No. 27 RESPONSE OF IRRIGATED SEEDLING CLOVER PASTURE TO SUBSTITUTED PHENOXYACETIC AND PHENOXYBUTYRIC ACID HERBICIDES

by

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SUMMARY:

Pasture sampling demonstrated that the application of 2,4-DB at $\frac{1}{4}$, $\frac{1}{2}$ and 1 lb. per acre to a weedy irrigated stand of seedling White and Red Clover, produced greater yields six months later than did MCPB applied at equivalent rates. 2,4-DB at 1 lb. per acre was better than at lower rates, and gave increased yields compared with 2,4-D or MCPA at $\frac{1}{4}$ or $\frac{3}{8}$ lb. per acre.

Esters and amine salts behaved similarly throughout the trial.

1. INTRODUCTION:

If a pasture is to be worthy of the expense brought about through irrigation, it must yield high quantities of nutritious herbage. In the case of newly establishing pastures, it is desirable that this high productivity be reached as early as possible, in order that best use may be made of the land. However, at the time of first cuts or grazings, the quantity of high quality feed available is often considerably reduced, due either to the presence of large amounts of weeds, or to poor clover growth due to weed competition shortly after germination.

The advent of the butyric derivatives of 2,4-D and MCPA has opened up a field of selective weed control in clovers which has promise of being applicable in this field, and it was felt that a comparison of these compounds with 2,4-D or MCPA may yield valuable results.

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2. EXPERIMENTAL:

The experiment was laid down at Richmond on an area of alluvial soil and was sown on 26th February, 1957, with Phalaris tuberosa and Red (Trifolium pratense) and White Clover (T. repens). It was irrigated fortnightly as necessary.

On the 30th April, 1957, the treatments shown in Table I were applied with a Land Rover and boom, using 10 gallons of spray per acre. Treatments were applied to three randomised blocks, having plots twenty-one yards in length and effectively boom-sprayed for about twelve feet in width.

At the time of spraying, the clovers were at the two to four trifoliate leaf stage. Staggerweed (Stachys arvensis) was the dominant weed, but had not commenced flowering at the time of spraying. Among other species present the more important were Shepherd's Purse (Capsella bursa-pastoris), Fathen (Chenopodium album), Noogoora burr (Xanthium pungens), Chickweed and Coronopus didymus. The latter developed into one of the dominant species later in the season.

(a) Three Weeks Inspection

The experiment was inspected on the 23rd May, 1957. At this stage there was no damage to White Clover, and only very few cupped leaves of Red Clover were found. It was considered that modification or retardation of either clover could not be assessed visually at this stage, as there appeared to be virtually no damage.

Weed control at this stage was far from complete, although there was a general reduction in the height of weeds in most plots.

Cooler weather had probably delayed the visible effects of the sprays.

(b) Three Months Inspection

A further inspection was made on 25th July, 1957. At this stage, Staggerweed and Coronopus were the dominant herbaceous weeds, together with a thick stand of Winter-grass (Poa annua). Docks (Rumex crispus) and Fat Hen were virtually eliminated from sprayed plots.

The visual assessment which was carried out by scoring the effects of the treatments with a rating scale, transformed the quite obvious field differences to a somewhat more quantitative form. The results are recorded in Table I. As was to be expected, 2,4-D treatments were more effective against the broadleaf weeds than the equivalent rates of MCPA, and this was also the case with the butyric derivatives.

However, any differences in activity between ester and amine forms of the chemicals were generally too small, or too variable to be relied upon.

One of the most important observations was the apparently lower activity of MCPB compared with MCPA at the same rate, whereas both 2,4-D and 2,4-DB appeared to affect the weeds to a similar degree.

Nevertheless, at least ½ lb. 2,4-DB per acre[+] was required to bring about a worthwhile reduction of weeds.

As at the earlier inspection, it was difficult to assess visually the differences in the clover contents of the plots; consequently it was decided to sample the plots by placing a quadrat 4' x 1½' equidistantly six times down the centre of the plot and removing the growth on the enclosed areas with hand shears.

The six samples were bulked for each plot and the clover was later sorted from the weeds and grasses. The samples were then dried on trays in a dehydrator and weighed. The results are shown in Table 2. Owing to the shortage of labour, only ester treatments were sampled in this way, and the grasses were not separated from weeds.

However, as the yields of weeds plus grasses have been reduced significantly (0.05 level) compared with controls, in all instances excepting ¼ lb. MCPB ethyl ester, and since grass suppression by these treatments is unlikely, it is sound to deduce that weeds have been reduced by at least the amounts shown in Table 2.

[+] NOTE : Throughout this paper, rates of chemicals are referred to as acid equivalent per acre unless otherwise stated.

TABLE I

EFFECTS OF VARIOUS TREATMENTS ON WEEDS

(MAINLY STAGGER WEED AND CORONOPUS)

ALMOST 3 MONTHS AFTER SPRAYING - INSPECTION 25/7/57.

CHEMICAL	RATE LBS A.E./a.	REPLICATION A	B	C	MEAN
2,4-DB butyl ester	¼	3	3	3	3.0
	½	5	3	5	4.3
	1	5.5	5	5	5.2
2,4-DB triethanolamine salt	¼	2	2.5	3	2.5
	½	4	4	4.5	4.2
	1	5	4	5	4.6
2,4-D ethyl ester	¼	3	2	4	3.0
	½	3	3	4	3.3
2,4-D triethanolamine salt	¼	2	3	3	2.6
	½	4	3.5	3	3.5
MCPA butyl ester	¼	1	1	2	1.3
	½	2	2	1	1.8
MCPA triethanolamine salt	¼	1	2	2	1.8
	½	2	2	2	2.0
MCPB ethyl ester	¼	1	0	1	0.6
	½	1	1	2	1.3
	1	2	2	2	2.0
MCPB triethanolamine salt	¼	1	1	1	1.0
	½	1	1	1	1.0
	1	2	2	2	2.0
Control	0	0	0	0	0.0
Control	0	0	0	0	0.0

SCALE:

0 = no effect 1 = slight reduction in height
2 = height reduced to ¾ of control
3 = height reduced to ½ of control and numbers reduced by less than 50%
4 = height reduced and numbers about 20% of controls
5 = height reduced, and severe reduction in numbers to less than 10% of controls. 6 = absence of weeds.

TABLE 2

MEANS OF THREE REPLICATIONS
OF BOTANICALLY SEPARATED PASTURE,
SAMPLED 3 MONTHS AFTER TREATMENT

CHEMICAL	RATE LBS. A.E./a.	POUNDS OF DRY MATTER PER ACRE	
		CLOVERS	WEEDS & GRASS
2,4-DB Butyl ester	¼	120	1529
	½	182	1168
	1	210	991
2,4-D Ethyl ester	¼	52	1538
	⅜	23	1025
MCPA Butyl ester	¼	77	1658
	⅜	35	1546
MCPB Ethyl ester	¼	66	1909
	½	55	1610
	1	61	1356
Control	0	101	1998
	0	62) 82	1956) 1977
Critical difference (0.05 level) between treatments		91	343
Critical difference (0.01 level) between treatments		124	
Critical difference between treatments and average control 0.05 level		79	298
Critical difference between treatments and average control 0.01 level		107	

In those cases where grasses have flourished because of the reduced weed competition, the reduction may be even greater than is shown. Observation during sampling indicated that this was probably the case with 1 lb. 2,4-DB butyl ester since the samples were almost weed free and contained a much greater quantity of grasses than did samples from other treatments. Furthermore, this treatment produced a significantly (0.05 level) smaller weight of weeds plus grasses than all other treatments except ½ lb. 2,4-DB butyl ester and ⅜ lb. 2,4-D ethyl ester, from which it could not be separated statistically.

The yields of clovers also bore out the advantages of the 1 lb. rate of 2,4-DB butyl ester in comparison with the other treatments, for, with the exception of ¼ and ½ lb. 2,4-DB butyl ester, this treatment produced yields shown to be greater (0.01 level of significance) than those from any other treatment. This was true of ½ lb. 2,4-DB butyl ester also, but at a lower level of confidence (0.05).

Although all chemicals other than 2,4-DB butyl ester produced clover yields which were lower than those of the unsprayed plots, the differences failed to reach significance (0.05 level). Nor did treatments involving these chemicals differ from one another.

Thus, three months after spraying, 2,4-DB was by far the best chemical, both from the aspect of weed control and clover yield.

(c) Six Months Inspection

During the early Spring, the pasture had been irrigated fortnightly, or as required following rain, and when the plots were inspected on 18th September, 1957, they were found to be free of most weeds, save for isolated docks, Shepherd's Purse and dying Coronopus. A similar weed pattern existed in unsprayed control plots and was representative of the normal decline of winter-growing weeds.

The most striking feature of the area at this stage was the marked increase in clover and Phalaris yield of some treated plots compared with controls, in which clovers and Phalaris were sparse and of poor vigour. The latter effects appeared to have been a direct result of weed competition during the previous months.

Clover in the area was generally 4 - 8" high and was approximately 60% White and 40% Red Clover. Phalaris was approximately 10" high and was showing good growth for the time of year.

The plots were sampled by mowing a three foot swathe down the centre of each and back again along the same strip. The sample was collected by raking, then weighed after drying in a dehydrator.

The dry weight results are shown in Table 3, from which it can be seen that MCPB gave no yield change from unsprayed plots. This was probably not due so much to phytotoxicity towards the clovers, for MCPB has been shown by many workers, including Wain[1], Carpenter and Soundy[2] and Meeklah[3] to be relatively mild in this regard, but rather to the poor weed control which was obtained with this chemical during the preceding months, resulting in severe competition with the legumes.

The only difference which could be shown between any of the 2,4-D and MCPA treatments was the lower yield of the $\frac{1}{4}$ lb. MCPA triethanolamine salt treatment, but since this is inconsistent with the general trend of results, it could well be the anomalous figure expected at the 0.05 significance level.

With 2,4-DB there were no significant differences between treatments except for 1 lb. 2,4-DB butyl ester which gave improved yields over all treatments applied except 1 lb. 2,4-DB triethanolamine salt, from which the difference failed to reach significance (0.05 level). However, as the ester gave consistently higher figures throughout the trial, it seems likely that further work would show its superiority.

3. DISCUSSION:

The experiment has shown that the selective properties of 2,4-DB make it possible to obtain markedly increased yields of clover pasture when the herbicide is applied to young clover infested with weeds. Although the effects described here were manifested on a mixture of Red and White Clovers, the relatively mild effects of 2,4-DB on legume species lead to the conjecture that it may produce desirable results when applied to Subterranean (T. subterraneum) and other species.

TABLE 3

TREATMENTS AND YIELDS OF HERBAGE PRODUCED AFTER SIX MONTHS

CHEMICAL	LBS. A.E./a.	MEAN YIELD LBS. DRY MATTER/ACRE
2,4-DB butyl ester	¼	347
	½	384
	1	510
2,4-DB triethanolamine salt	¼	335
	½	353
	1	413
2,4-D ethyl ester	⅛	277
	⅛	161
2,4-D triethanolamine salt	⅛	278
	⅛	224
MCPA butyl ester	⅛	247
	⅛	197
MCPA triethanolamine salt	⅛	142
	⅛	270
MCPB ethyl ester	¼	147
	½	217
	1	199
MCPB triethanolamine salt	¼	132
	½	210
	1	160
Control	0	180)
	0	88) 134
Critical difference (0.05 level) between treatments		123
Critical difference (0.05 level) between treatments and average control		107

Throughout the trial, clover yield was dependent upon the balance between reduction of weed competition and phytotoxicity of the treatments to the clovers themselves.

It has been shown by a number of workers, Elliott[4], Carpenter and Wilson[5], and Maclean[6], that Red and White Clovers react differently to each of the chemicals applied. In this trial, no attempt was made to discern these differences, but it was apparent that in the early months of the trial, some of the chemicals may have damaged the clovers, as the yields were lower than, but not significantly different from the controls. This lack of significance may have been due to weed control being obtained as well, the reduced competition permitting growth which masked the effect of the damage. By the six months inspection, most of the phytotoxicity effects on the clovers had diminished.

On the weeds present at spraying, 2,4-DB was as effective as 2,4-D. Thus the superiority of the former lay simply in its mildness towards the clovers. MCPB, on the other hand, though reputedly mild (Ochiltree[7]) towards these clovers, was unable to take advantage of this property because of its poor control of the weed species involved. Thus, although after six months, weeds had died down in all plots, through natural causes, the application of 1 lb. 2,4-DB at the 2-4 trifoliate leaf stage of the clovers, had enabled plots so treated to exceed untreated plots by three or four times the quantity of good quality herbage.

4. ACKNOWLEDGEMENTS:

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5. REFERENCES:

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