TOLERANCE OF PASTURE SPECIES TO DALAPON AND AMITROL

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SUMMARY

RYEGRASS has shown considerable tolerance to dalapon at rates up to 5 lb. Clover suffered a fairly severe initial check, and yields over the season were reduced. Cocksfoot is less tolerant than ryegrass. Five pound of dalapon has a severe effect on Yorkshire fog and other weed grasses. Browntop has proved susceptible to dalapon, but chewings fescue is more resistant. Amitrol increases the effect of dalapon and hastens the initial "knock down". Residual effects have been noted on clover seedlings from both dalapon and amitrol applied to pasture.

Since the advent of the grass-killing chemical dalapon and the systemic herbicide amitrol, an entirely new concept of pasture establishment and improvement has been introduced. This is the technique of destroying an existing poor sward by the application of sufficient dalapon, with or without amitrol, to destroy or seriously weaken the most resistant species and the sowing of an entirely new and more productive pasture. Where the field contains a reasonable proportion of good grasses an amount calculated to purge the pasture of the undesirable species with a minimum of damage to the good grasses and clover may be applied. The latter treatment can be followed by oversowing to thicken up the pasture.

If the new technique is to be widely accepted, it is of fundamental importance to know within fairly narrow limits the tolerance of the main species to be encountered and to know to what extent the chemicals exercise an adverse residual effect on the germination and growth of the sown grasses and clovers. To answer these questions trials have been conducted in various parts of the country. In this paper I intend to deal with those carried out at Rukuhia Soil Research Station.

TRIAL A—DALAPON ON A MIXED PASTURE

This was laid down on a pasture containing 25 per cent. of ryegrass (*Lolium perenne*), 20 per cent. of cocksfoot (*Dactylis glomerata*), 35 per cent. of other grasses, mainly Yorkshire fog (*Holcus lanatus*) with some sweet vernal (*Anthoxanthum odoratum*), *Poa annua*, goose grass (*Bromus mollis*), a little browntop (*Agrostis tenuis*), and chewings fescue (*Festuca rubra* var. *fallax*), 15 per cent. of clover, mainly white (*Trifolium repens*), and 5 per cent. of weeds.

Treatments were dalapon 1½, 2½, and 5 lb. per acre in 21 gallons per acre of water applied:

- (1) in early September (6/9/57) at the commencement of spring growth.
- (2) in mid November (15/11/57).

Data were obtained by mowing, weighing, dry matter determination, and herbage dissection. Treatments were replicated 4 times. The plots were mowed 10 times during the course of the trial, but to reduce the data to manageable proportions the results have been condensed into 4 production periods for the September spraying (see Table 1): spring (6/9/57—23/10/57), early summer (23/10/57—8/1/58), summer (8/1/58—3/3/58), and autumn (3/3/58—21/4/58) and 3 production periods for November applications (see Table 2): early summer (15/11/57—8/1/58), summer (8/1/58—3/3/58), and autumn (3/3/58—21/4/58).

TABLE 1—SEPTEMBER APPLICATION OF DALAPON

Relative dry matter production (Control = 100)

Species	Dalapon lb./ac.	Spring	Early summer	Summer	Autumn	Total production
Ryegrass	1½	72	126	151	126	101
	2½	70	170	254	161	123
	5	32	165	246	141	99
Cocksfoot	1½	101	102	107	65	92
	2½	77	120	111	101	104
	5	20	47	57	43	40
Other grasses	1½	79	99	107	104	93
	2½	34	46	61	51	43
	5	21	15	17	26	18
Clovers	1½	82	93	118	103	93
	2½	44	86	104	71	73
	5	24	85	111	85	72

TABLE 2—NOVEMBER APPLICATION OF DALAPON

Relative dry matter production (Control = 100)

Species	Dalapon lb./ac.	Early summer	Summer	Autumn	Total production
Ryegrass	1½	148	151	98	131
	2½	85	132	92	92
	5	40	95	73	57
Cocksfoot	1½	75	93	48	68
	2½	75	77	49	64
	5	26	18	35	28
Other grasses	1½	63	59	72	65
	2½	32	16	32	30
	5	23	24	17	22
Clover	1½	37	39	92	88
	2½	93	115	80	72
	5	38	104	116	63

September Application

(1) **Ryegrass:** The first period showed a reduction in yield at all rates, ranging from around 30 per cent. for 1½ and 2½ lb. treatments to a severe reduction of over 70 per cent with the application of 5 lb. The depressing effect, however, was comparatively short lived; by the beginning of November all treatments had fully recovered and were producing at a greatly increased rate compared with control. It is interesting to note that the more severe the treatment and the lower the level in the first period the greater the proportional gain in the second period. This is presumably due to the lack of competition:

(a) from weed grasses which were greatly reduced by 2½ lb. and almost eliminated by 5 lb.

(b) from clovers which suffered a severe check.

Production continued throughout summer and into autumn at substantially increased rates so that total yields from all treated plots were as good as or better than control.

(2) **Cocksfoot:** 1½ lb. caused no change in the level of cocksfoot production. 2½ lb. brought about a slight initial reduction, but growth thereafter continued on a plane generally above control.

The effect of 5 lb. was drastic. Reduced by 80 per cent. in the first period, production in subsequent periods dragged along at about 50 per cent. of normal. Total production was only 40 per cent. of control.

(3) **Other Grasses:** Again the effect of 1½ lb. was slight, resulting in no real change in the proportion of these grasses. 2½ lb. resulted in a severe initial reduction, followed by partial recovery to 50 to 60 per cent. of control. The effect achieved by 5 lb. was much more spectacular. In the first period weed grasses were lowered by 80 per cent. and production over the season was only 18 per cent. of control.

The most severely affected species appeared to be Yorkshire fog, followed in susceptibility by *Poa annua*, browntop, and goose grass.

(4) **Clover:** When dalapon first appeared it was said to have little effect on clover. Subsequent experience has not supported this claim.

In this trial even at 1½ lb. there was a noticeable check to growth, amounting over the spring period to 20 per cent. Yield thereafter was normal.

Applications of 2½ and 5 lb. saw a reduction over the period from spraying to the end of October of 55 per cent. and 75 per cent. respectively. Some reduction persisted until well into the early summer period when the normal decline in ryegrass growth allowed clover to recover. Following normal clover production through summer, there was a decline in autumn. This is assumed to be due to the increased ryegrass fraction offering greater competition. Both 2½ and 5 lb. treatments finished the season with a total yield of a little over 70 per cent. of control.

November Applications

Treatments applied at this time differed from those in September in the following ways:

(1) Ryegrass, except at the 1½ lb. rate, was more severely affected and took longer to recover. At the time of the last cut (21/4/58) ryegrass on the 5 lb. plots had not fully recovered; although the proportion of ryegrass had increased compared with control, the actual yield was lower.

(2) The effect on cocksfoot was more severe, particularly at the 2½ lb. rate. Yield in autumn from all treated plots was poor compared with control, probably due to a competition factor combined with dalapon damage.

(3) Clover was less severely affected, particularly by 2½ and 5 lb. and showed quicker recovery, presumably as a result of less competition from ryegrass. However, as with September treatments, total yield was below control.

Weed grasses showed reductions fairly similar to those obtained in September.

TRIAL B—SEASONAL TOLERANCE OF RYEGRASS

In Trial A differences in the tolerance of ryegrass treated in September and November have been noted. To determine the full range of this

seasonal difference an observational trial with dalapon at $2\frac{1}{2}$, 5, and 10 lb. per acre was laid down on a ryegrass/white clover pasture. Treatments were applied in early September, November, December and February, late March, and early June.

Dalapon at 10 lb. destroyed practically all of the ryegrass at all times of application except February. Treatment at this time, applied to a very dry sward, caused only a slight effect which did not appear until after rain had produced fresh growth.

Dalapon at 5 lb. applied in September and November produced results fairly similar to but slightly more severe than those reported in Trial A. Reduction in growth was greater and time taken to recover several weeks longer. Five pounds in December was much more severe than the same quantity applied earlier. This is in line with effects noted in Trial A and supports the conclusion that ryegrass is more susceptible to early summer treatments than those applied earlier at a time of more active growth. Five pounds in February had no effect whatsoever, while this quantity applied in late March was more severe than in spring.

Two and a half pounds caused only moderate damage at all times except in February when it had no effect.

It is too early to evaluate the effect of June treatments.

TRIALS C AND D—DALAPON PLUS AMITROL

An attempt was made to determine the value of amitrol as an additive to dalapon in two trials laid down in October 1957.

Trial C was on a pure stand of ryegrass sown in rows the previous autumn and trial D on a chewings fescue/browntop sward which had only had very lax grazing for a considerable time, resulting in rough fescue-dominant growth. Dalapon at rates of 0, $1\frac{1}{4}$, $2\frac{1}{2}$, 5, and 10 lb. per acre was combined with amitrol at 0, $\frac{1}{4}$, $\frac{1}{2}$, 1, and 2 lb. per acre. Treatments were applied in water at 50 gallons per acre.

(1) **Ryegrass:** Since dalapon alone at 10 lb. killed practically all of the ryegrass, there was no advantage to be derived from the addition of amitrol. Amitrol at 2 lb. added to $2\frac{1}{2}$ and 5 lb. of dalapon more than doubled the degree of toxicity. Amitrol at 1 lb. and $\frac{1}{2}$ lb. gave proportionate increases, but the increase in effect resulting from the addition of $\frac{1}{4}$ lb. was negligible. Dalapon at $1\frac{1}{4}$ lb. with or without amitrol at up to 2 lb. had only a slight effect, except for much more severe initial bleaching and burning at the higher rates of amitrol.

(2) **Browntop:** Browntop proved to be particularly susceptible to dalapon. At quantities as low as $2\frac{1}{2}$ lb. practically all of this species was destroyed, although there was some regrowth in autumn.

The addition of amitrol to dalapon for the destruction of browntop is not warranted, as dalapon alone at rates between $2\frac{1}{2}$ and 5 lb. will give adequate control.

(3) **Chewings fescue:** This grass showed itself to be a much tougher proposition. Dalapon at 10 lb. gave a severe initial suppression, but about 10 per cent of the plants survived, and in autumn succeeded in reinfesting a considerable part of the plots. The effect of 10 lb. of dalapon combined with 2 lb. of amitrol was at first better than that of dalapon alone. Only 2 or 3 per cent of fescue survived, but this later caused a fair degree of reinfestation. Although 5 lb. of dalapon plus 2 lb. of amitrol appeared good in the early stages, there was much recovery later.

Quantities of dalapon less than 5 lb. with or without amitrol had little effect except that of severe initial burning and bleaching where 1 or 2 lb. of amitrol was added.

It would appear that at least 10 lb. of dalapon is required to obtain reasonable control of chewings fescue. The addition of 2 lb. of amitrol will probably improve the effect, but that has not been fully proved in this trial. Trials elsewhere indicate 10 lb. of dalapon plus 2 lb. of amitrol to be giving fairly good results.

RESIDUAL EFFECTS OF DALAPON AND AMITROL

Five trials will be discussed. One has been concluded, but the other four are still proceeding and only interim results can be given.

The first trial was superimposed on Trial C, previously discussed, where dalapon and amitrol were applied to ryegrass growing in rows. Ryegrass and white clover seeds were drilled into the bare ground between the rows at intervals of 1, 2, and 4 weeks after spraying.

The only sowing to show residual effects was that made a week after spraying, where the following effects were noted:

- (1) Dalapon was the only material to cause damage to seedlings. Amitrol at up to 2 lb. had no effect nor, combined with dalapon, did it increase the effect of that material.
- (2) Dalapon did not affect germination. It was not until about a week after emergence that damage was observed.
- (3) Ryegrass seedlings were almost eliminated by 10 lb. of dalapon and numbers were reduced by 80 per cent. by 5 lb., 2½ lb. caused a 25 per cent. reduction and 1½ lb. a 10 per cent. reduction.
- (4) Clover was eliminated by 5 and 10 lb. Reductions in numbers by 2½ and 1½ lb. were 80 per cent. and 50 per cent. respectively.

Rainfall for the period was .4 in. in the first week after spraying and .3 in. in the second. Presumably this was enough to move the dalapon down to the layer in which the seedlings were rooted and so cause damage. A further 1.1 in. which fell 16 days after spraying probably leached the chemical to a lower level, before the second sowing had germinated.

A further four large trials were laid down in autumn of this year. Two were on an area of poor pasture, where dalapon at 5 lb. and amitrol at 2 lb. were applied in separate trials. In the other two trials the treatments were applied to bare ground. Ryegrass and white clover were sown separately on each trial at three times; on the day of spraying, 7 days after, and 14 days after. Seed was both broadcast and drilled on the pasture trials and broadcast only on those on bare ground.

Results obtained so far on the pasture trials indicate that ryegrass and clover drilled and ryegrass broadcast were not affected by dalapon or amitrol. Broadcast clovers were severely affected by both materials even when sown 14 days after spraying. Germination was not reduced, but subsequent growth was poor and many will die.

Ryegrass broadcast into bare ground to which dalapon had been applied was severely affected. Most of the plants died soon after emergence. More seedlings survived on the plots sown 14 days after spraying than at earlier sowings, but the difference was not great.

Effects on clover were similar to those noted on the pasture trial, but damage was more severe. Amitrol on bare ground reduced the numbers of broadcast ryegrass, but not nearly so severely as dalapon. Sowings made 14 days after spraying were noticeably less affected than those made on the day of spraying.

Effects on clover appear to be at least as severe as those of dalapon.

Differences in effect between this series of trials and that conducted in spring are probably due to differences in rainfall. At the time of the autumn

trials there was little or no rain over the period from spraying to emergence of the seedlings.

CONCLUSIONS

(1) In a poor pasture containing a number of species the task of evaluating the tolerance of individuals is complicated by the effects of competition. Two factors must constantly be allowed for:

- (a) the suppression of the less tolerant species aids the recovery of the more resistant.
- (b) the recovery of the tolerant species further depresses the susceptible ones.

(2) The effect on the more tolerant species is less severe at the time when they are making their most active growth; thus ryegrass was less depressed and recovered more quickly from treatment in early spring, whereas clover was less affected when treated in early summer.

(3) Dalapon has its most severe effect on ryegrass when applied in December. It has very little effect when applied to a desiccated summer pasture. Autumn treatments are more severe than those applied in spring.

(4) Cocksfoot is much less tolerant to 5 lb. of dalapon than ryegrass and suffers a semi-permanent reduction when treated in either September or November. It is fairly tolerant to 2½ lb., more so in September than November.

(5) Dalapon causes a severe initial suppression of clover, particularly at 5 lb., but recovery is rapid, especially when treated in early summer.

(6) There is no doubt that amitrol increases the immediate effect of dalapon, but it is doubtful whether the ultimate effect is much greater than if dalapon alone were applied at a rate equal to the combined weight of dalapon and amitrol.

(7) The addition of amitrol produces a much quicker "knock down" of grasses than dalapon alone. This should be an advantage where it is desired to oversow soon after treatment.

(8) Ryegrass and clover drilled into a sward treated with 5 lb. of dalapon and 2 lb. of amitrol suffer no residual effects.

(9) Where a treated sward is thin, with much bare ground, it is likely that residual effects will be encountered in ryegrass and clover seedlings sown soon after treatment.

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DISCUSSION

Q.—Can the speaker comment on why dalapon was more severe in December than in the other months? Poor results are obtained on grasses treated in the seed head stage in Canterbury.

A.—In each of two trials the results showed that the December treatments were more severe than earlier treatments. The only suggestion is that the plants sprayed at the commencement of summer cannot recover as well as those treated when conditions are more favourable for growth.

Q.—What was the stage of growth of the ryegrass?

A.—The ryegrass was still growing actively, although it had flowered and was going to seed.

Q.—What was the difference between the total production of the treated plots and the controls?

A.—The total production of ryegrass treated with 1½ lb. was similar to that of the control, with 2½ lb. it was more than the control, and with 5 lb. it was almost equal to the control.

Q.—What is the effect of spraying ryegrass in autumn when closing up paddocks?

A.—Late autumn applications are severe on all grass.

Q.—Were there any observable changes in the sward following the dalapon treatments? Did the pasture open up and enable weeds to come in?

A.—Dalapon at 2½ lb. did not bare the ground much, because clover filled any spaces left by grasses which had been killed. With the 5 lb. treatment, there was some flat weed infestation, but there was no increase of grassy weeds such as *Poa annua*. Clover subsequently spread over the ground.

Q.—The paper stated that there was no advantage in using dalapon-amitrol mixture instead of dalapon alone for killing browntop. In weedy pastures is it not advantageous to add amitrol to obtain a better kill of weeds?

A.—Yes, if there are many weeds present. The trials were to study the effects of the treatments on the grass species, and there were very few weeds present.