APPLICATION OF 2,4-DB to MATURE LUCERNE

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SUMMARY

RESULTS are given of five trials examining the effect of 2,4-DB on established lucerne. Three trials on lucerne free from weed competition indicated that there may be little effect on yields from 2,4-DB applied before active growth commenced.

Application to actively growing lucerne showed that yield reductions of up to 15 per cent were likely where grass or broad-leaf weed competition was not a factor, but that there was little consistent difference between spraying lucerne early (that is, short) or late (long). Yield reductions were increased to 21 per cent where weed grass competition occurred. Lucerne was more tolerant to one out of three formulations examined.

Control of established docks in lucerne was shown to be poor.

There is now considerable published work and abundant practical experience in the field of most aspects of the application and effects of 2,4-DB on seedling lucerne. It can be taken for granted that its use in the field is well established and justified. Unfortunately this is not the case with 2,4-DB on established lucerne and most workers in the industry are apprehensive about its effects on the crop and its efficiency in controlling several weeds.

The main application for this material is probably for the control of annual or biennial thistles, and that hardy perennial the dock (*Rumex* spp.)! The thistle problem mainly occurs in Canterbury and North Otago, but docks are the major problem in coastal Otago lucerne. It is surprising considering the importance of this problem that more has not been written about the use of 2,4-DB on established lucerne, but only one commercial concern has been noted to recommend its product for the control of docks in established lucerne, and even it was cautious enough to state that repeat applications may be necessary.

To find overseas work applicable to South Island conditions we may turn to the United Kingdom, but again there has been little in print. Elliot, Green, and Evans in 1956 reported an initial 22 per cent reduction in lucerne yield where 2 lb of 2,4-DB was applied to grass-infested lucerne. No further differences occurred at this rate in the following year, though we would have expected the grass infestation to have become more serious following this check to the lucerne. No dry matter figures are available, but they were working on a stand of rather low productivity by Invermay standards, and there is clearly a difference between the ecology of a high and a low producing stand. The only other principal reference in the United Kingdom is from a report by Ball and Wilson in 1958, in which it was noted that significant reductions in first cut yields occurred in tolerance trials on six varieties sprayed at rates of 1 to 2 lb acid equivalent at a height of 8 to 13 in., but not when sprayed at a height of 2 to 4 in. There was no difference in varietal susceptibility. Two lucerne-grass mixtures were included in this series, and grass competition was intensified in one of these. One report from the U.S.A. (Bondarenko, 1958) showed that neither the yield nor composition of a 95 per cent lucerne, 5 per cent perennial ryegrass mixture was affected by 2,4-DB applied at several different stages of growth. Similar findings, of little effect on established lucerne, were noted in a report from the United States in 1956.

Five trials completed at Invermay over the past four years provide data which may help to throw some light on this subject.

EXPERIMENTAL

All trials were laid down on N.Z. Certified lucerne, and most of the major details are shown in Table 1. All yield assessments were made by cutting at the hay stage and dry matter samples were taken. Herbage dissection was carried out whenever it was noted that species other than lucerne were contributing to the yield. All yields are in lb dry matter per acre. All applications were made either by a motorised plot sprayer or an Oxford Precision sprayer, with volumes from 15 to 30 gallons per acre. Plot sizes were 5 ft × 30 ft or 5 ft × 40 ft in randomised block layouts.

TABLE 1—SUMMARY OF MAJOR DETAILS OF THE FIVE EXPERIMENTS

Experiments.	1	2	3	4	5
Age of lucerne	5 years	2 years	2 years	1 year	3 years
Weeds present	Only occasional <i>Poa annua</i> daisy	<i>Poa annua</i>	Occasional docks & <i>Poa annua</i>	Docks & some <i>Poa annua</i>	Docks & occasional <i>Poa annua</i>
Growth activity at time of spraying	Good	From dormant to active	Slow in autumn active in spring	Good	Good
Formulation of 2,4-DB used	Potassium salt 40 per cent a.e.	Potassium salt 40 per cent a.e.	Various	Sodium salt 25 per cent a.e.	Potassium salt 40 per cent a.e.

RESULTS

Experiment 1

2,4-DB at 1 lb acid equivalent per acre was applied on (a) 13/9/57 to short lucerne 2 to 5 in. high: and (b) 25/9/57 to long lucerne 8 to 9 in. high. At the first cut (see Table 2) yield depression was approximately 8 per cent and there was no difference in yields due to the two spraying dates, though observations prior to cutting indicated that spraying at the short stage had a more severe effect on foliage. No differences were noted for the remainder of the season. In the following season there was a tendency for yields of treatment (a) to be higher than control, while in treatment (b) a highly significant yield reduction occurred.

The reason for this reduction is not clear.

TABLE 2—Experiment 1: YIELD (LB D.M./ACRE)
1957-58 SEASON

	23/11/57	23/1/58	15/4/58	Total
Control	4,310 a A	4,440 a A	1,810 a A	10,520 a A
(a) 2,4-DB short	3,950 b B	4,240 a A	1,840 a A	10,030 b A
(b) 2,4-DB long	3,960 b B	4,220 a A	1,870 a A	10,040 b A
C. of V.	6.0 per cent	8.0 per cent	6.2 per cent	4.1 per cent

1958-59 SEASON

	4/11/58	30/12/58	4/2/59	Total
Control	2,650 a	3,260 ab A	1,180 a	7,080 ab AB
(a) 2,4-DB short	2,700 a	3,390 a A	1,270 a	7,360 a A
(b) 2,4-DB long	2,530 a	3,070 b A	1,120 a	6,720 b B
C. of V.	5.2 per cent	6.0 per cent	13.8 per cent	4.9 per cent

Experiment 2

This trial was laid down to examine the effect of applications of 1½ lb acid equivalent per acre of 2,4-DB commencing in the late dormant stages

TABLE 3—Experiment 2: YIELD, 1958-59 SEASON

Date sprayed	14/8/58	21/8/58	1/9/58	5/9/58	17/9/58	29/9/58	Control	C. of V.
Estimated growth activity at time of application	V. slow	Slow	Slow	Good	Slow	Good		
Height	2 to 3 in.	2 to 3 in.	2 to 4 in.	3 to 5 in.	3 to 5 in.	4 to 6 in.		
Cut 1 (20/11/58)	3,540 a	3,590 a	3,800 a	3,570 a	3,750 a	2,940 b	3,620 a	5.7 per cent
Cut 2 (31/12/58)	3,190 ab	3,300 a	2,820 b	3,150 ab	3,080 ab	2,910 ab	3,060 ab	6.6 per cent
Total	6,730 a	6,890 a	6,610 a	6,720 a	6,830 a	5,840 b	6,680 a	5.2 per cent

Yield data after this date were unreliable due to drought conditions.

and going through to a period when active growth commenced. The issue was complicated by an infestation of prostrate *Poa annua* in the base of the stand and it was decided to eliminate the effects of the *Poa* by adding 1½ lb of dalapon to each application of 2,4-DB and to spray control plots with 1½ lb of dalapon alone at the same time as the first application of 2,4-DB. It is most important that this inclusion of a small quantity of dalapon be borne in mind when attempting to interpret the results of this trial. Table 3 shows the dates and growth activity of lucerne at each application. We are of the opinion that lucerne really starts its surge of spring growth when soil temperatures reach about 43 to 44 degrees F. Yield data in Table 2 show that little serious effect on yield occurs before this date, and this reduction is highly significant.

Experiment 3

It appeared possible that differences in formulation might have some connection with the problem, and the following formulations were applied at 1.5 lb acid equivalent per acre in autumn (24/4/58, lucerne height 2 to 3 in.) and reapplied in summer (10/12/58, height 12 in.) on regrowth following the first cut of the season:

2,4-DB (sodium) 25 per cent acid equivalent.

2,4-DB (sodium) 40 per cent acid equivalent.

2,4-DB (potassium) 40 per cent acid equivalent.

The trial was relatively weed free and no visual differences in vigour between treatments were noted. Yield data in Table 4 indicate that there were no significant differences caused by the autumn application of 2,4-DB by the time a cut was taken in spring. However, re-application caused a highly significant reduction in the case of the 40 per cent sodium salt for the remainder of the season, while the 25 per cent sodium salt and the 40 per cent potassium salt had recovered somewhat by the end of the season. The season's total reflects this trend with only the

40 per cent sodium salt showing a highly significant reduction, the 40 per cent potassium salt is significantly reduced, while the 25 per cent sodium salt shows no significant reduction compared with control.

TABLE 4—*Experiment 3*: YIELD, 1958–59 SEASON

Treatment	14/11/58	30/12/58	5/2/59	Total
Control	3,300 a A	3,650 a A	2,230 a A	9,180 a A
2,4-DB (sodium) 25 per cent a.e.	3,270 a A	3,210 b AB	2,010 ab AB	8,480 ab AB
2,4-DB (sodium) 40 per cent a.e.	3,000 a A	3,040 b B	1,800 b B	7,840 b B
2,4-DB (pot.) 40 per cent a.e.	3,080 a A	3,100 b AB	1,960 b AB	8,140 b AB
C. of V.	5.9 per cent	6.9 per cent	7.3 per cent	5.3 per cent

Experiment 4

Some indication of the effect of 1.5 lb acid equivalent per acre of 2,4-DB on lucerne where there was also a weed problem was obviously required, and an area was chosen where docks (*Rumex obtusifolius*) per square yard on four fixed lines per plot averaged 6.75. Two times of application were compared:

10/9/57 (Lucerne 5 to 6 in., docks 6 to 8 in. high).

7/10/57 (Lucerne 8 to 12 in., docks 10 to 14 in. high).

Some *Poa annua* was present in the crop, and two treatments were included in the September application which incorporated dalapon at 2 and 3 lb per acre.

Observations prior to the first cut indicated that lucerne growth was checked for about 7 to 10 days. During this period the *Poa annua* got away and the subsequent competition resulted in a greater loss in lucerne vigour where 2,4-DB was used alone.

Initially, the effects of the early spraying on foliage appeared more severe than late spraying. Yield data in Table 5 showed that there was no difference between early and late spraying. Herbage dissection data are also shown (dissection of the second cut was not carried out; observations indicated that the cut was virtually 100 per cent lucerne). The large proportion of other species (17 per cent) shown in the dissection of treatment 4 should be regarded as a sampling error, as observations showed only a small proportion of other species. The outstanding feature of the dissection figures is the low proportion of docks in the sample when one remembers that initial counts indicated an average of nearly seven docks per square yard. Extension of dissection data to obtain actual yields of components is vital when considering weed infested trials. When this is carried out on total seasonal yield in this trial we see that there is little difference between early or late applications of 2,4-DB alone. The highest yield of lucerne was shown by 2,4-DB + 2 lb of dalapon, barely 7 per cent less than control: it could be postulated therefore from this trial that 2,4-DB has little effect on established lucerne, but it must be remembered that some of this high yield may have come about by the release of lucerne from *Poa* competition. The difference in mean number of docks per plot at the end of the season is shown in Table 5c; there were no significant differences.

TABLE 5A—*Experiment 4*: YIELD, 1957–58 SEASON

Treatments	30/11/57	3/2/58	21/3/58	Total
1. 2,4-DB lucerne 5 to 6 in. 10/9/57	4,310 ab A	4,220 b B	2,150 a	10,680 bc AB
2. 2,4-DB + dalapon 2 lb 10/9/57	3,810 b AB	4,550 ab AB	2,180 a	10,530 bc B
3. 2,4-DB + dalapon 3 lb 10/9/57	3,030 c B	4,590 ab AB	2,270 a	9,890 c B
4. 2,4-DB, lucerne 8 to 12 in. 7/10/57	4,440 ab A	4,230 b B	2,250 a	10,920 b AF
5. Control	4,700 a A	4,860 a A	2,240 a	11,800 a A
C. of V.	9.9 per cent	4.9 per cent	4.4 per cent	4.7 per cent

Total
yield

Treatment	Date	30/11/57			21/3/58			Total yield
		Lucerne	Grass	Docks	Other Species	Lucerne	Docks	
1. 2,4-DB, 10/9/57	10/9/57	67	26	2	5	96	4	9,170
2. 2,4-DB+dalaapon 2 lb	10/9/57	94	1	3	2	98	2	10,270
3. 2,4-DB+dalaapon 3 lb	10/9/57	97	1	1	1	99	1	9,770
4. 2,4-DB, 7/10/57	10/9/57	52	30	1	17	94	6	8,650
5. Control	10/9/57	84	12	2	2	97	3	10,980

TABLE 6—Experiment 5: YIELD, 1959-60 SEASON

			Total yield of individual species						
			29/12/59	8/2/60	8/4/60	Total all species	Lucerne only	Dock	Grass
2,4-DB	1½	21/11/59	4,280 b B	2,630 a A	1,670 a A	8,580 b AB	8,210		380
2,4-DB	3	21/11/59	3,930 c BC	2,660 a A	1,550 abc AB	8,140 bc BC	7,740	Trace	400
2,4-DB	1½ + dalapon		3,600 d C	2,610 a A	1,590 ab AB	7,800 c C	7,430	40	330
2,4-DB	1½	1/12/59	4,300 b B	2,610 a A	1,510 bc AB	8,420 b BC	8,160	Trace	260
2,4-DB	3	1/12/59	4,050 bc BC	2,340 b B	1,450 c B	7,840 c BC	7,320		520
Control			4,810 a A	2,780 a A	1,580 abc AB	9,180 a A	8,930		240
C. of V.			5.3 per cent	4.9 per cent	5.3 per cent	4 per cent			

TABLE 5c—DOCK COUNTS IN MEANS PER PLOT

		Initial count 10/9/57	Final count 17/4/58	Reduction
1.	.....	26.7	25.7	—1.0
2.	.....	30.7	31.7	+1.0
3.	.....	29.3	25.7	—3.6
4.	.....	30.0	29.0	—1.0
5.	.....	25.5	25.8	+0.3

Experiment 5

There was some doubt as to whether 1½ lb acid equivalent per acre of 2,4-DB was sufficient for dock control, and accordingly a comparison was made of 1½ and 3 lb rates at two stages. A treatment including dalapon at 2 lb per acre was also included in case grass competition became a factor. The area chosen for the trial contained a scattered infestation of *Poa annua* and a dock population which averaged three per square yard in counts taken on four fixed lines per plot.

Spraying was carried out as follows:

21/11/59. Docks 4 to 9 in. lucerne 7 to 10 in. high 1.5 lb 2,4-DB
 " " " " 3.0 lb 2,4-DB
 " " " " 1.5 lb 2,4-DB + 2 lb dalapon
 1/12/59. Docks 12 to 17 in. lucerne 14 to 17 in. high 1.5 lb 2,4-DB
 " " " " 3.0 lb 2,4-DB

Observations prior to the first cut indicated a slightly more adverse effect on lucerne vigour from late rather than from early spraying. Good knock-down of docks was achieved at all rates and times. Yield dissection data and their extension to give yields of lucerne only are shown in Table 6. It can be seen that 3 lb of 2,4-DB is only slightly more severe on the lucerne than 1½ lb, while late spraying is a little more severe than early. The addition of dalapon in this trial is more noticeable because the depression sustained at the first cut was not recovered in the later stages. Grass competition was not a major factor prior to the first cut, because of a very dry spring, while the effect of dalapon on regrowth was poor, due possibly to the tall screen of lucerne preventing the spray from reaching the grass.

The reduction in dock numbers was poor in relation to the natural mortality that occurred in controls (see Table 6c). There were no significant differences.

TABLE 6c—DOCK COUNTS IN MEANS PER PLOT

		Initial count 16 Nov.	Final count 23 May	Reduction
1.	.....	14.00	6.75	7.25
2.	.....	10.00	6.25	3.75
3.	.....	9.00	6.50	2.50
4.	.....	7.25	5.00	2.25
5.	.....	14.75	8.75	6.00
6.	.....	18.50	11.75	6.75

DISCUSSION

It is difficult to get a clear picture of the effects of 2,4-DB on established lucerne from this work, but in no trial has the 2,4-DB caused any really serious effects. The most severe treatments in trials 1, 2, and 3 caused reductions of 8, 15, and 15 per cent respectively. Only in trials 4 and 5 where grass competition was a factor were reductions of 21 and 18 per cent sustained.

There was little evidence to suggest that any major differences result between applications to short or long lucerne. Similarly there was little difference between the effects of early or late spraying in experiments 4

and 5. Only in experiment 2, where the main reduction occurred with the last application, could any adverse effects be attributed to either, (a) difference in time, is that late as opposed to early sprayings, or (b) differences in height of growth, though as mentioned previously there is also the interaction between soil temperature and transition of lucerne from semi-dormant to active growth to consider.

It is doubtful whether formulation plays an important part, though only the 25 per cent sodium salt showed no significant difference from control at the end of the season.

There were no significant differences between formulations, however, and any recommendations or opinions regarding formulations would necessarily take effects on weeds into account. The 25 per cent sodium salt may also have less effect on weeds, but no data are available on this point. An interesting point to be noted from the above trial was that the effects of an autumn application of 2,4-DB could not be detected in the following spring.

In a damp spring there was a definite indication that the application of 2,4-DB to a stand infested with *Poa annua* may intensify the competition from that grass, with noticeable and measurable effects on lucerne vigour and yield. The addition of small quantities of dalapon to control or check the competition of weed grasses results in a reduction in total yield, but not necessarily in terms of yield of lucerne alone.

The addition of dalapon to 2,4-DB in no way affected the herbicidal properties of dalapon, or conversely of 2,4-DB, in this case on broad-leaved docks. However, the herbicidal action of 2,4-DB on docks can in no way be considered satisfactory on the basis of end-of-season dock counts.

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DISCUSSION

Q.—The speaker spoke of soil temperature of 44 degrees as critical for lucerne growth. At what depth were they taken?

A.—They were taken at 8 in. depth, as it has been found that temperatures at shallower depths, for example, 4 in. vary more; that is there are greater fluctuations.

Q.—Would the speaker repeat his definition of short and long growth of lucerne.

A.—Short and long growth in this trial was short 2 in. to 5 in. and long over 7 in.

Q.—With reference to the problem of docks, have you used esters of 2,4-DB for their control?

A.—No, we have only used esters of 2,4-DB on seedling lucerne.

Q.—What were the conditions of rainfall and soil moisture at and near spraying? With regard to use of esters of butyric, we have used them on mature lucerne and found them rather severe.

A.—This question was examined and there was no significant rainfall soon after spraying in any experiments. Similarly soil conditions were neither excessively wet nor dry.

Q.—Have you had any experience in the control of field daisy with either 2,4-DB or MCPB application?

A.—Have had no specific trials for control of field daisy, but have noted that daisies are not controlled by applications of these materials.

Q.—Have you compared the effects of applications of 2,4-DB and MCPB on mature lucerne?

A.—No.

Q.—Did the dock population consist of both mature and seedling docks?

A.—The docks were mature.

Q.—Would applications of esters of 2,4-DB give better control of docks than application of the sodium and potassium salts of 2,4-DB?

A.—It is doubtful if this would be so.