CHEMICAL CONTROL OF HOREHOUND

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Summary. A series of experiments were conducted to examine chemical control of mature horehound. The experiments showed that the phenoxy herbicides, especially MCPA and 2,4-D at rates of 1000-1500 g.a.i./ha were effective in controlling mature perennial horehound. Glyphosate, metsulfuron, triclopyr and dicamba were effective but are more costly and more damaging to pastures. Herbicides were more effective when applied in autumn than in spring or summer. Regeneration of horehound from seed was rapid at several sites.

INTRODUCTION

According to agronomists in N.S.W. tableland regions, horehound, *Marrubium vulgare*, is a major pastoral weed reducing pasture production and fleece values, and is estimated to cost the Australian wool industry $0.7 million annually (2). Herbicides registered for horehound control in pasture in N.S.W. are expensive and excessively damaging to pasture legumes (eg. dicamba 200g/L at 0.7-2.8 L/ha and dicamba/MCPA at 4.7 L/ha of Banvel® M) or they are only registered for control of seedlings (eg. 2,4-D amine 500 g/L at 2.8-4 L/ha). In other states MCPA amine (S.A.) and triclopyr (Tas.) are also registered (1). A series of experiments to test herbicides on mature perennial horehound were initiated in response to many inquiries about chemical control and some apparently poor commercial results.

METHODS

Six experiments were installed on the northern tablelands of N.S.W. on commercial grazing properties between November 1987 and May 1989. Five experiments included a variety of herbicides, at various sites and application times and the final experiment examined application time with the most cost effective herbicide from earlier experiments. Brief site details are listed in table 1.

Table 1. Site installation and assessment details.

EXPERIMENT	DATE INSTALLED	RAINFALL: 4 wks before applic.(mm)	SOIL MOISTURE	ASSESSMENT TIME AND (METHOD) (DAT) (v = visual q = quadrat)
1. Armidale	30/10/87	72	fair	40(v), 131(v), 356(v)
2. Glen Innes	14/4/88	175	exc.	32(v), 90(v), 176(v,q), 294(v), 447(v)
3. Walcha	15/4/88	156	exc.	25(v), 84(v), 188(v,q), 493(v)
4. Walcha	15/4/88	156	exc.	207(9)
5. Emmaville	23/9/88	112	good	39(v), 73(v,q)
6. Glen Innes	(a)22/12/88	117	good	42(v),89(v,q), 131(v), 195(v,q), 277(v,q),410(q)
	(b)21/3/89	40	good	42(v), 106(v,q), 321(q)
	(c)2/5/89	60	good	64(v,q),146 (v,q), (279q)

The horehound stand in each case consisted almost entirely of mature plants growing on rootstocks apparently several years old. Experiments were installed with a 3 m wide hand held boomspray applying between 123 and 187 L/ha of spraymix. Plots were 10 m long and replicated in three randomized blocks (four in experiment 1). Experiments were assessed by visual appraisal and counts of relative frequency using graduated quadrats. Quadrats were 50x50 cm and graduated into 25 squares of 10x10 cm. Usually eight quadrats were counted per plot and these were placed approximately two, four, six and eight m into the plot and .75 m from either edge. Visual assessment was carried out using a 0-5 scale, however results are reported according to the EWRC scoring system. Exp. 1 was assessed by visual appraisal only.

Exp. 3 was was assessed once by quadrat only. Assessment intervals were variable (see Tab.1). Tables of results include from one to several assessment times depending on the need to illustrate trends over time. Visual assessment of seedling density was undertaken in exp. 1 and 2 and the final relative frequency counts for expt. 6 include seedlings. Assessments were carried through for at least a full summer period following treatment to ascertain the death of established plants, except for the spring treatments where regrowth from established plants was obvious within a few months of application. Regrowing plants were pulled from plots to determine if they were seedlings or root regrowth where doubts existed.

Effects on pasture were not assessed except for damage to clover in exp. 4 and damage to lucerne in exp. 5. In other experiments, pasture cover was extremely poor. All sites were grazed up to and after the time of treatment. In exp. 6, the horehound itself was grazed more or less continuously throughout the trial period to a height of 5-15 cm but was 10-15 cm tall at each application time. In other experiments, the horehound was 20-30 cm tall.

Results were statistically analysed using the GENSTAT IV ANOVA programme. Herbicides are listed in results tables by common name of active ingredient and rates are reported in grams active ingredient per hectare.

RESULTS AND DISCUSSION

Experiments 1-5 indicated that the phenoxy herbicides were effective and that MCPA and 2,4-D were superior to other phenoxies tested. MCPP, 2,4-DP, dicamba, metsulfuron, glyphosate, 2,4,5-T, MCPB and 2,4-DB showed moderate to strong activity but generally gave inferior control and/or more pasture damage than MCPA and 2,4-D and are more costly at current prices. Clopyralid, diuron, metribuzin, imazaquin and hexazinone showed little activity on established plants but visual assessment of seedling numbers indicated pre-emergence activity with diuron, metribuzin and imazaquin (Tabs. 1 and 2).

Horehound develops herbicide symptoms relatively slowly and maximum development of symptoms occurred between 6-20 weeks after treatment, depending on time of application. The spring and summer treatments developed maximum symptoms more quickly but failed to reach the same level of control as the autumn treatments (see Tab 2 and 3 and Fig. 1). There was an obvious trend for autumn treatments to be more effective than spring in experiments 1 to 5 but spring treatments were applied under drier conditions, and it was thought that this might have contributed to the relatively poor results from spring application. In commercial practice, spring was the preferred time of treatment because horehound is most vigorous and flowers most actively in the spring.

Experiment 6 confirmed that autumn is the optimum time of application (Tab. 4). There was a significant difference between the March 21 and May 2 applications, despite similar moisture conditions before during and after the treatments. This suggests a relatively tight application window which appears to be related more strongly to plant phenology than to direct environmental responses.

Table 2. Horehound control - spring experiments.

	RATE	ARMIDALE (Exp. 1) CONTROL SCORE			PRESENCE OF SEEDLINGS*	EMMAVILLE (Exp. 5) CONTROL SCORE		REL.FREQU. 73DAT	
HERBICIDE	g.a.i./ha	40 DAT	131 DAT	356 DAT	131 DAT	39 DAT	73 DAT	HHD	LUC
MCPA	1500	4.5	2.4	6.6	2.5	4.0	3.9	4	14
	750	5.0	4.8	6.6	2.1	4.7	6.1	10	24
2,4-D ester	1500	5.0	5.0	7.6	2.0	-	-	-	
MCPA +	750 +								
DIURON	1500	-	-	-	-	3.6	4.2	5	30
MCPA +	1500 +								
METSULFURON	6	5.2	2.6	6.4	2.0	-	-	-	
MCPA +	750 +								
CLOPYRALID	21	5.2	4.7	6.3	2.5	-	-	-	
MCPA +	500 +								
CLOPYRALID	1500	5.3	5.8	6.9	2.0	-	-	-	
METSULFURON	12g +								
+ PULSE®	.2%v/v	7.7	6.8	9.0	1.8	-	-	-	
2,4 -DB+	1000 +								
DIURON	1500	-	-	-	-	6.6	7.6	18	95
DIURON	1750	6.4	8.4	9.0	0.3	-	-	-	
DIURON	1500	-	-	-	-	6.9	8.5	12	97
METRIBUZIN	350	6.6	8.2	8.5	0.8	-	-	-	
HEXAZINONE	1000	-	-	-	-	6.4	8.5	20	135
HEXAZINONE	500	-	-	-	-	8.2	9.0	31	122
IMAZAQUIN	540	9.0	8.0	9.0	0.5	-	-	-	
	270	9.0	8.5	9.0	0.3	-	-	-	
UNSPRAYED	-	8.8	8.2	7.9	0.5	8.5	8.7	25	83
l.s.d. 0.05	-	8.8	7.6	1.4	1.1	1.3	2.2	23	21

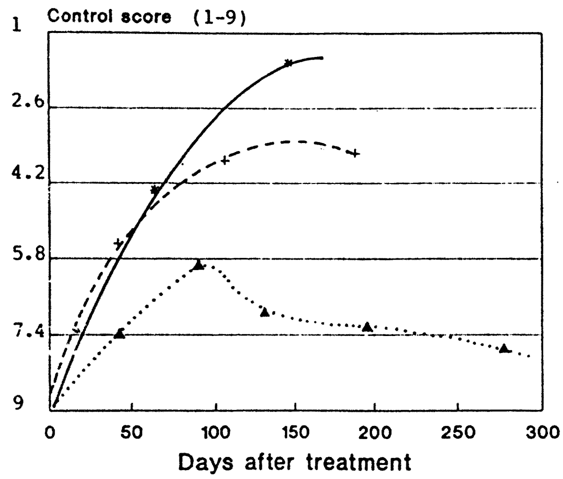
*0-nil 1-low level 2-moderate 3-many

For commercial practice, rates of 1000-1500 g/ha of phenoxy acid would give adequate control when applied during autumn. The higher rate gave better initial control, but was more subject to rapid reinvasion by seedling horehound (Tab. 3 and 4). In general, herbicide treated plots were more subject to seedling reinvasion (Tab. 2 and 3). This occurred mainly in the areas vacated by dead horehound plants but is also attributable to removal of competition from other broadleaf species in the pasture. This emphasises the need to establish competitive pasture into the areas where adult plants have been removed by herbicide treatment.

Table 3. Horehound control - autumn experiments.

HERBICIDE	Exp. 2 RATE (g.a.i./ha)	% REDUCTION (relative frequencies) Exp. 3 GLEN INNES 176 DAT	Exp. 4 WALCHA 188 DAT	WALCHA 207 DAT HOREHOUND % REDUCTION	CLOVER TOL.(0-9)	SEEDLINGS Exp. 2 score (see Tab. 2) (0-3)
MCPA	2000	100 a	-	100 a	5.3	2.5
	1500	100 a	100 a	-		2.0
	1000	100 a	-	-		2.0
	750	-	100 a	-		
2,4-D ester	2000	100 a	-	-		2.0
	1600	-	-	-		
	1500	100 a	100 a	-		1.5
	1000	97 a	-	-		2.0
2,4-D amine	2000	-	-	100 a	4.2	
	1500	-	100 a	-		
2,4-DB	1500	-	72 b	-		
MCPB	1500	69 b	81 b	-		3.0
MCPP	1500	-	100 a	-		
2,4-DP	2000	-	-	83 b	7.4	
	1500	-	98 a	-		
MCPA + DIURON	750 + 1500	-	99 a	-		
MCPA + DICAMBA	1500 + 350	-	100 a	-		
MCPA + METSULFURON	750 + 6	-	100 a	100 a	8.4	
METSULFURON	12	-	-	98 a	8.7	
TRICLOPYR	1440	-	-	94 a	7.9	
2,4,5-T	2240	-	-	100 a	7.9	
DICAMBA	560	-	-	87ab	8.7	
2,4-D/PICLORAM	560/140	-	-	83 b	8.8	
GLYPHOSATE	1080	-	-	79 b	4.2	
GLYPHOSATE + PULSE[R]	1080 + 0.2%v/v	-	-	78 b	4.7	
GLYPHOSATE + METSULFURON	1080 + 12	-	-	93 ab	8.8	
UNSPRAYED	-	0 c	0 c	0 c	1	0.5
l.s.d. 0.05		18.4%	14.0%	15.1%	1.9	

In the comparisons between MCPA amine and 2,4-D amine or ester, MCPA was always equal to or significantly better than 2,4-D at equivalent rates of active ingredient. On the N.S.W northern tablelands, MCPA is widely used for thistle control and presently retails slightly cheaper than 2,4-D on an active ingredient basis. For this reason, it is suggested that MCPA should be the chemical of choice, however efficacy data also justify the registration of 2,4-D for autumn application to control mature horehound.



Application date : 22/12/88 (▲); 21/03/89 (+); 02/25/89 (*)
(Mean of three rates of MCPA)

Figure 1. Change in apparent control of horehound over time following MCPA application on three dates.

Table 4. Effect of time and rate of MCPA application on relative frequency (RF) of horehound at time of maximum horehound biomass reduction (best) and in mid summer of the season following application (final).

APPLICATION DATE	APPLICATION RATE (g.a.i./ha) 500		1000		1500		main effect	
	best	final	best	final	best	final	best	final
22/12/88	48.0	61.3	24.3	41.7	18.7	54.7	30.3	68.0
21/3/89	24.0	46.7	5.30	42.3	1.0	46.3	10.1	48.1
2/5/89	7.7	96.0	2.7	60.3	0.0	68.3	3.4	56.4
main effect	26.6	52.6	10.8	45.1	6.6	74.9		

s.e.d. rate*date: best=5.1; final=14.5 rate or date (main effect): best=3.0; final=8.4

MCPA caused high lucerne plant mortality in experiment 5. The stand was in a phase of rapid decline due to invasion by grasses. Hexazinone slowed the rate of decline by giving very good grass control, and no observable damage to the lucerne. Some control in lucerne is possible by correctly timing 2,4-DB in autumn but the levels of control would probably not be commercially acceptable. Damage to white clover was recorded in experiment 2. All effective herbicides damaged clover, but recovery was fair with MCPA and 2,4-D at 2000 g/ha and glyphosate at 1080 g/ha. All other treatments almost eliminated clover.

REFERENCES

1. Department of Plant Protection, Queensland Agricultural College. 1989. Peskem, 10th ed.
2. Sloane, Cook and King Pty Ltd. (1989) The economic impact of pasture weeds, pests and diseases on the Australian wool industry. A report to the Australian Wool Corporation.