GRASS WEED AND SHEEP'S SORREL CONTROL IN WHITE CLOVER SEED CROPS

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Summary

Carbetamide and pronamide controlled bromus mollis (*Bromus mollis*), vulpia hair grass (*Vulpia* spp.), and ryegrass (*Lolium* spp.). Applied in July, August or at increased rates in September, these chemicals proved satisfactory alternatives to paraquat for removing grass competition in white clover (*Trifolium repens*) grown for seed production. Paraquat was superior to carbetamide and pronamide when competitive broad-leaved weeds were present. Carbetamide and pronamide gave significant reduction in the number of sheep's sorrel (*Rumex acetosella*) inflorescences present at harvest and of sheep's sorrel seed in riddle-cleaned white clover seed.

INTRODUCTION

SINCE THE INTRODUCTION of carbetamide and pronamide, the writers have been conducting small plot trials in the field to determine the place of these chemicals as alternatives to paraquat for reducing competition from grass species during flowering and ripening of the white clover (*Trifolium repens*) seed crop and also the possibility of controlling sheep's sorrel (*Rumex acetosella*).

Good yields of clover seed depend on building up high densities of flower-heads over a period of about two months in early to mid-summer. Initiation and maintenance of flowering is dependent to a large extent on the amount of light available at stolon level and as Zaleski (1970) states in summarizing his work on the crop, "... insufficient light could lead to a complete failure of floral induction or to a complete abortion of buds and inflorescences". Number of flower-heads will depend on the number of stolon branches present since flower-heads are produced in the axils of developing leaves. Hard grazing in the early part of the season can ensure light penetration and encourage branching but once stock has been removed to allow flowering, smothering regrowth may occur. Leonard (1964) showed that paraquat applied before shutting up is a more positive means of removing competition and application of 0.2 to 0.6 kg/ha of paraquat at this period is now common practice with white clover seed growers. However, Leonard suggested that the system was best suited to moisture-retentive soils as intervention of dry conditions before fresh foliage had replaced that removed by the treatment could result in a crop too short to harvest. Treating about three weeks before the estimated normal (for grazing management) shutting up time for the district, soil type and season reduces this risk, but yield suppression from "late" defoliation is still reported.

Sheep's sorrel is unwanted because England, an important market for white clover seed, requires the certification working sample to be free of

FIG. 1: Effect of time and rate of treatment with carbetamide and pronamide on ground cover of bromus mollis, ryegrass and white clover at December 21, 1971.

Rumex spp. While skilful seed dressing can handle undamaged sorrel seed, skinned seed, the result of hard threshing, is very difficult to remove (Hartley, 1969). When present in a field, sheep's sorrel is favoured by lack of competition (Harris, 1968) which pertains when white clover is established by undersowing a crop such as wheat or peas in the spring and seed is taken in the second summer. In the autumn following harvest of the cover crop, the clover offers no competition to the weed and subsequent management of the clover ensures that the sheep's sorrel is not adversely shaded. The problem is less evident where white clover seed is taken in the year following a grass seed crop and surviving ryegrass plants and fresh seedlings provide autumn competition.

EXPERIMENTAL

Treatments as set out in Tables 1 and 2 were applied during September and October at four sites to plots 2 m × 10 m in complete randomized block layout with a hand-propelled compressed-air-operated boom sprayer using a volume of 200 l/ha.

TABLE 1: COUNTS OF SHEEP'S SORREL AND GRASS
INFLORESCENCES AND OF YIELD OF WHITE CLOVER SEED:
BARRHILL 1970-1

Treatment (kg/ha)	Inflorescences/m ²			Yield White
	Sheep's Sorrel	Vulpia Hair Grass	Ryegrass	Clover Seed
	$\sqrt{(n + 0.5)}$	$\log(n + 1)$	$\log(n + 1)$	Untrtd = 100

September 28:				
pronamide 0.41	41.6 b-dB-E	210 b-dBC	231 abA	152 a-eA-D
pronamide 0.82	5.6 efE	2 fDE	50 cdC-E	192 abAB
pronamide 1.65	6.4 efDE	2 fE	6 eF	199 aA
carbetamide 0.82	44.0 b-dB-E	342 abAB	242 abA	125 deB-D
carbetamide 1.65	86.4 bBC	94 dC	198 abAB	152 a-eA-D
carbetamide 3.3	18.4 c-fC-D	0 fE	0 fG	179 a-cA-C
paraquat 0.3	45.6 b-dB-E	128 dBC	71 cB-D	136 c-eA-D
Untreated	52.0 bcB-E	822 aA	322 aA	110 eCD
October 19:				
pronamide 0.41	85.6 bBC	708 aA	262 aA	131 c-eA-D
pronamide 0.82	24.0 c-eC-E	150 cdBC	156 abAB	150 a-eA-D
pronamide 1.65	0 fE	0 fE	26 dDE	167 a-dA-D
carbetamide 0.82	61.6 bcB-D	656 aA	338 aA	121 deB-D
carbetamide 1.65	57.6 b-dB-E	182 b-dBC	118 bcA-C	142 b-eA-D
carbetamide 3.3	12.0 d-fD-E	10 eD	2 efFG	142 b-eA-D
paraquat 0.3	211.6 aA	302 bcA-C	30 dE	187 a-eA-D
Untreated	98.4 bAB	694 aA	278 aA	100 eD
Untreated yield (kg/ha)				148
CV %	25	13	13	19

Grass and sheep's sorrel inflorescences were counted in 1/10th or 1/8th m² frames, three per plot. Plots were harvested with a reel mower, dried, threshed with a beater-drum mill and dressed with a Clipper office cleaner. A 4 g sample of dressed seed from every plot of the Darfield trial was separated into clover and sheep's sorrel seed.

RESULTS AND DISCUSSION

Good control of vulpia hair grass (*Vulpia* spp.) at 0.82 kg/ha of pronamide and 1.65 kg/ha of carbetamide was obtained up to the end of September (Table 1) but double these rates was needed by mid-October. Control of bromus mollis (*Bromus mollis*) and ryegrass (*Lolium* spp.) fell away earlier (Fig. 1), the high rates being required in September, though ryegrass appeared to be intermediate in tolerance between these two troublesome weed species in some instances (Table 1). Paraquat at 0.3 kg/ha gave similar control of ryegrass to 1.1 kg/ha pronamide but was less effective at this rate against vulpia hair grass and bromus mollis at Barrhill (Table 1). At both times of treatment, ryegrass control by 0.3 kg/ha of paraquat was adequate, but less effective than the high rates of pronamide and carbetamide. Visual scorings for grass control in trials including the 0.6 kg/ha rate of paraquat were consistently better than for the high rates of the other two chemicals at both times of treatment.

TABLE 2: SHEEP'S SORREL CONTROL DATA AND WHITE CLOVER SEED YIELD: DARFIELD 1971-2

<i>Treatment</i> (kg/ha)	<i>Sheep's Sorrel</i> <i>Inflorescs./</i> <i>m²</i> <i>log (n + 1)</i>	<i>% Seed in</i> <i>Dressed</i> <i>Clover</i>	<i>Sorrel-free</i> <i>White Clover</i> <i>Seed</i> <i>Untrtd = 100</i>
October 13:			
pronamide 0.55	60 abAB	15.0 abA	110 c-fA-B
pronamide 1.1	33 a-cA-C	4.8 d-gCD	132 a-cA
pronamide 1.65	31 bcA-D	4.0 e-gCD	138 abA
carbetamide 1.65	42 a-cA-C	4.5 e-gCD	115 b-fAB
carbetamide 3.3	5 efEF	2.8 fgD	122 a-eAB
paraquat 0.3	37 a-cA-C	7.3 deCD	139 aA
paraquat 0.6	43 cdB-E	5.3 d-gCD	120 a-eAB
Untreated	46 abA	7.8 aA	109 c-fA-C
October 29:			
pronamide 0.55	36 a-cA-C	6.0 d-gCD	109 c-fA-C
pronamide 1.1	16 deC-E	3.5 e-gCD	119 a-eAB
pronamide 1.65	2 fF	1.8 gD	124 a-eAB
carbetamide 1.65	52 a-cAB	6.0 d-gCD	119 a-eAB
carbetamide 3.3	17 deD-F	2.8 fgD	120 a-eAB
paraquat 0.3	65 abA	7.0 d-fCD	93 fgBC
paraquat 0.6	59 abAB	4.8 d-gCD	82 gC
Untreated	85 aA	13.0 bcAB	100 e-gBC
Untreated yield kg/ha			224
CV %	7	46	14

Spectacular loss of yield occurred in heavily infested untreated plots representing in effect total loss of crop. Untreated in one instance yielded less than 1/16th of the 279 kg/ha produced by the best treatment. Yield response depended on time of treatment, on density of infestation and effectiveness of overall weed control. At Lincoln (Table 3) in the presence of a moderate infestation of barley grass (*Hordeum* spp.), and ryegrass, only July and August treatments were significantly better than untreated. Similarly at Barrhill and Darfield 5 of 14 early comparisons but only 1 of 14 late comparisons gave significant responses. However, at Lincoln College with a heavy infestation of grasses and broad-leaved weeds, treatment at the end of October with 0.6 kg/ha of paraquat gave 200 kg/ha of dressed seed compared with 17 kg/ha from untreated. On the other hand, 0.6 kg/ha of paraquat applied at the end of October at the lightly infested Darfield site under similar dry conditions tended to reduce yield in line with the previously mentioned opinion of the effect of late treatment.

Weeds not controlled by some treatments, principally composites such as hawksbeard (*Crepis capillaris*), and not spread uniformly over the sites, undoubtedly reduced the precision of yield estimation. The importance of determining the incidence of such weeds before choosing and applying a treatment is illustrated by the Lincoln College trial. Prickly sow thistle (*Sonchus asper*) and hedge mustard (*Sisymbrium officinale*) were not controlled by carbetamide or pronamide but were adequately checked by 0.6 kg/ha of paraquat. Though the paraquat and the 1.65 kg/ha pronamide

TABLE 3: EFFECT OF TIME OF TREATMENT WITH 1.2 kg/ha OF PRONAMIDE ON YIELD OF WHITE CLOVER SEED, LINCOLN 1971-2

<i>Date Applied</i>	<i>Yield (kg/ha)</i>	<i>Yield Untreated = 100</i>
May 10	303 abAB	141
Jun. 8	316 abAB	147
Jul. 12	419 aA	195
Aug. 3	418 aA	194
Sep. 6	341 abAB	159
Oct. 13	319 abAB	148
Untreated	215 bB	100
CV %	20.4	

treatments had similar visual scores for grass control, the paraquat yielded 279 kg/ha compared with the 109 kg/ha of the pronamide treatment.

Sorrel inflorescences were significantly reduced at Barrhill by 0.82, and 1.1 kg/ha of pronamide and 3.3 kg/ha of carbetamide at both times of application. At Darfield, 3.3 kg/ha carbetamide both early and late and 1.1 and 1.65 kg/ha of pronamide late reduced panicle numbers. Inflorescence numbers on paraquat-treated plots were similar to untreated except for an increase at the second time of treatment at Barrhill.

All treatments other than 0.55 kg/ha pronamide significantly reduced the amount of sorrel seed in the dressed sample. There was good agreement between panicle number and seed content of sample for treatments other than paraquat. Burning off the sheep's sorrel with paraquat probably delayed flowering and thus the quantity of seed mature by harvest.

Though no treatment gave a clean sample, the reduction in sheep's sorrel seed content is promising and assessment in large block plots followed by commercial seed dressing seems warranted.

The September/October treatment time used in this series of trials was chosen for two reasons. It proved difficult in 1969 in the Barrhill/Methven area to locate uniform areas of sheep's sorrel before the first week of September because of frost and sheep trampling, while treatment of plots at about the time for paraquat treatment reduces complications due to differential grazing. At first this decision appeared to be justified by the results. Early treatment gave better control of grasses than later treatment while at the sheep's sorrel control sites there were fresh flowering panicles in the early treated plots by harvest time. This appeared to indicate temporary control only with the need for a limited interval between treatment and harvest. However, results of time of treatment trials, one of which was sampled for clover seed yield (Fig. 1, Table 3) indicated that the optimum time for clover response to and grass control by carbetamide and pronamide is much earlier (July/August). Grass control was less effective in September/October though later treatment can be compensated for to some extent by increased dose rate (Fig. 1 and Tables 1 and 3). This raises the question as to whether the high rates which gave promising sheep's sorrel control may not, if applied earlier, have killed the weed thus preventing regrowth. Trials to check this point are under way.

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