THE EFFECT OF VARIOUS CROP ROTATIONS ON WILD RADISH POPULATIONS

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Summary. In an experiment evaluating the effect of crop rotations over five years on wild radish *raphanus raphanistrum* L. populations, plant numbers declined from 375 to 99 m^{-2} over the five years in continuous wheat sprayed annually with bromoxynil plus MCPA ester followed by 2,4-D amine or MCPA sodium salt. When lupins, sprayed with simazine, were grown in rotation with two wheat crops, sprayed as described above, wild radish increased to 1335 plants m^{-2} by the fifth year and after two lupin crops. When peas, sprayed with metribuzin followed by MCPA sodium salt, were grown in rotation with one wheat crop sprayed as above, wild radish declined to 153 plants m^{-2} after five years and two pea crops.

INTRODUCTION

Wild radish is a common weed in crops in parts of Victoria (6, 8) and all other Australian States (3). In north-east Victoria farmers effectively control wild radish in cereal crops using herbicides (1, 2), but in lupins control is often poor with herbicides registered for use in this crop.

Lupins are widely grown in Victoria and other States, and their value in rotations with wheat is well documented (5). However, in north-east Victoria, farmers are concerned that if they grow lupins on paddocks infested with wild radish it will rapidly increase due to the often poor control provided by herbicides. This will then lead to problems in subsequent lupin crops-yield loss; harvesting problems; and problems with storage of grain contaminated with green wild radish seeds.

Accordingly, the experiment reported in this paper was conducted over five years to examine how rapidly a wild radish population would increase in lupin/wheat rotations and compare this with population changes in certain other rotations. The main results obtained from selected rotations from the experiment are reported in this paper.

METHODS

The experiment reported was located near Rutherglen Research Institute in north-east Victoria in a farmer's field heavily infested with wild radish. The soil was a solodic grey/brown sandy clay loam with an acidic top soil. Average annual rainfall at Rutherglen Research Institute (8 km to the south-west is 590 mm. Treatments evaluated involved rotations of various crops over five years (1981 to 1985), with or without use of selective herbicides for wild radish control in crops (Table 1). Treatments were applied to plots 20 x 2 m and were replicated four times in randomised blocks.

All crops were sown into a cultivated seedbed in 1981 and were direct sown with a drill fitted with narrow points in subsequent years.

Wheat (cv. Egret, 1981; cv. Oxley, 1982; cv Millewa, 1983 to 1985) was sown at 80 kg ha^{-1} and lupins (cv. Uniharvest) and peas (cv. Dunn, 1982 and Dundale, 1984) were sown at 100 kg ha^{-1}. Sowing was between 3 and 13 May, except for lupins in 1983 (sown 13 April). In 1984 all plots were resown on 13 June due to mouse damage.

Wheat plots receiving herbicide were sprayed with bromoxynil plus MCPA ester 0.4 plus 0.4 kg a.i. ha^{-1} (1983) or 0.28 plus 0.28 kg ha^{-1} (other years). Wheat when sprayed was mid-tillering (1984) or early-tillering (other years) and wild radish when sprayed was from the cotyledon stage to small rosettes. A second treatment with 2,4-D amine 0.85 kg a.i. ha^{-1} or MCPA sodium salt 0.63 kg a.i. ha^{-1} was applied between the end of tillering and the boot stage to control late germinating wild radish.

Simazine 2 kg a.i. ha^{-1} was applied within 10 days after sowing to sprayed lupin plots.

Metribuzin 0.28 kg a.i. ha^{-1} was applied to sprayed pea plots when peas were 10 cm tall (1982) or 15 cm (1984) and wild radish from the cotyledon to 6 leaf stage. This was followed by MCPA sodium salt at 0.35 kg ha^{-1} when peas were at early flowering and wild radish 8 to 20 cm rosettes.

Paraquat plus diquat, or glyphosate, were used for weed knockdown before direct sowing. Diclofop-methyl or trifluralin plus oryzalin were used in some years to obtain control of annual ryegrass *Lolium rigidum* Gaud wild oats *Avena* sp. and silver grass *Vulpia* sp. Herbicides were applied through a portable sprayer in 60, 80, 90 L of water ha^{-1} at 200 kpa.

Wild radish populations were counted each season in five to eight $0.06m^{-2}$ samples per plot. Grain yields were obtained from the whole plot and wild radish seed production was also measured.

RESULTS AND DISCUSSION

Wild radish populations measured each season are shown in Table 1.

Wild radish populations at the start of the experiment were 375 plants m^{-2} in unsprayed wheat (average of two treatments) and 479 m^{-2} in unsprayed lupins.

In unsprayed continuous wheat, the population increased more or less steadily over the five years to 1408 plants m^{-2} in 1985. This increase reflects an increase in the store of wild radish seed in the soil. Wild radish seed production in the unsprayed wheat ranged from 1440 seeds m^{-2} (1982) to 8700 seeds m^{-2} in 1984.

In sprayed continuous wheat, the count in 1981 and the second counts in 1982 to 1984 show the effectiveness of the herbicides used. Wild radish seed production in herbicide treated wheat was very low with less than one seed m^{-2} counted in 1982 and none in other seasons. This resulted in a decline in the wild radish population due to a decline in the soil seed store. Wild radish populations in the continuous sprayed wheat would have arisen from seed produced before the experiment commenced. Other work at Rutherglen Research Institute has shown wild radish seed will remain viable in the soil for more than five years (3, 4).

In lupins in 1981, simazine reduced wild radish population by 56% compared with the unsprayed lupins. However, wild radish seed production was higher, with 7400 seeds m^{-2} compared with 4900 m^{-2} in the unsprayed. Plants in the unsprayed lupins were small with few seeds, while plants in sprayed lupins grew well and produced many seeds per plant. The large amount of seed produced in both sprayed and unsprayed lupins gave an increase in wild radish levels in the following crops. In the second lupin crop a direct comparison cannot be made to assess the effectiveness of simazine, but the relatively low

population (61 plants m^{-2}) indicates simazine worked better in this season. However, uncontrolled wild radish still produced 11600 seeds m^{-2} compared with 16500 m^{-2} produced in the unsprayed treatment.

Table 1. The effect of crop rotations and herbicide use on wild radish populations (plants m^{-2}) over 5 years

Rotation	Selective Herbicide[b]	Wild radish population[c] 1981 12 Oct	1982 29 Jun	1982 16 Sep	1983 23 Jun	1983 19 Sep	1984 23 Aug	1984 14 Nov	1985 26 Jun
		L	W		W		L		W
LWWLW[a]	Yes	212	830	0	179	0	61	nc	1335
	No	479	855	233	723	530	903	nc	1851
		W	P		W		P		W
WPWPW	Yes	0	246	10	114	0	158	8	153
	No	367	404	170	794	403	670	nc	1868
		W	W		W		W		W
WWWWW	Yes	0	379	0	88	0	163	1	99
	No	383	516	142	428	242	695	nc	1408
l.s.d. (P=0.05)		139	316	109	220	157	224		549

[a] L = Lupins W = Wheat P = Peas nc = not counted

[b] Selective herbicides used were:- bromoxynil plus MCPA ester followed by 2,4-D amine or MCPA sodium salt in wheat; simazine in lupins and metribuzin followed by MCPA sodium salt in peas.

[c] Counts were taken in lupin crops after simazine application. In wheat and peas the 1985 count and the first in 1982 to 1984 were before herbicide application while the 1981 count and the second in 1982 to 1984 were after herbicide application.

In the wheat following the second lupin crop the wild radish population had increased further still, to 1335 plants m^{-2} in the sprayed treatment.

Effective control of wild radish was obtained in pea crops. The uncontrolled wild radish produced some seed (230 seeds m^{-2} in 1982 and 560 seeds m^{-2} in 1984). The wild radish population did not increase in the sprayed wheat/peas rotation as it did with the lupins/wheat, wheat rotation, but instead there was a decline over the five years similiar to that seen with the sprayed continuous wheat.

In conclusion, these results show that wild radish populations can increase dramatically over successive cycles of a lupin/wheat, wheat rotation using currently available herbicides, and could cause severe problems if this rotation was adopted on paddocks infested with wild radish. There is obviously need for effective herbicides for wild radish control in lupins. In recent experiments conducted by Rutherglen Research Institute some herbicides have given good results (7). Rotations involving peas with wheat would enable wild radish to be managed more satisfactorily than with lupin/wheat rotations with currently available herbicides.

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