QUEENSLAND DEPARTMENT OF PRIMARY INDUSTRIES

DIVISION OF PLANT INDUSTRY BULLETIN No. 812

EFFECTS OF 2,2-DPA, RIPPING AND OVERSOWING ON PASTURE YIELD AND COMPOSITION

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SUMMARY

Four rates of 2,2-DPA (2,2-dichloropropionic acid) were used in conjunction with ripping and oversowing of additional white clover (*Trifolium repens*) to rejuvenate rain-grown clover pastures invaded by mat grass (*Axonopus affinis*) at Cooroy in south-east Queensland. Herbicide treatment applied between June and July 1971 markedly increased clover yield in May and July 1972, and decreased mat grass yield in May 1972. By November 1972 the herbicide's effect had worn off. Clover or mat grass yields were insensitive to herbicide application rates. Oversowing did not confer any benefits under the prevailing weather conditions, but there was a suggestion of benefit from ripping on clover yield in the absence of herbicide application.

I. INTRODUCTION

The use of herbicides to remove selected unwanted species in a pasture or to remove all species in preparation for reseeding without cultivation is practised in Australia and overseas. As a legume-grass pasture can revert entirely to grass and weed species because of some change in management, any treatment which can shift the botanical composition from grass dominance to a reasonable balance of grass and legume must be a valuable management tool. In south-east Queensland white clover (*Trifolium repens*) often fails to perennate because of severe competition from mat grass (*Axonopus affinis*) and paspalum (*Paspalum dilatatum*). Cultivation is used to kill the grass prior to reseeding, but this also kills any clover still surviving. The translocated herbicide 2,2-DPA (2,2-dichloropropionic acid) is a relatively cheap and effective chemical for killing mat grass and if applied at the correct time can result in a substantial increase in the white clover content of pasture (Murtagh 1977). An experiment was conducted to assess the feasibility of rejuvenating white clover in raingrown mat grass pastures by spraying with 2,2-DPA, ripping and oversowing with additional clover and grass seed.

II. MATERIALS AND METHODS

The experiment was located at Cooroy in the Near North Coast region of south-east Queensland, on a typical mat grass dominant latosolic clay loam ridge soil derived from phyllite (Gn3·5 (Northcote 1974)). The pasture, consisting of mat grass, white clover and paspalum had been grazed on an irregular basis by milking-cows and dry stock. The area was topdressed annually with 25 kg P ha^{-1}. The experimental site was mown to 5 cm with an autoscythe, cuttings were raked off, and the area was fenced before the treatments were imposed.

Design

Treatments were 2,2-DPA at 0, 2·8, 5·6 and 11·2 kg ha^{-1} a.c. x ripping (±) x oversowing (±) applied to 12·5–m^2 plots in a thrice replicated randomized block design. The 11·2 kg ha^{-1} herbicide treatment was applied in two equal applications of 5·6 kg ha^{-1} on 28 June and 20 July 1971, the lower rates all being applied on the first date. Ripping and oversowing were carried out on 10 September 1971, the oversowing mixture being *T. repens* cv. Ladino (3·4 kg ha^{-1}) and cv. Louisiana (3·4 kg ha^{-1}), *Setaria anceps* cv. Narok (0·56 kg ha^{-1}), and *Panicum maximum* cv. Gatton (0·56 kg ha^{-1}). Legume seed was inoculated with commercial peat cultures of a 2% methyl cellulose–water slurry sticker and coated with lime. Adequate basal (49 kg ha^{-1} P and 62 kg ha^{-1} K) and maintenance (25 P + 63 K) fertilizers were applied at sowing and in autumn 1972 respectively. Seed and fertilizers were hand broadcast on plot surfaces.

Measurements

Rainfall recorded during the experiment is shown in table 1.

TABLE 1

MONTHLY RAINFALL (mm) FOR EXPERIMENTAL PERIOD AT COOROY AND LONG TERM MEAN

Month	1971	Month	1972	81–yr Mean
		January	191	241
		February	871	267
		March	127	243
		April	250	137
		May	229	110
June	24	June	59	100
July	49	July	1	68
August	116	August	12	46
September	44	September	28	57
October	61	October	217	89
November	74	November	182	107
December	272	December	40	162

Plant population counts were not feasible as there was almost no germination due to dry weather. No harvesting for dry matter yields was possible in 1971, but weeds were mown and removed several times over the 1971 summer. For dry matter determinations in 1972 a 2·74–m x 0·914–m fixed quadrat was cut with an autoscythe from each plot. The harvested material was separated into legume, mat grass and paspalum, dried and weighed. After sampling all top growth was removed from the plots with an autoscythe and raked off.

III. RESULTS

Statistical analyses (table 2)

Analyses of variance were used for dry matter yields at each of the three post-treatment harvests. The pre-treatment harvest was used in convariance analyses at the various post-treatment dates. However, there was a non-significant regression coefficient in all cases and hence unadjusted results are shown.

TABLE 2

ANALYSES OF VARIANCE FOR TOTAL DRY MATTER YIELDS AND COMPONENTS OF YIELD FOR INDIVIDUAL HARVESTS AND THE FULL SEASON IN 1972
SIGNIFICANCE OF F RATIOS FOR MAIN EFFECTS AND INTERACTIONS

Date	Component	Main Effect			1st Order Interaction			2nd Order
		Ripping	Over-sowing	Herbi-cide	R × O	R × H	O × H	R × O × H
24 May ..	Clover (C)			**		*		
	Mat grass (Mg) ..			**		*	*	*
	C + Mg			**				
7 July ..	Clover			**				
	Mat grass							
	C + Mg							
20 Nov. ..	Clover						*	
	Mat grass		**	**			**	
	Paspalum	**		**			*	
	C + Mg		**	**		*	**	
	Total		**	**			**	
Season's Total	Clover			**				
	Mat grass		**	**			*	
	Paspalum	**		**				
	C + Mg		*	*			*	
	Total		*				*	

* Significant 5% level.
** Significant 1% level.

There was an obvious kill of mat grass at all herbicide rates and no white clover growth occurred for 6 months after the application of 11·2 kg ha^{-1} 2,2-DPA. The 2·8 and 5·6 kg ha^{-1} rates severely burnt and retarded white clover growth with the lower rate being less severe on the clover, but there was little growth in any plot in the dry conditions. The effect of herbicide on mat grass was clearly evident 10 weeks after application. By December 1972 there were no significant residual effects of the herbicide applied in July 1971, and by March 1973 mat grass had returned to its original density. There was no germination of Narok setaria or Gatton panic.

Ripping

Ripping generally had little effect, but by 20 November 1972 a minor but highly significant increase of paspalum yield was recorded (table 3) whilst the ripping x herbicide interaction was significant for white clover yield on 24 May and clover + mat grass yield on 20 November (table 4). In May there was a greater increase in clover yield due to the use of the herbicide when the plots were not ripped (table 4). The ripping by herbicide, oversowing x herbicide and ripping x oversowing x herbicide interactions were also significant for mat grass yield on these dates, due mainly to the high yield of mat grass on the nil herbicide plot being higher still (significantly) in the absence of ripping and/or oversowing.

On 20 November the clover + mat grass yield also showed a significant ripping x herbicide interaction (table 5) due to low yield in the nil herbicide, unripped plots.

TABLE 3

MAIN EFFECTS ON YIELD (ODM kg ha^{-1}) OF WHITE CLOVER, MAT GRASS AND PASPALUM AT THE THREE HARVEST DATES IN 1972 AND THE HARVEST AND SEASONAL TOTAL YIELDS

Harvest and Yield Component	Ripping			Oversowing			2,2-DPA Spraying (kg ha^{-1} a.c.)				
	Not Ripped	Ripped	L.S.D. + Signif.	Not Sown	Sown	L.S.D. + Signif.	0	2·8	5·6	11·2	L.S.D. + Signif.
24 May											
Clover	407	311	n.s.	387	331	n.s.	85	371	561	419	217†
Mat grass	543	519	n.s.	556	506	n.s.	1 228	360	229	307	243†
Total	949	830	n.s.	943	837	n.s.	1 313	731	790	725	277†
7 July											
Clover	444	522	n.s.	436	531	n.s.	260	625	510	539	300†
Mat grass	183	134	n.s.	151	166	n.s.	280	102	126	125	n.s.
Total	628	656	n.s.	587	697	n.s.	540	728	636	664	n.s.
20 Nov											
Clover	513	555	n.s.	541	526	n.s.	446	552	575	562	n.s.
Mat grass	1 147	1 145	n.s.	1 276	1 016	146†	1 167	1 065	1 317	1 034	206†
Paspalum	33	98	39†	65	65	n.s.	1	82	82	96	56†
Clover + Mat grass	1 660	1 700	n.s.	1 817	1 542	180†	1 614	1 617	1 891	1 596	255†
Total	1 692	1 797	n.s.	1 883	1 607	198†	1 615	1 699	1 973	1 692	280†
1972 Totals											
Clover	1 364	1 388	n.s.	1 363	1 388	n.s.	790	1 548	1 645	1 519	529†
Mat grass	1 873	1 798	n.s.	1 983	1 688	277†	2 676	1 528	1 672	1 466	391†
Paspalum	33	98	39†	65	65	n.s.	1	82	82	96	56†
Clover + Mat grass	3 236	3 186	n.s.	3 347	3,075	256*	3 466	3076	3 317	2 985	361*
Total	3 269	3 283	n.s.	3 412	3 141	267*	3 467	3 158	3 399	3 081	n.s.

N.B. Nil paspalum yield 24 May and 7 July.
* L.S.D. P= 0·05; † L.S.D. P = 0·01; n.s. = not significant.

TABLE 4

EFFECT OF HERBICIDE AND RIPPING ON CLOVER AND MAT GRASS YIELD (ODM kg ha^{-1}) ON 24 MAY 1972

—	Herbicide Rate (kg ha^{-1} a.c.)			
	0	2·8	5·6	11·2
CLOVER				
Not ripped	0	518	573	536
Ripped	169	224	549	301
	L.S.D. 5% 228			
MAT GRASS				
Not ripped	1 433	285	151	302
Ripped	1 023	436	307	311
	L.S.D. 5% 255			

TABLE 5

EFFECT OF HERBICIDE AND RIPPING ON CLOVER PLUS MAT GRASS YIELD (ODM kg ha^{-1}) ON 20 NOVEMBER 1972

—	Herbicide Rate (kg ha^{-1} a.c.)			
	0	2·8	5·6	11·2
Not ripped	1 459	1 715	1 948	1 517
Ripped	1 769	1 519	1 835	1 676

L.S.D. 5% 268.

Oversowing

There was no main effect of oversowing on clover yield, but the oversowing x herbicide interaction was significant with increased clover yields at the nil and 2·8 kg ha^{-1} herbicide rates on 20 November. At this harvest mat grass yields were highly significantly greater on the non-oversown plots ($P < 0{\cdot}01$) which was large enough to increase the combined yields of clover + mat grass and clover + mat grass + paspalum ($P < 0{\cdot}01$). The oversowing x herbicide interaction was also consistently significant at this harvest (table 6).

Herbicide application

Herbicide treatment markedly increased the clover yield and decreased the mat grass yield at 24 May and 7 July harvests although the mat grass decrease in July failed to reach significance. These effects were generally still present by the November harvest but were confounded by a series of significant interactions with oversowing (table 6).

TABLE 6

EFFECTS OF HERBICIDE RATE AND OVERSOWING ON COMPONENTS OF DRY MATTER YIELD (ODM KG HA^{-1}) MEASURED ON 20 NOVEMBER 1972

Yield Component	Oversowing	Herbicide rate (kg ha^{-1} a.c.)				L.S.D.	P
		0	2·8	5·6	11·2		
Clover	—	380	486	630	668	169	0·05
	+	512	617	520	456		
Mat grass	—	1 447	1 162	1 268	1 229	291	0·01
	+	888	969	1 365	839		
Paspalum	—	3	100	40	119	59	0·05
	+	0	64	124	73		
Clover + mat grass + paspalum	—	1 829	1 748	1 938	2 017	397	0·01
	+	1 401	1 651	2 009	1 368		
Clover + mat grass	—	1 827	1 648	1 898	1 898	361	0·01
	+	1 401	1 586	1 885	1 295		

IV. DISCUSSION

The dry season experienced and the lack of harvests until 10 months after the initial treatments were imposed make interpretation of these results difficult. This is especially the case with the interactions recorded, and considerable care should be exercised in this regard.

The general stimulation in white clover growth by the use of 2,2-DPA is, however, in line with the results recorded by McGowan (1970) and Murtagh (1977).

The suppression of clover in the year of spraying due to the severity of 2,2-DPA and dry weather indicates the importance of timing, rate of application and the amount of ground cover when spraying this herbicide. Murtagh (1977) found that spraying in March when grass leaves were longer reduced the severity of 2,2-DPA on clover and significantly increased clover yield in spring; late April spraying decreased the spring yield. In the current experiment the herbicide was sprayed late (June–September) on a previously mown grass sward exposing the clover to full effects of the herbicide which prevented any spring growth.

It seems that ripping 2 months later stimulated clover yield 10 months after herbicide application where no herbicide was applied, but possibly had an adverse effect on the clover plants already weakened by 2,2-DPA application (table 4).

On the other hand it is difficult to see any valid reasons for significant oversowing x herbicide effect if, as appeared to be the case, none of the oversown species established. In fact it is doubtful whether any of the clover harvested in 1972 was actually a result of oversowing; it is more likely that it arose from naturally present plants whose growth had responded to the better rainfall of summer and autumn 1972.

Ten months after treatment, that is at the close of the first growing season, the mat grass was still strongly depressed by the herbicide treatments. By mid winter (12 months after application of the 2,2-DPA) the mat grass yields were still depressed but not significantly so, and the consistent effects had disappeared by the following November.

Although dry conditions are unfavourable for translocated herbicides, the effectiveness of the low rates of 2,2-DPA is due to the ability of the herbicide to be absorbed quickly through the leaves and roots. It also appears that the growth stage of grass has an important influence on its response to 2,2-DPA. The results of this experiment showed that all rates of 2,2-DPA were equally effective when applied to the grass during winter but Murtagh (1977) found late April sprayings more effective than March sprayings.

The decline in mat grass yield at the May sampling as a result of herbicide application was not associated with any measureable increase in weeds. A tendency for a change in botanical composition was observed once mat grass was removed, but this was too small to be measured. If there had been favourable weather a significant increase in weed proportion might have been measured.

Although 2,2-DPA may be useful in removing mat grass, its success as a pasture renovation tool appears highly dependent on timing, the degree of protection afforded by the grass to clover, and moisture. The reduction in yield in the year of spraying and possible increase in weed proportion are two disadvantages to be considered before implementing this practice on a commercial scale.

V. ACKNOWLEDGEMENTS

The author gratefully acknowledges the assistance of Mr B. Beeston, Cooroy for the provision of land and equipment, Miss E. A. Goward, Senior Biometrician, Department of Primary Industries, Brisbane for statistical analyses, and the Australian Dairy Produce Board for finance.

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(Received for publication 7 April 1978)

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