPA where the mean grain yield increases were 0.80 t ha^{-1}, 1.69 t ha^{-1} and 0.67 t ha^{-1} respectively.

INTRODUCTION

Wild radish is a problem weed in crops worldwide, as well as in southern Australian states (Piggin *et al.* 1978). Although it occurred in only 3% of cereal crops in a Victorian survey (Wells and Lyons 1978), it is particularly important in parts of the north-eastern and western districts as a severe competitor with crops. Competition studies at Rutherglen Research Institute between wheat and wild radish (Reeves and Code unpublished data) have shown that only 7 wild radish plants m^{-2} reduced yield by approximately 10%. The use of effective herbicides that can be applied early in the crops' growth is consequently important.

The prolific production of seed by wild radish, its high degree of dormancy and its staggered germination (Reeves *et al.* 1981) emphasize the need to prevent seeding of this annual weed.

The effect of several herbicides applied approximately 6 weeks after sowing wheat on wild radish and wheat grain yield has been reported previously (Code *et al.* 1978); bromoxynil/MCPA ester at 0.28/0.28 kg ha^{-1} was one of the most effective treatments based on one year's data.

This paper reports further results with bromoxynil/MCPA and compares the mixture with two other newly marketed herbicides, metribuzin/methabenzthiazuron and dicamba/MCPA amine.

MATERIALS AND METHODS

Three experiments were conducted on naturally occurring wild radish infestations in wheat cv. Egret near Rutherglen in 1978, 1979 and 1980.

Randomized block designs were used with three or four replicates and plot sizes of 1.8 by 10 m (1978 and 1980) or 1.8 by 20 m (1979). Treatments were applied in 100 L of water ha^{-1} at 210 kPa using a hand-held sprayer. Experimental details are given in Tables 1 and 2.

Table 1. Treatment information for 1978, 1979 and 1980.

		1978	1979	1980
Sowing date		May 31	June 14	May 23
Early spraying date		July 21	July 20	July 19
Growth stage	wheat	3-3½ 1f[1]	3 1f	ET
	wild radish	2-4 1f	Cot-4 1f	Cot-6 1f
		20-75 mm^2	20-70 mm	20-120 mm
Late spraying date		Sept 20	Sept 17	Aug 26
Growth stage	wheat	End tillering	Jointing	Jointing
	wild radish	Bolting to EF1	Rosettes 150-200 mm	Bolting to EF1

[1] 1f = Leaf, Cot = Cotyledon, ET = Early Tillering, EF1 = Early Flowering.
[2] Rosette diameter.

Wild radish densities were recorded in spring at least 4 weeks after spraying of the late treatments. Sample size was 250 by 250 mm in 1978 and 1980 (5 quadrats/plot) and 200 by 200 mm in 1979 (10 quadrats/plot). Wheat yield was measured using a mechanized plot harvester. Wild radish seed production figures were visually estimated.

Growing conditions were generally favourable for crop growth in all years although waterlogging occurred in 1978 between the early and late sprayings.

RESULTS

Herbicide treatments, wheat yields and wild radish densities for 1978-80 are shown in Table 2.

Wild radish density. Wild radish populations in unsprayed controls ranged from 16 plants m^{-2} in 1979 to 280 plants m^{-2} in 1978.

The three early-applied herbicides in 1978 and all treatments except dicamba/MCPA in 1980 reduced wild radish populations. Natural variation in weed populations across the sites is often high with wild radish and this probably accounted for the lack of significant differences in 1979.

Speed of kill was greatest with bromoxynil/MCPA and metribuzin/methabenzthiazuron, where weeds died 7 to 10 days after spraying. Dicamba/MCPA, 2,4-D amine and MCPA all gave much slower weed control associated with stunting of the weeds. The anomalous result with the latter two chemicals in 1978 was attributed to water-logging at the time of spraying and spraying later than the optimum time.

The wild radish plants counted on early-treated plots had either survived spraying or germinated after spraying (germinations through to late August

were observed). They were generally weak and less vigorous than those of the control treatment. Observations at the end of the season showed that with bromoxynil/MCPA only 0.2 to 0.5 plants m^{-2} had grown to any size and the seed production from these was estimated to be approximately 60 seeds m^{-2}. With metribuzin/methabenzthiazuron more plants developed, with approximately one vigorous plant m^{-2} and approximately 300 seeds m^{-2}. Dicamba/MCPA was less effective in preventing radish seed set; in 1978 and 1980 seed produced was estimated at only slightly less than that of the unsprayed controls (approximately 1 400 seeds m^{-2}).

Table 2. The effect of various herbicides on wild radish density and wheat yield, 1978-1980.

Herbicide	Rate (kg ha^{-1})	Wild radish (no m^{-2})			Grain Yield (t ha^{-1})		
		1978	1979	1980	1978	1979	1980
Early spraying:							
Metribuzin/ methabenz-thiazuron	0.105/ 0.42	37bc[1]	8a	5bc	3.46a	3.76a	2.84a
Bromoxynil/ MCPA ester	0.28/ 0.28	12c	12a	0	1.30b	3.32ab	2.75a
Dicamba/ MCPA amine	0.08/ 0.34	84b	9a	39ab	1.05b	3.34ab	2.60ab
Late spraying:							
2,4-D amine	0.85	-[2]	2a	5bc	0.35c	2.75b	1.98cd
MCPA sodium salt	0.5	-	7a	3c	0.53c	3.03b	2.24bc
Unsprayed control		280a	16a	124a	0.42c	2.88b	1.68bc

[1] Values followed by different letters within columns are significantly different ($P < 0.05$) according to Duncan's multiple range test.
[2] - = not counted (no visual control).

Wild radish plants counted on 2,4-D and MCPA treated plots survived spraying but were generally stunted. In 1979 and 1980 little seed was set on these plants.

Wheat grain yields. Wheat yields on the unsprayed controls ranged from 0.42 t ha^{-1} in 1978 to 2.88 t ha^{-1} in 1979.

In 1978 and 1980 when wild radish densities were high, the three early applied herbicides resulted in significant yield increases ($P < 0.05$). In 1979 only metribuzin/methabenzthiazuron applied early increased the yield.

The higher yield from metribuzin/methabenzthiazuron in 1978 could be attributed to the presence of other weed species, especially toad rush (*Juncus bufonius*), hyssop loosestrife (*Lythrum hyssopifolia*) and annual ryegrass (*Lolium rigidum*). These were controlled with metribuzin/methabenzthiazuron but not by the other herbicides.

2,4-D amine and MCPA applied after crop tillering generally gave no significant grain yield increases. The mean yield with 2,4-D was 1.69 t ha^{-1} and with MCPA, 1.93 t ha^{-1}.

DISCUSSION

These experiments showed that herbicides can be used to effectively reduce wild radish densities and subsequent seed production, resulting in wheat grain yield increases.

The most effective herbicide for controlling wild radish early in the growing season was bromoxynil/MCPA, thus confirming the results of Code *et al.* (1978). Mean grain yield increase, however, was greatest with metribuzin/methabenzthiazuron. This could have resulted from greater selectivity as it is known that bromoxynil/MCPA can significantly reduce the yields of weed-free wheat (Elliott *et al.* 1975), but it was more likely due to control of other weeds present in addition to wild radish.

Dicamba/MCPA is a much cheaper herbicide and has recently been marketed for wild radish control in wheat. Our results showed that whilst radish control was generally inferior to that of metribuzin/methabenzthiazuron or bromoxynil/MCPA, resultant grain yields were similar to those obtained with bromoxynil/MCPA. However, a major factor against the dicamba/MCPA mixture was its observed failure to substantially reduce wild radish seed production.

Wild radish is dependent on seed production for its persistence and its seed can remain viable in the soil for at least four years (Reeves *et al.* 1981). Control measures should be aimed at not just reducing density but also preventing seed production.

For this latter purpose both 2,4-D amine and MCPA were quite effective in two out of the three experiments as well as in previously reported experiments (Code *et al.* 1978). Many growers around Rutherglen spray their crops twice in the growing season. The first spray is with metribuzin/methabenzthiazuron or bromoxynil/MCPA applied 6 weeks after sowing to reduce weed density and increase wheat yield and is followed with 2,4-D or MCPA later in the season to prevent seed production of surviving or late germinating weeds. This is a desirable practice. If all control measures are delayed until post-tillering major irreversible yield losses have already occurred, the extent of the loss depending on weed density. Similar situations have been reported with other annual weeds in wheat (e.g. Lumb 1967; Reeves and Lumb 1972).

Of major interest to growers contemplating chemical weed control is the economic return likely to result from spraying. In these experiments the value of extra wheat produced over the cost for herbicides was $205, $91, $80, $0 and $30 for metribuzin/methabenzthiazuron, bromoxynil/MCPA,dicamba/MCPA, 2,4-D amine and MCPA respectively (based on $130 per tonne for wheat).

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