PARAQUAT ON LUCERNE

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Summary

Paraquat, at rates of up to 8 oz active ingredient per acre, were applied to a weedy lucerne (*Medicago sativa*) stand. *Poa annua* and two species of storksbill (*Erodium* spp.) proved susceptible but tolerance increased as the plants grew older. Dandelion (*Taraxacum officinale*), beaked hawkbit (*Crepis taraxacifolia*) and browntop (*Agrostis tenuis*) recovered after treatment.

In three yield trials (one on a young crop) mouse-eared chickweed (*Cerastium glomeratum*), chickweed (*Stellaria media*), storksbill (*Erodium moschatum*), speedwell (*Veronica persica*) and *Poa annua* were well controlled as young plants but only partially controlled at rates up to 8 oz per acre when mature.

Application of paraquat 1, 2 and 4 oz per acre to a very weedy stand of young lucerne, gave good control of chickweed and speedwell at the two higher rates. Tolerance of young lucerne to paraquat needs further checking, but seems quite satisfactory for mature lucerne treated during dormancy.

INTRODUCTION

WEEDS IN LUCERNE (*Medicago sativa*) have been a long-standing problem, and in recent years some progress has been made towards their control. TCA and more recently dichloropropionic acid have given control of grass weeds, while 2,4-DB has taken care of many broad-leaved weeds.

Young lucerne stands, however, are sometimes submerged by chickweed (*Stellaria media*) and occasionally by storksbill (*Erodium moschatum*) while storksbill and mouse-eared chickweed (*Cerastium glomeratum*) very commonly infest mature stands. Though these are broad-leaved species all three are resistant to 2,4-DB.

Weed competition in establishing stands is, naturally, to be avoided if possible, but the presence of storksbill in mature stands has been viewed largely with indifference, if not a little favour. Certainly, storksbill often interferes with the drying of the season's first hay cut and renders the hay less palatable; but on dry country it provides useful grazing during winter when other species make little growth.

Over the past year or two, however, attention has been drawn more and more to the damage to sheep and lamb pelts through perforation by weed seeds. Even carcasses are rejected because of injury from penetration by seeds and Loughnan (1964) has shown that storksbill seed is among those causing damage.

TRIALS WITH PARAQUAT

Of the four trials conducted with paraquat, three were on mature lucerne and one on an establishing stand. Trial 1 was a time-of-

application one on a run-out stand where weed control was the prime consideration. Trials 2 and 3, while involving more weed control than expected, were sited on very productive lucerne stands where crop tolerance took precedence over weed control. The young stand where Trial 4 was sited was very heavily infested with annual weeds when treated.

Details of individual trials are as follows, rates of application in all cases being expressed in terms of active ingredient. Where production figures are given, they represent pounds of dry matter per acre.

In Trial 1 a precision plot sprayer was used to apply paraquat at the rates 2, 3, 4, 6 and 8 oz per acre in 20 gal of water, under conditions set out in Table 1. There were three replications.

TABLE 1: CONDITIONS FOR TRIAL 1

	<i>Crop</i>	<i>Soil</i>	<i>Temperature</i>	<i>Light</i>	<i>Humidity</i>
May	2 in. tall Mod.-leafy	Moist	Mild	Overcast	Moderate
June	3 in. tall Fairly leafy.	Moist	Cool	Hazy sun	Mod. to high
July	As for June	Wet	Cool	Bright cloud	Mod. to high
Aug.	3 in. tall Less leafy after grazing.	Mod.-wet	Cold	Hazy sun	Fairly high

The only rain to fall within two days after spraying was when rain began 3½ hours after the June treatments were completed. Overnight 1.32 in. fell but did not appear to affect the results.

Weed Species

The main weed was storksbill (mostly *Erodium moschatum* with some *E. cicutarium*), most plants of which were 2 in. to 3 in. in diameter in May. In June, July and August most were 3 in. to 4 in. in diameter with some plants up to 6 in. across.

Also present were dandelion (*Taraxacum officinale*), beaked hawkbit (*Crepis taraxacifolia*), *Poa annua*, white clover (*Trifolium repens*) and patches of browntop (*Agrostis tenuis*).

Results

The most readily-killed species were storksbill and *Poa annua* and the rate of paraquat needed for a complete kill is set out in Table 2.

TABLE 2: RATES OF PARAQUAT (OZ/ACRE) FOR COMPLETE KILL OF STORKSBILL AND *POA ANNUA*

				<i>May</i>	<i>June</i>	<i>July</i>	<i>August</i>
Storksbill				2	4	6	8
<i>Poa annua</i>				2 to 3	3	3	4

The other species, although severely damaged, recovered from even the 8 oz rate to fill the spaces left by the susceptible weeds. There was no regeneration of storksbill during the winter, but a good deal of shepherd's purse (*Capsella bursa-pastoris*) appeared in bare spots.

When studying the rates of application needed for control of individual weed species, it must be borne in mind that crop competition contributed nothing to the over-all result.

TOLERANCE TRIALS

Trial 2 was laid down on August 9, 1963, when the weather was cold with a hazy sun and fairly high humidity. The soil was wet. The crop was leafy and 2 in. to 3 in. tall, but spring growth had not yet begun. The main weed was mouse-eared chickweed with some storksbill (both species) and *Poa annua*. The chickweed was mainly young plants ½ in. tall and 1 in. diameter, the storksbill was 2 in. to 3 in. in diameter while *Poa annua* was 2 in. tall.

Yields from the first cut, taken on October 21, are set out in Table 3.

TABLE 3: YIELDS FROM FIRST CUT OF TRIAL 2, OCTOBER 21

Treatment (oz)	Total Herbage (lb)	% Difference from Control	Lucerne (lb)	% Difference from Control
Paraquat:				
2	2,170 b B	-17	1,830a A	+ 95
4	2,240 b B	-15	2,220a A	+136
6	2,150 b B	-19	2,150a A	+129
8	2,070 b B	-22	2,020a A	+115
Control	2,640a A	—	940 b B	—

Further cuts were taken in December and January. These were practically weed-free and produced yields none of which differed significantly from control.

For Trial 3 a crop was purposely chosen in which spring growth had already begun. The lucerne was very leafy and 4 in. to 6 in. tall. The trial was primarily a tolerance one, but there was considerable weed present (*Poa annua*, speedwell (*Veronica persica*), mouse-eared chickweed and common chickweed), and all species had reached the flowering stage.

Yields from the first cut on October 17 are shown in Table 4.

TABLE 4: YIELDS FROM FIRST CUT OF TRIAL 3, OCTOBER 17

Treatment (oz)	Total Herbage (lb)	% Difference from Control	Lucerne (lb)	% Difference from Control
Paraquat:				
2	3,080a A	-2	1,390a	- 10
4	2,820abAB	-10	1,310a	- 15
6	2,550 b B	-19	1,770a	+14
8	2,620 bAB	-17	1,600a	+ 3
Control	3,140a A	—	1,550a	—

As in Trial 2, cuts taken in December and January were relatively weed-free. The only significant difference in yield (5% level) was a reduction in both total yield and lucerne content at the 8 oz rate compared with the 4 oz rate.

YOUNG LUCERNE

Trial 4 was sited on a paddock which, between drilling in March and treatment on June 27, had become heavily infested with chickweed and, to a lesser extent, speedwell. Both the chickweed and lucerne were about 7 in. tall with the speedwell a little shorter.

A cut taken on December 12 yielded results shown in Table 5.

TABLE 5: YIELD FROM FIRST CUT OF TRIAL 4, DECEMBER 12

Treatment (oz)	Total Herbage (lb)	% Differ- ence from Control	Lucerne (lb)	% Difference from Control
Paraquat:				
1	1,580 b B	+116	1,360 b B	+100
2	2,640a A	+262	2,350a A	+246
4	2,950a A	+304	2,870a A	+322
Control	730 c B	—	680 c C	—

DISCUSSION

WEED CONTROL

Trial 1 showed that storksbill and *Poa annua* are readily killed with paraquat in the winter, the rate required increasing with the age of the plants. Dandelion, beaked hawkbit and browntop survived 8 oz per acre, while white clover increased markedly in dominance after treatment. The removal of the predominant weeds early in the winter left much bare ground which was covered by resistant weeds or colonized by other volunteer species.

In Trials 2, 3 and 4 the important weeds were storksbill, chickweed, mouse-eared chickweed, speedwell and *Poa annua*. All species proved susceptible to paraquat but the rate needed varied with the stage of growth. Weeds in Trial 2 were very young when treated, while those in Trial 3 were fully-developed. The variation in weed control between these trials is demonstrated by the proportion of lucerne in the dissected samples as set out in Table 6. This result confirms visual assessments made before cutting.

TABLE 6: PERCENTAGE PURE LUCERNE, TRIALS 2 AND 3

Treatment (oz)	Trial 2	Trial 3
Paraquat:		
2	84	45
4	99	46
6	100	67
8	98	61
Control	36	49

The small proportion of weeds in the control samples from Trial 4 was because the annual weeds, having caused the death of many lucerne seedlings, themselves died down before the cut was taken. An earlier assessment of weed control revealed that the 4 oz rate had killed all chickweed and speedwell, leaving 50 to 60% bare

ground. Two ounces per acre killed 75%, giving dominance to the lucerne, while the one ounce rate checked the weeds enough to allow many lucerne plants to survive.

CROP TOLERANCE

In English work, reported by Jones (*I.C.I. (N.Z.) Information Sheet*), 4 lb of paraquat was slightly toxic to growing lucerne and up to 2 lb per acre was harmless to lucerne treated at the dormant stage. In only one of the seven cuts reported here was there a significant reduction in lucerne yield, that being at 8 oz per acre. On mature lucerne there was an apparent increase in yield over the lower rates (due presumably to weed control) with a slight fall at the highest rate. In fact, in Trial 3, spraying at a leafy stage produced what appeared to be definite lucerne suppression up to the first cut, though this was not entirely borne out by yield data.

In Trial 4 the yield of lucerne from the young stand increased as the rate of paraquat increased up to 4 oz per acre. However, this must be regarded as primarily a response to relief from weed competition.

INTERIM CONCLUSIONS

These results represent only one season's work and require confirmation. However, it appears that 4 to 6 oz per acre of paraquat will control storksbill, chickweed, mouse-eared chickweed, speedwell and *Poa annua*, if applied during winter. Younger plants are more easily killed but, if re-infestation is to be avoided, treatment should be delayed until just before onset of spring lucerne growth.

There is sufficient tolerance in mature lucerne for use of the suggested rates of paraquat, provided application is made before commencement of spring growth.

The yield of weeds plus lucerne, in the absence of treatment, generally exceeds the yield from treated areas. However, the yield of lucerne is increased by weed control. Storksbill has undesirable features that merit special attention but, for other weeds, the reward for a lower total yield will be an increase in hay quality and a possible extension of the life of the lucerne stand. Unless weeds can be replaced by useful species, however, the spraying of a run-out stand is not justified.

The outstanding response to spraying the young stand undoubtedly resulted from weed control. Further work is needed to establish the true tolerance of young lucerne to paraquat, but as a salvage treatment, I consider its use already justified.

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REFERENCE

Loughnan, R. J. M., 1964: Economic losses from barley grass. *Proc. 17th N.Z. Weed & Pest Control Conf.*, p. 40.