

TOLERANCE OF PASTURE GRASSES TO NEW CHEMICALS

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Summary

Paraquat at 0.45 lb a.i. per acre applied during the spring and summer, gave good kills of perennial ryegrass (*Lolium perenne*), Chewings fescue (*Festuca rubra* var. *fallax*) and cocksfoot (*Dactylis glomerata*). Browntop (*Agrostis tenuis*) and paspalum (*Paspalum dilatatum*) recovered from the highest rates applied, namely 1.8 lb and 3.6 lb a.i. per acre, respectively.

Mercer grass (*Paspalum distichum*) was resistant to 1.8 lb a.i. per acre of either paraquat or diquat.

"Basinex" (2,2-dichlorobutyric acid) was less effective than 2,2-DPA when compared at equivalent rates of active ingredient on browntop, Chewings fescue, cocksfoot and paspalum.

A substituted uracil C82 controlled Mercer grass, but not paspalum at 24 lb a.i. per acre. Mixed vegetation of other grasses, including tall fescue (*Festuca arundinacea*), and broad-leaved weeds was controlled by 8 lb or 16 lb a.i. per acre.

INTRODUCTION

IN A PAPER at the Fourteenth N.Z. Weed Control Conference, Bramley (1961) concluded that paraquat was the most efficient of five new herbicides tested for the "chemical ploughing" technique. He found that in trials at Wellington there were marked differences in the susceptibility of grass species to paraquat and that these differences varied from one time of application to another. To obtain further information on the tolerance of pasture grasses to paraquat, a series of trials was commenced in spring, 1961, at Rukuhia Soil Research Station. This paper gives the results of the treatments applied during the spring and summer months.

Results are also given of trials with "Basinex" (2,2-dichlorobutyric acid) and diquat on grasses, and trials with a substituted uracil, C82, on mixed vegetation in several localities. Quantities of chemicals used are expressed in this paper in terms of active ingredient per acre.

EXPERIMENTAL

The paraquat trials were conducted on relatively pure swards of mature perennial ryegrass (*Lolium perenne*), cocksfoot (*Dactylis glomerata*), paspalum (*Paspalum dilatatum*) and Chewings fescue (*Festuca rubra*, var. *fallax*) on separate blocks sown either two or four years previously. In addition there were plots in an old pasture where browntop (*Agrostis tenuis*) was dominant.

Paraquat was applied to plots of each grass at monthly intervals commencing in August or September, 1961. Other plots were treated with 2,2-DPA for comparison. The rates of application on all the grasses except paspalum were 0.45, 0.9 and 1.8 lb of paraquat and 3.7 lb and 7.4 lb of 2,2-DPA. The paraquat rates were doubled on paspalum and the 2,2-DPA increased to 5.6 and 11.1 lb. The plots were mown at intervals prior to spraying to avoid rank growth at the time of application. The ryegrass, Chewings fescue and browntop were generally between 1 and 4 in. high, the cocksfoot 5 in. and the paspalum 6 in. at the time of spraying. In the early spring the grasses were slightly shorter than these average figures, and slightly longer in December.

In another series of trials "Basinex" was compared with 2,2-DPA. The applications were made in March, 1961, using the logarithmic sprayer (Sweetman, 1959). The grasses treated and the heights at

the time of spraying were: browntop 1 in., Chewings fescue 2 in., cocksfoot 2 in. and paspalum 4 in. In these trials the treatments were applied with an "Oxford" precision sprayer at 30 lb/sq. in. using 30 gal water per acre. The trials were on Horotiu sandy loam at Rukuhia Soil Research Station, Hamilton.

Information on the tolerance of various species to diquat and to C82 was obtained from trials on drain banks in Hamilton, the Hauraki Plains and the Bay of Plenty.

In all the trials the treatments were replicated and randomized. A wetting agent was used with the paraquat and diquat.

RESULTS

PARAQUAT

As nearly 700 plots were involved in these trials, accurate measurement of the results would have involved much work. Estimates were therefore made of the percentage kills relative to the unsprayed controls. The results were assessed at the end of December and again in late April or early May. It was considered that reports made less than three or four months after treatment would not be reliable owing to subsequent recovery. Therefore treatments subsequent to January or February are not considered in this paper although the monthly treatments have been made up to May.

The results for ryegrass and cocksfoot are given in Tables 1 and 2, respectively. In view of the possibility that the translocation of the paraquat within the plants may be more extensive, and therefore the treatment more effective, if applied in the absence of bright sunshine, the hours of bright sunshine after each spraying time are stated in the tables. The figures for the bright sunshine remaining on the day of spraying and also for the following week are quoted.

TABLE 1: PERCENTAGE KILLS OF RYEGRASS TREATED WITH PARAQUAT AND 2,2-DPA APPLIED FROM SEPTEMBER TO FEBRUARY

Treatment (lb)	Sept.	Oct.	Nov.	Dec.	Jan.	Feb.	Ave.
Paraquat 0.45	98	92	100	98	100	100	98
Paraquat 0.9	100	98	100	98	98	99	99
Paraquat 1.8	100	100	100	100	100	100	100
2,2-DPA 3.7	85	93	67	60	55	88	75
2,2-DPA 7.4	99	93	96	83	91	95	93
<i>Hours sunshine:</i>							
Spraying day	6.6	0.9	5.1	5.8	7.7	7.5	
Following week	43	44	52	82	56	88	

TABLE 2: PERCENTAGE KILLS OF COCKSFOOT TREATED WITH PARAQUAT AND 2,2-DPA APPLIED FROM AUGUST TO JANUARY

Treatment (lb)	Aug.	Sept.	Oct.	Nov.	Dec.	Jan.	Ave.
Paraquat 0.45	78	59	75	75	85	87	76
Paraquat 0.9	90	80	97	94	93	95	91
Paraquat 1.8	94	88	93	97	99	97	95
2,2-DPA 3.7	88	80	83	83	70	82	81
2,2-DPA 7.4	78	88	85	90	84	90	86
<i>Hours sunshine:</i>							
Spraying day	6.5	7.7	0.2	1.5	2.7	3.6	
Following week	42	53	75	69	35	59	

Paraquat gave very high kills of ryegrass at all times, even with the lowest rate of application (0.45 lb). No effect of time of application could be detected.

Cocksfoot was more resistant to paraquat and the average kill with 0.45 lb was 76%. With all three rates of paraquat, the lowest kills resulted from the September applications. The day of spraying

in September was the most sunny in the series. If the poor kills were due to this factor, poor kills would also be expected from the August spraying (also on a sunny day), and good kills in October (when the weather was dull). However, the August kills were not consistently lower than those in October. There was no other trend in either the paraquat or 2,2-DPA results with cocksfoot.

In the Chewings fescue trial the unsprayed plots were somewhat variable owing to invasion of other grasses. It was therefore difficult to assess accurately the percentage kills each month. The results, which are not presented, were of a similar order to those for cocksfoot. There was no evidence that the results were associated with times or conditions of application.

In the browntop trial, all the paraquat and 2,2-DPA plots treated up to the end of January had, with the exception of the January application of paraquat at the highest rate, completely recovered by May. The only information available from this trial relates to the recovery period. When applications of the lower rates of paraquat and the 2,2-DPA were made in August or September, the recovery period was about four months, whereas it was about two months following the January applications. Recovery from the highest rate of paraquat (1.8 lb) was slightly slower.

Paspalum was resistant even to the highest rate of paraquat, namely 3.6 lb. On areas sprayed during the period September to January inclusive, recovery was complete within two to three months, irrespective of times of application. The corresponding period for the 2,2-DPA plots was about five months.

In the Hauraki Plains, Mercer grass was resistant to both paraquat and diquat when each was applied at 1.8 lb.

"BASINEX"

The results of the trials with this material were assessed four or five months after treatments were applied. The positions in the logarithmic strips where the kills with "Basinex" and 2,2-DPA were similar were recorded. With all four grass species "Basinex" was less effective than 2,2-DPA when the materials were compared on active ingredient basis.

C82

In the drain bank trials, paspalum was resistant to this material applied at 24 lb. However, Mercer grass was more susceptible and the control was fair, good, and excellent with 8, 16 and 24 lb, respectively. Good control of tall fescue (*Festuca arundinacea*) was obtained with rates down to 8 lb. Good control of mixed vegetation was obtained with 8 lb and 16 lb, provided paspalum was not present.

DISCUSSION AND CONCLUSIONS

Paspalum appears particularly resistant to single applications of paraquat, and in recent trials rates up to 12 lb have had little effect apart from a scorching of the foliage. Overseas experience (Anon., 1961) indicates that paspalum species are susceptible to low rates of application followed by a retreatment two or three weeks later on the regrowth from the first treatment. Trials along these lines have recently been commenced.

The resistance of paspalum to both paraquat and C82 is disappointing since paspalum is also somewhat resistant to 2,2-DPA. Mercer grass is another problem species. Previous trials (Rukuhia Soil Res. Stn., 1960) show that it recovered from treatments of up to 30 lb of 2,2-DPA with or without 4 lb of amitrole. The results with C82 on Mercer grass are therefore promising although the preliminary work suggests that high rates are necessary for complete control.

The recovery of the browntop after the paraquat treatments was surprising. For several weeks after treatment there appeared to be

a complete kill of this species, but regrowth appeared later. Conditions may have been atypical in that the trial was on a 14-year-old pasture which was almost entirely browntop, and a layer of organic matter including a mass of live stolons had been built up. These stolons survived the treatments and were able to make fresh growth. Also, there was practically no clover in the sward and the mat of dead browntop did not expose any bare ground to permit flat weeds to establish after the treatment. Therefore, there was little other vegetation to compete with the browntop struggling to survive.

There is some evidence that different results may have been obtained with a younger and less dense browntop sward. In another trial paraquat had been applied with the logarithmic sprayer to a 2-year-old sward of browntop in March, 1961. An inspection five months later showed that 0.75 lb of paraquat gave a 50% kill whereas in the trials on the 14-year-old pasture the browntop completely recovered within two months from 0.9 lb applied in March, 1962. The state of the sward may therefore be more important than the time of application.

In the ryegrass and Chewings fescue trials, 0.45 lb of paraquat gave better kills than 7.4 lb of 2,2-DPA. Thus, the relative efficiency of paraquat compared with 2,2-DPA on these grasses was more than 16 to 1. With cocksfoot the ratio was approximately 8 to 1.

The results from these trials did not show that time of application of paraquat during the period studied affected the susceptibility of the grasses. To determine the statistical significance of effects due to this factor, it would be preferable to adjust the rates of application so that the resulting percentage kills were nearer to 50%. Furthermore, it would be easier to obtain more precise data if the individual plants could be counted more easily than in a sward. A nursery of grasses has been established to provide material for further trials along these lines.

The interim results show that ryegrass, cocksfoot and Chewings fescue are readily killed by paraquat applied during the spring and summer months and that for practical purposes time of application is not important. Paspalum and old established browntop swards are much more resistant. These results were confirmed by chemical ploughing trials with paraquat (Thompson, 1962b) in which 1.8 lb applied to a ryegrass/cocksfoot sward at various times from August to January gave good results except where paspalum and browntop were present. It now appears that the rate of paraquat used in chemical ploughing could perhaps be reduced if susceptible grasses only are present. Another practical application of the results of these trials is that, if paraquat is used in summer to prevent barley grass (*Hordeum murinum*) from setting viable seed, as has been suggested recently (Thompson, 1962a), damage to ryegrass/cocksfoot pastures may be expected.

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