EFFECT OF TIME OF SPRAYING ON PASTURE PRODUCTION

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SUMMARY

TRIALS have been carried out to determine the effect of time of spraying on clover damage, the rate of recovery of the clovers, and the effect of clover suppression on production. A reduction in yield occurred at any time of the year if clovers were suppressed. The greatest loss in production resulted from spraying MCPA or 2,4-D at the end of autumn or early spring, when clover damage was most extensive and recovery slowest. Though the total loss was not more than 18 per cent., the main reduction took place in early spring, at a time when feed supply is low. In contrast MCPB had little effect on clovers or on production at any time of the year.

INTRODUCTION

Grass production is dependent on the growth of clover in the sward. Yet pastures are sprayed throughout most of the year with weedkillers that cause clover suppression. It is not always realised how much production is lost through damaging clover growth. To illustrate this the differences in production over a year between pasture sprayed with 2,4-D in late spring and one unsprayed are given in Fig. 1.

Fig. 1—Effect of spraying on pasture production. 1. Unsprayed. 2. Sprayed with 2,4-D. 3. Resprayed with 2,4-D. 4. Sprayed with 2,4,5-T.

After a 20 per cent. reduction in clover content the sprayed area was lower yielding than the unsprayed, and where it was resprayed the following

autumn the yield was further reduced. The even smaller yield of a pasture sprayed with 2,4,5-T where only a trace of clover is left is also shown. Just how much difference time of spraying makes to this loss in production associated with clover damage has been investigated in 5 trials carried out during the last 18 months.

DETAILS OF TRIALS

The trials were laid down at the Marton Experimental Area, at the Milson Experimental Area, and at the Invermay Research Station on established pastures with a good clover content, but with few weeds. In this type of sward there was a sufficient density of clover to give reliable comparisons between spraying treatments, but little difference in weed content between sprayed and unsprayed areas or between weedkillers to cause variations in production.

The potassium salt of MCPA, the ethyl ester of 2,4-D, and the sodium salt of MCPB were applied at different times from early spring through to the end of autumn, so that a variety of growth stages of red and white clover were encountered. For example, in Table 1 the times of year at which applications were made and the growth activity of clovers and air temperatures are given of a trial at Marton.

TABLE 1—DETAILS FROM MARTON TRIAL

Time of spraying	Date sprayed	Growth activity of clovers	Temperature (max.) Degrees F.
Early flowering	12/12/55	Very strong	66.0
Summer	16/2/56	At a standstill	80.5
Autumn	3/4/56	At a standstill	73.1
End of autumn	21/5/56	Fairly slow	65.6
Early spring	6/9/56	Fairly strong	57.4
Spring flush	1/10/56	Strong	59.0

Dry conditions prevailed at the summer and autumn times of spraying.

Results of this trial have been quoted in this paper to illustrate differences due to treatments.

Rates of application were 1lb. acid equivalent per acre for MCPA and 2,4-D and 1lb. and 2lb. acid equivalent per acre for MCPB.

Techniques: Pasture production was measured by the "mowing only and clippings returned" technique, and differences in botanical composition were determined by point quadrat analyses and herbage dissection analyses.

RESULTS

MCPA

(a) **Immediate effect of weedkillers on clover is as follows:—**

White clover is severely reduced by MCPA applied in either the spring or autumn, provided the clover is making vigorous growth (see Table 2). The damage is greatest from an end-of-autumn application, when growth is slowing down before a winter-dormant period. During dry weather when growth is at a standstill little if any damage occurs.

TABLE 2—EFFECT OF TIME OF SPRAYING OF MCPA ON WHITE CLOVER

(Percentage cover at time of first cut after spraying)		
Times	Control	MCPA
Early flowering	18	8
Summer (dry)	14	10
Autumn (dry)	15	16
End of autumn	12	2
Early spring	24	11
*Spring flush	22	19

*Rain fell shortly after spraying. Less damage occurred here than in the other trials.

Red clover is tolerant of MCPA except at the start of its new season's growth in spring, at which time it is slightly reduced (see Table 3).

TABLE 3—EFFECT OF TIME OF SPRAYING OF MCPA ON
RED CLOVER

(Percentage cover at time of first cut after spraying)		
Times of spraying	Control	MCPA
Early flowering	20	15
Summer (dry)	20	26
Autumn (dry)	23	24
End of autumn	21	19
Early spring	37	31
*Spring flush	37	26

*Rain fell shortly after spraying.

(b) **Recovery of clovers was as follows:—**

Sprayed in spring **white clover** recovers by the following autumn, provided there is adequate rainfall. If, however, dry conditions prevail after spraying, recovery may take a year or more. Sprayed during autumn white clover recovers from mid-spring onwards; that is, within 9 months. It is slowest to recover from late autumn and early spring sprayings, and the clover is suppressed for a year or more.

Red clover soon recovers from any minor setback it may receive from MCPA in spring.

In a mixed sward of red and white clovers spraying with MCPA leads to red clover dominance, wherever the white clover is suppressed (see Table 4).

TABLE 4—RECOVERY OF CLOVERS FROM SPRAYING WITH MCPA

(Percentage cover of clovers at May 1957)		
Times of spraying	White clover	Red clover
Control	38	43
Early flowering	31	57
Summer	36	53
Autumn	38	45
End of autumn	29	50
Early spring	24	51
*Spring flush	39	48

*Rain fell shortly after spraying.

Under mowing the sward has not regained its original ratio of red to white clover, but this could be altered under hard grazing.

(c) **Effect on Production was as follows:—**

The immediate effect on production was a reduction in yield for the first cut after spraying. The amount of reduction varied according to the extent of the clover damage, it being greatest for the end of autumn application on white clover, at which time the damage was severest.

After the first cut following an application during the spring flush, production was maintained due to an immediate increase of the proportion of grass in the sward. Later, during summer, if conditions are dry, yields may be slightly lower, but by the following autumn the yield is improved due to the increased grass growth. However, this improvement is not necessarily permanent, as lower yields may occur in early spring due to the lack of clover. If white clover makes a good recovery over summer and early autumn, early spring yields are not reduced.

Grass tends to increase after an early spring application, but loss in production is greater than for spring flush (and it also occurs at a time of year production is low) due to a slower recovery of white clover and to the fact that grass is not growing as rapidly as during the spring flush and takes longer to increase in the sward. Late spring or early flowering applications result in a reduced yield during summer, which may be critical during dry weather. White clover recovers quickly from any damage in summer during a wet season, and under dry conditions little if any clover damage occurs. Applied in autumn, grass growth is encouraged with the suppression of the clover and little production is lost, but as for the spring sprayings the yield is likely to be lower in early spring. Yields are much lower in early spring (36 per cent. reduction) after an end-of-autumn application, and continue to be reduced until clover recovers later in summer and early autumn.

Red clover: Time of spraying does not affect production, as clover reduction is so minor. In a mixed sward of red and white clover, MCPA does not cause such a reduction in yield due to white clover suppression, as red clover soon compensates for the lack of white clover growth.

2,4-D

(a) **Immediate effect of weedkiller on clovers is as follows:—**

White clover when making strong growth or when it is slowing down after a period of active growth receives severe damage from 2,4-D. Least damage occurs early in the season at the start of its first spring growth or during dry conditions in summer or in autumn (see Table 5).

TABLE 5—EFFECT OF TIME OF SPRAYING OF 2,4-D ON WHITE CLOVER

(Percentage cover at time of first cut after spraying)		
Times of spraying	Control	2,4-D
Early flowering	18	8
Summer (dry)	14	22
Autumn (dry)	15	12
End of autumn	12	5
Early spring	24	20
*Spring flush	22	17

*Rain fell shortly after spraying.

Red clover is very susceptible to 2,4-D throughout the year. However, the damage does vary slightly with the time of application. It is greatest at the end of autumn and least in early spring before red clover is actively growing (see Table 6).

TABLE 6—EFFECT OF TIME OF SPRAYING OF 2,4-D ON RED CLOVER

(Percentage cover at time of first cut after spraying)		
Times of spraying	Control	2,4-D
Early flowering	20	3
Summer	20	6
Autumn	23	2
End of autumn	21	tr.
Early spring	37	21
*Spring flush	37	5

*Rain fell shortly after spraying

--- ABOVE THIS LINE YIELDS SIGNIFICANTLY HIGHER THAN CONTROL
 --- BELOW THIS LINE YIELDS SIGNIFICANTLY LOWER THAN CONTROL

Fig. 2.
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(b) **Recovery of clovers was as follows:—**

White clover recovers from damage received in spring before the following autumn provided weather conditions are good, and recovers from autumn sprayings by the middle of the following spring. Under dry conditions recovery is slower. It appears that white clover recovers more quickly from damage from 2,4-D applied during spring than it does from MCPA.

Red clover is slow to recover from the extensive damage it receives from 2,4-D. Under favourable growing conditions it becomes a major species in the sward again a year after spraying. In a mixed sward spraying with 2,4-D encourages white clover dominance (see Table 7).

TABLE 7—RECOVERY OF CLOVERS FROM SPRAYING 2,4-D

(Percentage cover of clovers at May 1957)		
Times of spraying	White clover	Red clover
Control	38	43
Early flowering	58	25
Summer	53	22
Autumn	45	19
End of autumn	48	9
Early spring	48	21
*Spring flush	44	16

*Rain fell shortly after spraying.

(c) **Effect on production was as follows:—**

When 2,4-D is applied to **white clover** during the spring flush there is an immediate reduction in yield followed by slightly lower yields during summer. An increase in yield does not always follow in the autumn, as the proportion of grass does not apparently increase as much as it does after MCPA treatment. It appears that MCPA suppresses white clover for a longer time and thus encourages more grass growth.

At other times of the year 2,4-D causes similar differences in yield to MCPA on white clover, with the exception that slightly less reduction occurs in early spring, as clover damage was less severe.

Loss in yield is always substantial for 2,4-D on **red clover** at any time of the year. As this clover is usually in association with white clover, the greatest reduction in yield occurs at the end of autumn, when white clover is also much reduced.

COMPARISON OF MCPA AND 2,4-D ON A MIXED SWARD OF RED AND WHITE CLOVERS

Results from the Marton trial (see Tables 8 and 9) show that the total loss of production is much less with MCPA than with 2,4-D on a mixed sward. This is due to the severe effect of 2,4-D on red clover, and to the fact that red clover being tolerant of MCPA quickly compensates for any lack of growth of white clover on this treatment. As the botanical composition has been changed according to the weedkiller used, the yields at different cuts vary due to differences in seasonal production between red and white clovers. The main differences are shown in the yields of grass and red and white clovers for the first cut after spraying and the most recent cut for flowering, end of autumn, and early spring times of application. In addition the second to last cut is shown for early spring (see Fig. 2).

TABLE 8
(Total yield of control = 10,538)

	Summer	Autumn	Winter	Spring	Summer	Autumn	Difference from control over period
Early flowering	-	.	.	.	...	.	-178
Summer		.	.	.	...	.	65
Autumn		-	.	.	...	.	234
End of autumn			-	.	...	.	-532
Early spring				...	...	†	-360
Spring flush				...	...	†	188

. = Yield does not differ significantly from control.

† = Yield is significantly **higher** than control.

- = Yield is significantly **lower** than control.

TABLE 9
(Total yield of control = 10,538)

	Summer	Autumn	Winter	Spring	Summer	Autumn	Difference from control over period
Early flowering	-	.	.	...	...†	†	-1061
Summer		.	.	...	...*	.	-264
Autumn		-	.	...	...	†	-675
End of autumn			-	...	...	†	-1875
Early spring				...	...	†	-1000
Spring flush				...	...	†	-644

. = Yield does not differ significantly from control.

† = Yield is significantly *higher* than control.

- = Yield is significantly *lower* than control.

* = almost †

FLOWERING (See Fig. 2)

White clover made a good recovery on the MCPA treatment, but while it was suppressed straight after spraying, red clover slightly increased. By May 1957 the proportion of grass to clover is similar to the control at the last cut and no difference in yield occurs. On the 2,4-D treatment grass made a slight increase, while both clovers were severely reduced. Red clover then made a slower recovery than white clover, which had the chance to become more dominant in the sward. The greater proportion of white clover in the sward mainly accounts for the increased yield at the last cut.

END OF AUTUMN

Recovery of white clover has not been complete on MCPA due to competition from red clover and accounts for the reduced yield. 2,4-D is yielding more at the last cut due to the big increase in white clover and slight increase in grass.

EARLY SPRING

Red clover gained dominance on the MCPA treatment and accounts for the improved yield at the second to last cut. By the last cut white clover is making more rapid growth and this treatment is lower yielding due to a smaller proportion of white clover than on the control. 2,4-D

with white clover as the dominant has an improved yield over control.

MCPB

(a) Immediate Effect of Weedkiller on Clover

Little if any reduction in clover content (either for red or for white clover) occurs with MCPB, and time of spraying makes little difference. Applied at 1lb. acid equivalent per acre it caused a slight retardation in growth. With 2lb. acid equivalent per acre, clovers making strong growth receive a 5 per cent. reduction in cover.

(b) Recovery of Clovers

After being retarded in growth for approximately a month clovers then grow more rapidly if growing conditions are suitable. This was particularly noticeable for a late spring application. Two months after spraying clovers were much leafier and denser on the MCPB treated area than on the unsprayed.

(c) Effect on Production

With no major change in the proportion of grass to clover there is no significant effect on production at any time with 1lb., but at the 2lb. rate the yield of the first cut after spraying is reduced as damage was greater.

TOTAL YIELD OF CONTROL = 7073 LB. PER ACRE DRY MATTER.

DIFFERENCE FROM CONTROL		
MCPA (1LB. A.E.)	- . . . +	- 226
MCPB (2LB. A.E.)	-	- 143

Fig. 3.

(d) Comparison of MCPB and MCPA

Damage from MCPB is negligible compared with that from MCPA. For example, MCPA causes a 30 per cent. to 50 per cent. reduction in clover content applied during the spring flush, whereas the reduction from MCPB is in the order of 5 per cent. The main differences between the two are shown for the spring flush time of spraying on a white clover dominant sward in Fig. 3. Grass has come in on the MCPA treatment and in autumn is responsible for an improved yield.

CONCLUSION

1. Time of spraying of MCPA and 2,4-D affects pasture production because of the differences in the tolerance of red and white clovers to these chemicals throughout the year. Damage from MCPB is so slight that there is little or no reduction in yield at any time of the year.
2. Clover damage varies with the growth activity of clovers. When clovers are making strong growth or slowing down after a period of active growth MCPA and 2,4-D cause severe damage. Under dormant conditions in dry weather damage is slight except for 2,4-D on red clover.
3. The most damaging times of application for MCPA on white clover are at the end of autumn and in early spring; for 2,4-D spraying at the end of autumn gives the most damage. Time of application of MCPA makes little difference to red clover as it is very tolerant; for 2,4-D end of autumn is the most damaging time.
4. Clovers mainly recover from damage during their actively growing period in late spring and summer, when temperatures favour their growth more than grass. Some recovery also takes place during the autumn flush. Recovery is slowest from end-of-autumn and early spring applications, as the longest time elapses between spraying and the period of active growth.
5. The immediate effect of clover damage on production is a loss in yield, which varies according to the extent of the clover damage. The subsequent effect of clover damage on production is influenced by the time taken for clovers to recover, the growth activity of the other constituents of the sward, and the weather conditions following spraying. Following a substantial reduction (20 per cent. to 30 per cent.) of a clover, the pasture species making vigorous growth at the time of spraying usually becomes more prominent in the sward; for example, grass increases after spraying during spring or autumn flush.
6. The greatest loss in production occurs with end-of-autumn applications for both MCPA and 2,4-D. Reduced yields mainly occur during late winter and early spring, when feed is in short supply. Loss of production is also substantial for an early spring application of MCPA to a white clover dominant sward, and yields are lowest in early spring.
7. The least reduction in yield occurs when clovers are sprayed under dormant conditions in dry weather, but only a few very susceptible weeds could be killed at this time. Further work has to be done on spraying at winter dormancy.
8. MCPA applied to a pasture containing red and white clover encourages red clover dominance when white clover is damaged; 2,4-D encourages the dominance of white clover.
9. All clover damage is of less consequence during a wet season. Under dry conditions clover may take a year or more to recover instead of 6 months.
10. Any spraying with MCPA or 2,4-D should preferably be carried out from mid-spring onward until mid-autumn. The new growth of clovers

after winter dormancy receives a severe setback from MCPA, but it is indicated that 2,4-D causes less damage at this stage of growth.

As MCPA and 2,4-D cause considerable clover damage, which in turn reduces production, MCPB (or 2,4-DB) should be used whenever weeds are susceptible to these chemicals, particularly if the clover content of the sward is at a critical level or if spraying is carried out at the end of autumn or in early spring.

DISCUSSION

Q.—Heavy blanket applications of hormones have sometimes been so severe on pastures as to affect their production for lengthy periods. Would you advocate that in such cases clover should be oversown after spraying to guard against any undue loss of clover in the sward?

A.—Where there is any doubt about clover survival clovers should certainly be sown, because without them a rapid deterioration of the pasture will occur. However, I would again stress the importance of using the right formulations at the right time. Serious weakening or the elimination of clovers in the sward should not be the price we have to pay for weed control.

Q.—Can it be said that there is a significant temporary increase in grass production from a pasture, when associated with damage?

A.—This will depend largely on the time of application. Significant temporary increases in production have been measured. However, there would probably be no increase following an early spring application because of the normally low nitrogen status of the soil at the time of the year due to previous leaching.

Q.—What would be the effect of a blanket application of 2,4,5-T to a pasture?

A.—At 2lb. acid equivalent per acre most of the clover would be killed.