COMPARISON OF THE SUBSTITUTED PHENOXY-ACETICS AND THE PHENOXY-BUTYRICS ON A WHITE CLOVER-PERENNIAL RYEGRASS

By W. F. A. MEEKLAH, Invermay Research Station, Mosgiel

SUMMARY

AN account is given of two replicated mowing trials involving the use of 2,4-D, MCPA, MCPB, and 2,4-DB on a perennial ryegrass-white clover sward, carried out over two seasons. It is shown that 2,4-D and MCPA can cause immediate and drastic reductions in total yield. However, this effect is short lived, but composition changes may persist for some time. MCPB and 2,4-DB are shown to have a minor effect on the yield and composition of this type of sward. The merit of using 2,4-D and MCPA on clover dominant swards is discussed.

INTRODUCTION

Until recently pasture spraying was confined to 2,4-D and MCPA which, though giving excellent weed control, suffer from the disadvantage of causing varying degrees of clover damage with consequent harmful effects on stock (Lewis 1956, 1957). With the introduction of 2,4-DB and MCPB (hereafter referred to as gamma-butyrics), however, the problem of clover damage has been largely overcome. The use of gamma-butyrics, particularly MCPB, has become widespread and as expected, there has been a swing against them by some farmers. This is because several years of experience with 2,4-D and MCPA (hereafter referred to as phenoxy-acetics) has educated them to a standard of weed control that, unfortunately, cannot always be attained with the gamma-butyrics. Progressive farmers, however, realise that the great asset of the gamma-butyrics lies in their ability to leave clovers unharmed and, providing an acceptable standard of weed control is achieved, they prefer to use them because pasture production is not checked.

The tolerance of established white clover-perennial ryegrass swards to the phenoxy-acetics has been studied for several years at Invermay, but only during the past two seasons have the gamma-butyrics been included. The results of two replicated mowing trials are presented in this paper. Effects of treatments were measured by yields of dry matter, while point quadrant analysis and herbage dissection analysis were used to estimate the species composition.

EXPERIMENTAL METHOD

Both trials were laid down on adjoining sites in the same paddock, and spraying was carried out at approximately the same stage of growth at all times, that is when the clovers were 2 in. to 3½ in. high. Volume rates were about 20 gallons per acre.

Uniformity cuts showed that there was 40 per cent. of white clover in the herbage in 1956 before treatments were applied, but only 25 per cent. in 1957. Also at the beginning of the 1957-58 season total yields were higher initially, thus grass yields at this time were much higher than in 1956-57.

The proportion of red clover present in both seasons is so small that little significance can be attached to changes in population, apart from noting that 2,4-D ester completely eliminated it from the sward at any

stage, while MCPA caused a slight increase in red clover due to white clover suppression. Therefore all clover yields include both red and white clover.

All yields quoted are in terms of lb. dry matter per acre. All dosage rates are in terms of lb. acid equivalent per acre.

Treatments were as follows:

Trial A (1956-57)		Trial B (1957-58)	
MCPA 1 lb.	} flush of spring clover growth	2,4-DB 2 lb.	} flush of spring clover growth
MCPB 2 lb.		MCPB 2 lb.	
2,4-D 1 lb.		MCPA 1 lb.	
Control		Control	
MCPA 1 lb.	} flush of autumn clover growth	2,4-DB 2 lb.	} flush of autumn clover growth
MCPB 2 lb.		MCPB 2 lb.	
2,4-D 1 lb.		MCPA 1 lb.	
Control		Control	

Application details are shown in Table 1.

TABLE 1—APPLICATION DETAILS

		Trial A		Trial B	
		Spring	Autumn	Spring	Autumn
Date of uniformity cut		19/10/56	5/3/57	17/10/57	25/2/58
Date of spraying	---	13/11/56	16/3/57	8/11/57	24/3/58
Spraying conditions	---	Good	Good	Good	Good
Air temp. (shade)	---	62.5°F.	65°F.	70°F.	66°F.
Soil temp. (3 in. deep)	---	58.5°F.	63.5°F.	57.5°F.	59°F.
Subsequent weather conditions	---	Favourable	Rain fell 3 hrs. later	Favourable	Favourable
Rainfall measured 24 hours later	---	Nil	0.01 in.	Nil	Nil
Rainfall Sept. to May	---	28.16 in.		26.87 in.	

The following formulations were used: the sodium salt of MCPB and 2,4-DB, the potassium salt of MCPA, and the ethyl ester of 2,4-D.

RESULTS

Trial A

Spring Application: The first cut was taken on 26/11/56 (see Table 2) and showed the highest total yield from control, whereas MCPB had caused the least production drop; 2,4-D was next with MCPA showing the biggest production loss. All reductions were significant ($P = 0.01$) and MCPA was significantly lower than MCPB ($P = 0.01$). It is interesting to see that the reduction with MCPB was highly significant, showing that a sward of this composition is not entirely immune from the effects of this chemical. Only slight differences in total production occurred for the rest of the season except for the last cut, where MCPA has a small though significant increase ($P = 0.05$).

Losses in production were due to clover suppression (see Table 3). Increased grass growth on 2,4-D and MCPA treatments apparently compensated for loss in production from white clover (see Table 4). The increase in grass growth was greater on the MCPA treatments where clover was suppressed for a longer time, and in the autumn cut this grass dominant sward was significantly higher yielding than the control.

TABLE 2—TRIAL A (Total yield in dry matter lb./acre.)

	26/11/56	3/1/57	21/1/57	5/3/57	29/4/57	2/10/57	8/11/57
Control	2340	1190	1190	1300	1050	850	880
MCPA Spring	1820**	1200	1280	1400	1150*	910	960
MCPB "	2110**	1180	1190	1310	1030	790	880
2,4-D "	1950**	1230	1160	1410	1060	830	860
MCPA Autumn					610**	1190**	950
MCPB "					990	940	940
2,4-D "					760**	1100**	900
Sig. diffs. 5 per cent*	160	N.S.	130	110	80	110	N.S.
from control 1 per cent**	210	—	170	N.S.	110	140	—
Coefficient of variation	66.6%	6.2%	10.0%	8.0%	6.8%	10.1%	8.2%
Sig. diffs. between 5 per cent	220	N.S.	170	150	100	130	N.S.
treatments other 1 per cent	280	—	220	200	130	180	—
than control							

TABLE 3—TRIAL A (Relative clover production per acre (Control = 100 per cent).)

	26/11/56	3/1/57	21/1/57	5/3/57	29/4/57	2/10/57	8/11/57
Actual yield of control	1265	665	760	885	545	350	280
MCPA Spring	49	72	76	98	93	100	114
MCPB "	80	107	111	106	93	100	100
2,4-D "	36	74	86	101	105	109	121
MCPA Autumn					22	66	61
MCPB "					85	120	107
2,4-D "					42	89	75

TABLE 4—TRIAL A (Relative grass production per acre (Control = 100 per cent).)

	26/11/56	3/1/57	21/1/57	5/3/57	29/4/57	2/10/57	8/11/57
Actual yield of control	1080	450	430	415	505	480	580
MCPA	111	160	164	128	128	115	105
MCPB	102	104	80	93	102	90	98
2,4-D	139	164	118	125	97	94	88
MCPA					97	194	128
MCPB					104	102	105
2,4-D					105	163	119

There are large differences between the phenoxy-acetics and MCPB as far as clover yields are concerned: apart from a small reduction at the first cut MCPB maintained the balance of species and yields were comparable to control throughout the season. Two cuts taken at the beginning of the 1957-58 season showed no significant differences in production.

Trial A

Autumn application: Only one autumn cut was obtained about 6 weeks after spraying (see Table 2). Production from the phenoxy-acetics was significantly less ($P = 0.01$) than control and MCPB, while MCPA was significantly less than 2,4-D ($P = 0.01$). Losses were entirely due to clover suppression (Tables 3 and 4). The phenoxy-acetics compensated for these production losses in the following spring when significant increases ($P = 0.01$) were obtained at the first cut, but by mid spring yields were almost normal. Severe clover suppression was still evident by the phenoxy-acetics, with MCPA being more severe than 2,4-D. It is possible that the clover population would have regained normal proportions with the onset of more favourable climatic conditions in late spring and early summer.

A small drop in clover yield was indicated where MCPB was applied in autumn.

Trial B

Spring application: At the first cut 4 weeks after spraying yields from MCPA plots were significantly less ($P = 0.01$) than control and all other treatments. Differences in production for the rest of the season were small, except for some fluctuation by MCPA plots, which in mid summer yielded significantly less ($P = 0.01$) than control and 2,4-DB, also MCPB ($P = 0.05$). At the end of the season a significantly higher yield than control and the gamma-butyrics was shown by MCPA (see Table 5).

TABLE 5—TRIAL B (Total yield in dry matter lb./acre)

			3/12/57	3/1/58	28/1/58	25/2/58	7/5/58
Control	---	---	3360	1440	1190	1170	1190
2,4-DB Spring	---	---	3160	1500	1200	1180	1140
MCPB	„	---	3330	1490	1120	1200	1130
MCPA	„	---	2700**	1510	1000**	1230	1380*
2,4-DB Autumn	---	---					1260
MCPB	„	---					1140
MCPA	„	---					870**
Sig. diff. 5 per cent*	---	---	240	N.S.	90	N.S.	150
from control 1 per cent**	---	---	320	—	120	—	210
Coefficient of variation	---	---	6.4%	5.6%	6.6%	7.5%	10.4%
Sig. diffs. between 5 per cent	---	---	300	N.S.	110	N.S.	180
treatments other 1 per cent than control	---	---	410	—	150	—	240

Again production losses were due to clover suppression (see Table 6). The increase in grass population was not rapid enough to compensate for the ideal conditions which existed for clover growth in mid summer (see Table 7): By autumn, however, there were indications that both grasses and clovers were more vigorous than control.

TABLE 6—TRIAL B (Relative clover production per acre
(Control = 100 per cent).)

Actual yield of control	---	375	840	685	635	410
2,4-DB Spring	---	147	99	114	85	93
MCPB "	---	115	83	93	106	93
MCPA "	---	21	52	63	76	122
2,4-DB Autumn	---					107
MCPB "	---					76
MCPA "	---					27

TABLE 7—TRIAL B (Relative grass production per acre
(Control = 100 per cent).)

		3/12/57	3/1/58	28/1/58	25/2/58	7/5/58
Actual yield of control	---	3060	570	500	535	785
2,4-DB	} Spring	86	118	84	120	97
MCPB		95	139	96	97	96
MCPA		86	188	114	140	112
2,4-DB	} Autumn					104
MCPB						106
MCPA						97

Significant differences ($P = 0.01$) in actual hits on clover were found by point analysis in early and mid summer, MCPA being less than any other treatment.

Trial B

Autumn application: The complete picture for these treatments cannot be drawn until spring 1958 when recovery can be assessed. Only one cut has been obtained, 6 weeks after spraying (see Table 5), when only MCPA plots yielded significantly ($P = 0.01$) less than all other treatments.

Clover suppression was again the entire cause of production losses (see Table 6) and there was an indication that MCPB also caused some clover suppression.

DISCUSSION

As far as total production is concerned, even though the volume of production differs greatly between the two seasons, the trends between MCPB and control are the same for both seasons, there being virtually no difference, and the difference (control minus MCPB) between grand totals at the end of the first season with both trials is insignificant.

There is, however, a wider difference between control and MCPA in Trial B than there was in Trial A, the actual difference in Trial A being 220 lb. dry matter at the end of the season, and in Trial B 530 lb. dry matter. A similar pattern occurred between MCPB and MCPA. There was little difference between 2,4-D and MCPA or MCPB total yields in Trial A. There was no difference between the gamma-butyrics in Trial B.

Trends in grass production show no differences between control and MCPB for the two trials, but there are larger grass yield increases where MCPA was used in Trial A, there being 900 lb. more grass than control, only half this amount dividing MCPA and control in Trial B. This then is the component which caused the wider differences in total production

between MCPA and control in Trial B; it would appear that in the first season (Trial A) there was a greater proportion of clover present initially, and its destruction by MCPA enabled the grass to make marked increases in production due to reduced clover competition, or nodule nitrogen released from decaying plants.

In the second season (Trial B) where less clover was present initially, competition and nitrogen release effects caused by MCPA would be smaller.

The autumn applications in the two trials cannot be compared because these treatments represent the two extremes of clover height encountered at spraying throughout these trials; that is Trial A was sprayed at a clover height of 2 in., the smallest of the series, whereas Trial B was sprayed at 3½ in., the tallest of the series (unfortunately weather conditions delayed application).

Probably the reason for the greater effect of herbicides in autumn is that growth conditions at this period are contrary to those of spring, in that growth is slowing down, and so there is not the proportionate increase in grass production when clover is suppressed. This increase does not occur until the following spring as is shown by Table 2; the detrimental effect on the clover population is then intensified because grass growth begins earlier and is stronger than the clover, the suppression effect is repeated, and clover suppression is prolonged. Possibly only the onset of a season quite favourable to clover growth can remedy this situation; or perhaps the imposition of a management system to favour clover dominance would restore the clover to its original level.

To appreciate the changes resulting from the suppression of a certain fraction of a mixed sward, one must have some concept of the dynamics of grassland ecology. It seems obvious that any treatment which has a detrimental effect on clover has a greater effect on the sward that contains the higher proportion of clover. If growing conditions are favourable, such as we get in late spring and in a summer without droughts, then a proportional increase in the grass fraction will occur.

It seems clear that if nitrogen is not a limiting factor, grass (in particular, perennial ryegrass) is more productive than clover. Thus the increased grass fraction resulting from clover suppression can give some measure of increased production to compensate for the initial loss in yield which results at the onset of clover suppression.

To sum up it would appear reasonable to assume that if clover suppression is to be avoided, either of these materials, MCPB or 2,4-DB, may be used with confidence, only minor effects being detected. Even these may not be present with normal application rates, that is 1 to 1½ lb. acid equivalent/acre. Where a clover dominant sward (of the type present at the start of Trial A) is to be sprayed, it can be argued that the cheapness and better weed control of the phenoxy-acetics may be preferable, because the reduction of inter-species competition or release of nodule nitrogen enables grass to contribute more, and the total yield over the whole season is hardly affected. It must not be overlooked, however, that there is a severe production drop in the period immediately following application of phenoxy-acetics. This drop in production and change in sward composition could be embarrassing where the pasture is required for fat lamb production or where all possible feed needs to be conserved to provide winter grazing. In fact where autumn spraying is contemplated there would appear to be no case for the use of the phenoxy-acetics, if persistent changes in sward composition are to be avoided.

Finally we must not overlook one of the most important factors in these trials, which is the height of growth of clovers at the time of spraying, this being in all cases between 2 to 3½ in. high. At this stage it was

considered any effects of hormone-type weedkillers should become clearly evident (a necessary condition for the purpose of these trials). It is highly probable that on a farm scale clover damage could be lessened by grazing the clovers down before spraying.

Acknowledgments

The author would like to thank Mr Mountier and his staff for the statistical analyses carried out, and the staff of Invermay Research Station for their assistance in the various phases of this investigation.

References

- Lewis, K. H. C. (1956). Proc. 9th N.Z. Weed Control Conference. P. 101.
Lewis, K. H. C. (1957). Proc. 10th N.Z. Weed Control Conference. P. 44.

DISCUSSION

Q.—Was there any increase in weeds with the reduction in clover content of the sward treated with MCPA?

A.—No. Experiment was initiated on a weed-free sward. Under the fertility conditions there was a temporary reduction only in pasture growth due to clover damage.

Q.—On what dates were the autumn and spring spraying carried out?

A.—13 November 1956, 16 March 1957, 8 November 1957, and 24 March 1958.

Comment: Those dates are not used in practice, as spraying is done 2 months earlier in spring and damage is lessened by earlier spraying.

A.—It is agreed that earlier spraying gives less damage, but in the Invermay area spraying of perennial weeds is done at the time used in the trials.

Q.—Were the trial plots specially fertilised?

A.—No, a 4-year-old pasture was used in which the level of fertility was satisfactory.

Q.—Would seasonal variation have any effect on the trials? In a dry season more weeds would be expected.

A.—The two seasons were not wetter than normal. Temperatures did not vary from normal either.

Comment: The 2 lb. rate of MCPB and 2,4-DB gives a significant check to white clover, while the 1 lb. gives only a slight check.

Q.—The spraying done on weed-free swards was misleading. It is safe to assume that pastures benefit from weed removal.

A.—In a previous trial where a Californian thistle infestation of 30 to 40 per cent was involved there was no significant increase in production after the removal of the weed.

Comment: In the Wellington district farmers had sprayed four successive years for control of ragwort on poor fertility areas. The check to the clover was severe and more ragwort encouraged. Increased fertiliser and the use of sheep have given more satisfactory control.

Comment: If ragwort is sprayed before clover growth in early spring, little clover damage results.