A SCREENING OF HERBICIDES FOR YARROW SEEDLING CONTROL

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SUMMARY

Yarrow (*Achillea millefolium*) seedling populations with c. 60% of the plants in the three to six leaf stage were treated with cereal, clover and some non-selective herbicides in a screening trial in Canterbury. Over 90% mortality was achieved with clopyralid at 0.25 kg ai/ha, chlorsulfuron at 0.08 kg ai/ha, bromacil at 2.4 kg ai/ha and terbacil at 2.4 kg ai/ha. In contrast, phenoxy, benzoic, phenol, urea, triazine and dinitroaniline herbicides were relatively ineffective and others including benazolin, bentazone and oxyfluorfen also showed little activity.

INTRODUCTION

It is generally believed that yarrow is not susceptible to the herbicides commonly used on arable, pastoral and horticultural land in New Zealand and this has been advanced as a reason for this weed's persistence in Canterbury, Southland, Otago and parts of the North Island. It is a particular problem in cereal/white clover rotations and in some horticultural crops newly established on old pasture or cropping land.

Culturally based control strategies for eradicating the rhizomes during land preparation for cropping have been discussed by Bourdôt (1982) and Bourdôt *et al* (1982) but, for complete control, seedling reinvasion in crops must be prevented. Herbicides could play an important role here. Reports on herbicide activity have unfortunately not distinguished between seedling and established rhizomatous plants. Nevertheless several chemicals have been reported as effective, presumably on established yarrow; 2, 4-D amine and ester (Svensson 1959), mecoprop and dichlorprop (Jakobsons 1974), 2, 4, 5-T plus picloram (Richter 1966), dicamba (Ahrens *et al* 1962), glyphosate (Matthews 1976), simazine, dinoseb and diphenamid (Collins and Everett 1965), dichlobenil (Jones 1969) and clopyralid (Robocker 1977).

The aim of the experiment reported here was to compare the herbicides currently registered for use in cereals, white clover and some horticultural crops for their abilities to kill a cohort of spring-germinated yarrow seedlings. The residual activities of the herbicides on later flushes of seedlings was not investigated.

METHOD

A screening trial was conducted on a Templeton silt loam (2.53% organic carbon) at the MAF Templeton Research Station in Canterbury in the 1983/84 season. A randomised complete block design was used with three blocks of 26 treatments (25 herbicides plus untreated; Table 1). One rate of each herbicide was used set at the highest rate registered for use in either cereals, white clover or asparagus. The only exceptions were chlorsulfuron and clopyralid which were applied at higher than registered rates. The blocks occupied three adjacent 8 m wide irrigation borders which had been cultivated to a fine tilth.

On 16 September 1983 lime-pelleted yarrow seed was sown 5 to 10 mm deep in rows 500 mm apart lengthwise along the borders. The seed was sown at a rate of 250 per m of row using a single coulter Stanhay hand pushed drill. A laboratory germination test showed that 93% of the seed was viable.

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TABLE 1: Mortalities of yarrow seedlings treated with herbicides at the three to six leaf stage (means of three replicates).

Classification	Herbicide	Rate kg ai /ha	No. seedlings /m row before treatment (10.11.83)	% mortality (19.1.84)
Phenoxy	MCPA	1.5	25	9
	2,4-D amine	1.2	28	16
	2,4-D ester	1.5	28	2
	dichlorprop	3.0	24	52
	mecoprop	2.8	29	37
	2,4-DB	1.8	29	4
Benzoic	MCPB	1.6	32	4
	dicamba	.14	28	11
Nitrile	bromoxynil	.4	22	45
	ioxynil	.75	27	82
Phenol	dinoseb	1.2	27	12
Urea	methabenzthiazuron	1.0	26	9
	diuron	1.6	27	8
	linuron	1.6	26	62
Uracil	bromacil	2.4	32	99
	terbacil	2.4	31	97
Triazine	simazine	2.4	27	38
	metribuzin	.7	34	40
	prometryn	.4	25	4
Dinitroaniline	trifluralin	.8	-	-
Unclassified	benazolin	.25	30	11
	clopyralid	.25	26	99
	bentazone	.96	27	21
	oxyfluorfen	.48	31	2
	chlorsulfuron	.08	28	90
	untreated control		19	-6
	SE (mean)			7.83
	LSD (0.05)			22

The plots were 1.5 m wide running across the borders. The herbicides were applied in 200 litres/ha at 210 kPa through TeeJet 8002 hydraulic nozzles mounted on a 1.5 m hand-held outrigger boom powered by compressed nitrogen gas. The trifluralin treatment was applied and incorporated to 25 mm the day before sowing (15 September) while all other treatments were applied on 10 November after yarrow seedlings had ceased emerging (Fig. 1).

To allow seedling mortality to be assessed, randomly chosen 500 mm lengths of drill row were pegged out in each plot. There were four 500 mm lengths per plot in replicate one and two per plot in replicates two and three. Before spraying on 10 November, the yarrow seedlings in each 500 mm length of row were counted and classified by number of expanded leaves. The mean number of leaves at the time of spraying was 4.7 per seedling with a standard deviation of 1.26 (Fig. 2). The seedlings in each length of row were counted again on 19 January when herbicide activity had finished and the mortality rate of the seedlings was calculated.

Seedling emergence was monitored on nine 500 mm lengths of row chosen at random from within the trial area by regular counting and removal. Daily rainfall was also recorded (Fig. 1). The plots were kept handweeded throughout to prevent the confounding of herbicide and interspecific competition effects.

Fig. 1: Daily rainfall and yarrow seedling emergence pattern during the experiment.

RESULTS

Yarrow seedlings began to emerge in early October c. 20 days after sowing and continued at a constant rate until late October. By early November emergence had almost stopped giving c. 20 seedlings per m of row (8% of sown seed) (Fig. 1). The plots were treated during this plateau in the emergence curve. A second flush of seedlings occurred on the monitor plots in response to rain in December (Fig. 1) but new seedlings did not occur as numerous on the treated plots. These new seedlings were ignored in the mortality assessment.

Average mortality rates, and average numbers of seedlings before treatment are given in Table 1. Clopyralid was extremely effective, killing 99% of the seedlings while chlorsulfuron was also very effective resulting in a final mortality of 90%. Bromacil and terbacil gave 99% and 97% mortality respectively and were much quicker acting than the former herbicides. Shortly after treatment the nitriles, particularly ioxynil had caused severe leaf chlorosis but many of the plants recovered resulting in 82% mortality. Linuron also caused severe damage early on but recovery took place and final mortality was only 62%. All other herbicides showed very little activity. The phenoxy group were particularly weak although the propionics were more effective than the acetics and butyrics.

Survivors on most plots had become large and vigorous rosettes or flowering plants by 19 January 1984. However plants on the clopyralid, chlorsulfuron and dicamba treatments survived as stunted rosettes with little prospect of flowering in the current season.

Fig. 2. Frequency distribution of yarrow seedlings at the time of treatment (10 November) on the basis of number of leaves.

DISCUSSION

The mortality rates induced in a spring-germinated cohort of yarrow seedlings by cereal, white clover and some nonselective herbicides have been investigated. The cereal herbicides at maximum registered rates performed very poorly. The phenoxy group in general was particularly ineffective although the propionics were more active than the acetics and butyrics. This result supports those of Jakobsons (1974) who reported that mecoprop at 4 kg ai/ha gave better control of yarrow in pasture than MCPA at 2 kg ai/ha. However none of the phenoxy herbicides gave an acceptable level of mortality in our experiment and furthermore, the survivors grew into vegetative and flowering plants by mid-summer.

Dicamba, often held to give good control of yarrow (Ahrens *et al* 1962) resulted in only 11% mortality although the survivors were very stunted. In the presence of a cereal or some other competitive crop adequate suppression of seedling growth may be achieved with dicamba.

The most promising cereal herbicides for yarrow seedling control were clopyralid and chlorsulfuron; both giving a high level of mortality and substantial suppression of survivor growth. Application rates several times those currently registered were used for both herbicides and further work is now required to determine the dose response with these products. Since both herbicides have a soil residual life of one or two months, successive flushes of seedlings would probably be prevented by these materials.

The nitriles were quite active on the seedlings and although at maximum cereal rate bromoxynil gave only 45% mortality, 82% mortality was achieved with ioxynil at 750 g ai/ha. Although these herbicides have no soil residual effect they may provide useful knockdown of yarrow seedlings in cereals.

Of the root absorbed soil residual herbicides which were included in the experiment as potentially of use in some horticultural situations, only the uracils were effective. Bromacil and terbacil at 2.4 kg ai/ha gave nearly 100% mortality. The uracils as a group may be effective since Jones (1964) reported that dichlobenil at 7.5 kg ai/ha gave 90% control of yarrow (probably established plants).

The experiment did not identify an effective herbicide for use in white clover. The materials registered for use in this crop resulted in very low mortality and the survivors grew vigorously. Furthermore 2, 4-D ester, currently used (but not registered) in established white clover during winter dormancy, gave only 2% mortality and vigorous survivors. These very low levels of control support the belief that the commonly used herbicides may promote the ingress of yarrow by removing other competitors from clover and grass swards.

To conclude, this screening trial has demonstrated that yarrow seedlings have a high resistance to a wide range of cereal and white clover herbicides. Clopyralid and chlorsulfuron have been identified as effective herbicides at high rates and the nitriles also show promise for seedling control in cereals. On a less optimistic note, currently registered clover herbicides proved ineffective, leaving the control of yarrow seedlings in white clover still without an herbicidal solution.

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