COMPARISON OF PROPRIETARY FORMULATIONS OF PARAQUAT IN WHITE CLOVER SEED CROPS

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SUMMARY

Four commercially available paraquat formulations were compared for grass control in white clover (*Trifolium repens*) seed crops. Visual differences of grass kill which were associated for formulation persisted through to harvest as measured by dry matter production. Addition of surfactant to one product upgraded its grass killing efficiency to that of the most active product. Seed yields of all treatments were lower than untreated but differences were not consistently affected by differences of grass kill caused by formulations. Timing of application of paraquat earlier than the present farming practice is suggested.

INTRODUCTION

Paraquat has been used extensively since 1964 (Leonard), to control ryegrass (*Lolium* spp.) in white clover seed crops and thereby increase seed yield.

The early chloride anion formulations of paraquat required addition of surfactant to increase efficiency. More recently surfactant has been included in the formulation and since 1976 formulations based on methyl sulphate anions have been available. With this diversity of products have come claims by users that formulations were different in their field performance. This paper reports on three trials laid down in 1977 and 1978 to test four commercial formulations of paraquat for their efficiency of grass control in white clover seed crops and resultant seed yields. The recommended time of application is mid October but these trials were deliberately laid down in November to accentuate possible treatment differences.

METHOD

Formulations listed in Table 1 were purchased from agencies representing four companies formulating paraquat. Two other formulations were compared with the four commercially purchased brands. ICI Gramoxone (1968) was purchased in 1968 for MAF trials and had less surfactant than ICI Gramoxone (1977). After trial 1 was laid down IWD Paraquat (batch a) was reported to have less surfactant than IWD Paraquat

TABLE 1: Formulations and Manufacturers.

Registered Product name	Manufacturer	Neutralizing anion
ICI Gramoxone (1968, 1977)	Imperial Chemical Industries, Plant Protection Division, England.	chloride
Rural Paraquat	Associated Rural Industries, N.Z. Farmers Fertiliser, Auckland.	sulphate
IWD Paraquat (batch a,b)	Ivon-Watkins Dow Ltd., New Plymouth	sulphate
Tartan paraquat	Farm Chemicals Co., Nelson	sulphate

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(batch b). Batch b supplied by the company concerned from another commercial batch, was included in trials 2 and 3.

Trial sites were at Irwell and Lakeside in the Leeston area. The treatments were applied with a bicycle wheel mounted, hand pushed, compressed air operated spray boom delivering 200 litres/ha. Pasture growth at application was short (2-4 cm) as all treatments were applied about one week after grazing the sward.

The degree of grass desiccation was visually assessed for each plot 3, 7 and 14 days after application. Scores (range from 0 = no desiccation to 10 = complete desiccation) were made by 3 or 4 independent observers.

Dry matter yields (DM) were determined from two samples of size 0.5 x 0.5 m cut with a portable shearing machine. Seed yields were obtained by harvesting strips of size 8 x 0.75 m (trial 1 and 2) and 4.0 x 1.0 m (trial 3) with a sicklebar mower, and threshing the dried samples in a stationary thresher. The dates of harvest are given in the tables.

Trial design was a splitplot layout for trial 1 (four replicates) and trial 3 (eight replicates). A randomised block design with four replicates was used for trial 2. Plot size was 2 x 8-10 m long. All trials were sprinkler irrigated.

RESULTS AND DISCUSSION

Conditions at the time of application of treatments were suitable for good herbicidal activity of paraquat. The weather was cool, calm and overcast, with the exception of the second application time in trial 3 when cool but sunny conditions prevailed. All treatments delayed flowering of white clover by up to 2 weeks. In the trial 3, at the second application date a number of white clover flowers were already present and treatment killed these heads.

Chloride formulations tended to be quicker in their action than sulphate formulations but the effect was gone after 7 days.

Visual scorings.

Results for the 7 day assessment are presented, as patterns were similar for the other assessment date. Scores for trial 3 are means of two scorings each 7 days after application. The degree of grass desiccation increased as the rate of paraquat increased (Table 2). ICI Gramoxone formulations gave higher scores than other formulations at

TABLE 2: Trial 1 effect of rate and formulation of paraquat on white clover seed crops.

Treatments 7.11.77	Visual grass score 14.11.77	Dry matter 13.12.77 grass kg/ha	clover kg/ha	Seed yields 3.2.78 kg/ha
<i>Rates of paraquat (main plot)</i>				
0.1 kg/ha	2.7 c	1200 a	520 a	270 a
0.2 kg/ha	5.3 b	880 ab	660 a	290 a
0.4 kg/ha	7.2 a	610 b	440 a	270 a
se (mean)	0.2	108	64	24
CV%	18	54	56	38
<i>Formulations (sub plot)</i>				
ICI Gramoxone (1968)	5.9 a	800 bc	590 ab	280 a
ICI Gramoxone (1977)	6.0 a	760 c	470 bc	260 a
Rural Paraquat	4.5 b	1050 a	430 c	290 a
IWD Paraquat				
(Batch a)	4.6 b	920 abc	600 a	290 a
Tartan Paraquat	4.3 c	970 ab	500 abc	270 a
se (mean)	0.09	64	41	13
CV%	18	24	28	16
Rate x formulation				
interaction	**	ns	ns	ns
untreated (not included in analysis)	0.1	1470	630	300

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all applications. When additional surfactant (Rural Wetter/sticker) was added to Rural Paraquat (Table 4) there was no significant difference compared with ICI Gramoxone. IWD Paraquat (batch b) scores were higher than batch a. These results suggest that addition of surfactant to this formulation improved grass desiccation even in good application conditions.

In trial 1 differences between the formulations increased with higher application rates (Table 2). This was contrary to the expectation when designing the trial that at the commercial rate of 0.4 kg/ha there would be no difference between formulations.

Dry matter.

Increased paraquat rates reduced the amount of grass surviving. Differences in grass yield between the formulations followed the same pattern as the visual scores, with grass yields from the ICI Gramoxone formulations being lower (but not always significantly) than the yields from alternative formulations other than Rural Paraquat plus surfactant.

TABLE 3: Trial 2 Effect of formulation of paraquat on white clover seed crops.

Treatments	0.2 kg/ha 29.11.77	Visual grass score 5.12.77	kg DM/ha 31.1.78 Live grass*	Clover	Seed yield 3.2.78 kg/ha
ICI Gramoxone (1977)	6.5 a	6.8 bc	(860)	2200 a	200 ab
Rural Paraquat	4.3 c	7.1 ab	(1260)	1600 bc	180 abc
Rural Paraquat plus 1% V/V surfactant	7.2 a	6.7 c	(810)	2560 a	160 bcd
IWD Paraquat (batch a)	4.4 c	7.2 a	(1340)	1430 bc	120 d
IWD Paraquat (batch b)	5.6 b	7.0 abc	(1100)	1950 abc	180 bc
Tartan paraquat	4.9 bc	7.2 a	(1340)	1360 c	140 cd
untreated		7.0 abc	(1100)	2020 ab	220 a
se mean	0.28	0.135		184	15
CV%	11	4		20	18

* Live grass data was log_e transformed and the back transformed means are in brackets.

TABLE 4: Trial 3 effect of formulation and time of spraying of paraquat on white clover seed crops.

Time of application (main plot)	Visual grass score (21.11.78 + 4.12.78)	kg DM/ha 16.1.79 Grass	Clover	Seed yield (kg/ha) 2.2.79
13.11.78	5.5	64	4130	190
27.11.78	6.0	50	4500	166
se (mean)	0.2	13	50	3
<i>Formulations (sub plot)</i>				
ICI Gramoxone (1977)	6.0	35	4170	174
Tartan paraquat	5.1	60	4320	184
IWD Paraquat (batch b)	4.9	66	4020	182
Rural paraquat	5.0	65	4320	170
se (mean)	0.09	39	104	3.5
Time x formulation interaction	ns	ns	*	ns
untreated (not included in analysis)		1200	2840	248

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Clover foliage yields were not greatly affected by the rate of paraquat used (Table 2) but the formulation and the date of application have affected DM yields (Tables 3,4). The clover DM and formulation relationship appears to be the consequence of relative efficiency of grass control of the products. Poor grass control was generally reflected in less clover growth. The time of treatment effect is likely to be the consequence of better ground cover at time of spraying and at the later dates the foliage provided more protection to the clover stolons at spraying (Tables, 2,3).

Seed yields.

In all 3 trials clover seed yields were depressed by treatment with paraquat. Seed yield is the crucial measure of the value of paraquat use in white clover seed crops and there are two conflicting factors that influence seed yield following paraquat application — increased yield following removal of grass but decreased yield due to damage to white clover plants.

Timing of application was deliberately late, though some crops were sprayed as late as the first week of November. The lack of seed yield increase from November treatment was also reported by Leonard (1964) on lower moisture retentive soils than those reported here. He recommended application in mid October, 2-4 weeks before closing. On soils with adequate moisture the recommended closing date is mid November (Clifford, 1979). Our results show that even with adequate moisture the current practice to apply paraquat late does not increase seed yields.

Differences due to formulation are more difficult to explain. The better the grass control the higher the seed yield, but at higher rates of paraquat, or if applied late, yields were reduced because of clover damage.

CONCLUSION

Claims by users that there were differences in field performance of commercially available formulations have been substantiated in the trials reported.

Differences, attributable to formulation, occurred both visually as desiccation of grass and as the amount of grass and clover left in the sward pre-harvest. Differences between a sulphate and a chloride based formulation could be overcome by the addition of surfactant to the sulphate formulation. Seed yield differences resulting from various formulations cannot be easily attributable to formulation. Application of paraquat in November reduced clover seed yields supporting Leonard's (1964) results, and suggesting that his recommendation to apply paraquat in October should be adhered to.

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