THE EFFECTS OF WEED CONTROL WITH PARAQUAT ON THE YIELD OF LUCERNE

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Summary

Paraquat was applied at 4 or 8 oz a.i./acre in two successive years to control weeds in established lucerne. In the only possible harvest following the second year of application, the dry matter yields of lucerne and weeds were measured: at the higher rate (8 oz) paraquat reduced the dry matter yield of weeds by 68% whereas lucerne dry matter increased by 77%. Paraquat at 4 oz/acre increased lucerne yield at the same time of sampling by 57%. Following application of paraquat (8 oz) in the first year only, weeds re-invaded the lucerne and at the time of sampling had reached the same level as in untreated lucerne.

INTRODUCTION

BLAIR (1968) showed the importance of grass and weed invasion as a factor in the deterioration of lucerne crops. Apart from the possibility of introducing grasses with cool season activity into established lucerne to control weeds, and weed control by grazing or cultivation methods (O'Connor and Vartha, 1968; Clare, 1968), herbicides can be safely applied during the winter and are now widely used to reduce weeds, particularly grasses, in lucerne.

Leonard (1964) reported the use of paraquat for weed control in lucerne and showed that the yield of lucerne in the first summer after spraying could be markedly increased. Weed seeds can, however, remain viable in soil for several years or can be carried into established lucerne by many factors. Seeds are quickly spread by wind and irrigation water or carried by birds and grazing animals; in many cases, weeds are introduced by the practice of feeding hay on lucerne during winter when the competitive ability of lucerne is minimal. Thus, weeds can quickly become re-established in lucerne.

Although some residual herbicides can be applied to lucerne, the extended period of weed control is unlikely to prevent the germination of weed seeds in the winter following the year of application (Cassels and Upritchard, 1968; Meeklah, 1966). As paraquat is inactivated on contact with soil, it could be applied to lucerne in successive years to control invading weed species with little, if any, direct effect on established lucerne plants. The value of such herbicide treatment will, however, depend on the rate of weed ingress and the extent to which the yield of lucerne is affected by controlling competition from weeds. To study some of these effects, a trial has been laid down to compare annual treatment with paraquat at different rates with a treatment in which paraquat is applied in alternate years only.

METHODS

Treatments were applied to lucerne sown in 1965 on a Templeton silt loam soil. Paraquat was applied in 20 or 25 gal/acre. At the time of the initial application, the main weeds were *Poa* spp., storksbill (*Erodium* spp.), mouse-ear chickweed (*Cerastium glomeratum*), subterranean clover (*Trifolium subterraneum*) and shepherd's purse (*Capsella bursa-pastoris*). Before spraying, the trial area was close-grazed by sheep; storksbill plants varied from 1 to 3 in. in diameter at the time of spraying in 1967, at the beginning of the trial. Other weeds, present to a much lesser degree, were plantains (*Plantago* spp.), Scotch thistle (*Cirsium vulgare*), suckling clover (*Trifolium dubium*) and perennial ryegrass (*Lolium perenne*). The following treatments were applied (all rates in a.i. per acre):

1. Unsprayed.
2. paraquat 4 oz applied July 11, 1967, and July 22, 1968.
3. paraquat 8 oz applied July 11, 1967, and July 22, 1968.
4. paraquat 8 oz applied July 11, 1967: not sprayed in 1968.

Treatments were applied to plots, 6 × 30 ft, arranged in randomized blocks with five replicates. Lucerne and weeds were cut with shears at a height of about one inch from an area of 3 × 3 sq. ft: duplicate samples were taken from each plot. Lucerne and weeds were separated and dried for determination of dry matter yields.

RESULTS

The trial was first sampled on November 4, 1967, but, following heavy rain during sampling and consequent difficulties in storing, separating and drying the wet herbage, it was found impossible to estimate reliably either the dry matter yield of lucerne and weeds or the total yield. It was apparent, however, that in the sprayed plots, where weeds had been checked, the total yield had been reduced; the suppression of weeds had not been followed in this early period by an equivalent increase in lucerne growth. At the second harvest, on January 22, 1968, weeds were absent and the yields of lucerne from the different treatments (see Table 1) were similar.

At the time of the second application of paraquat, July 22, 1968, the treatments not sprayed in 1967 contained mainly ryegrass, *Poa* spp., storksbill, mouse-ear chickweed, subterranean clover and occasional flatweeds. Paraquat at 4 oz/acre had reduced grasses but other weeds were similar; at 8 oz/acre the main weeds were mouse-ear chickweed, subterranean clover and some flatweeds.

Further samples were cut on November 4, 1968: the results are given in Table 1. In general, yields were low, owing mainly to low rainfall during the early summer period. In spite of marked differences in the yield of lucerne and weeds between treatments, the total yield was relatively unaffected but with a tendency for sprayed lucerne to outyield untreated plots. Paraquat at 4 and 8 oz/acre in both 1967 and 1968 reduced weeds to about one-third of the values for the untreated plots. Where paraquat was applied only in 1967 (Treatment 4) the dry matter yield of weeds did not differ significantly from the yield of weeds in untreated plots.

TABLE 1: EFFECT OF PARAQUAT ON THE DRY MATTER YIELDS OF LUCERNE AND WEEDS

Treatment	Lucerne Sampled 22/1/68	Yield (lb D.M./acre) Sample 4/11/68		
		Lucerne	Weeds	Total
1. Untreated	1,556	983 bC	878 aA	1,861 a
2. Paraquat (4 oz) July 11, 1967, and July 22, 1968	1,471	1,541 aAB	335 bB	1,876 a
3. Paraquat (8 oz) July 11, 1967 and July 22, 1968	1,482	1,740 aA	302 bB	2,042 a
4. Paraquat (8 oz) July 11, 1967	1,759	1,159 bBC	908 aA	2,067 a
CV		17.8%	19.6%	13.1%

The dry matter yield of lucerne was markedly increased by paraquat at both rates (4 and 8 oz/acre) applied each year. At the higher rate of paraquat, lucerne yield was increased by 77%.

Following the continuing dry conditions in 1968 and early 1969, re-growth of lucerne was too limited to warrant further sampling.

DISCUSSION

The response of lucerne to the removal of weeds will depend on several factors. Provided the nutrient status of the soil and rainfall are not limiting growth, a marked yield increase would be expected following the removal of a dense cover of weeds. Grass weeds are particularly important in this respect in that they will grow during winter and early spring when lucerne is relatively dormant. Furthermore, differences in the pattern of nutrient uptake at different depths in soil by grasses and lucerne suggest that surface-applied fertilizer would be more readily available to grasses than lucerne.

The effect of controlling weeds on the yield of lucerne will also depend to a large extent on the vigour and density of the stand. Where weeds have seriously invaded lucerne, plant density and vigour may be reduced so that removal of the weeds results in a very sharp drop in total dry matter production. This temporary loss of production could possibly be overcome by overdrilling a winter-feed cereal or grass shortly after applying a non-residual herbicide such as paraquat.

The main effect of paraquat in the present trial was to control ryegrass, *Poa* species and susceptible flatweeds. It is unlikely that lucerne yield was markedly affected by weed control in the first cut after herbicide application and total yield of weeds and lucerne was probably reduced in this trial in the first cut. The lucerne dry matter yields did not differ in the second cut. The wide difference in lucerne yield in the second season between untreated lucerne (983 lb DM per acre) and lucerne sprayed for two successive winters (1740 lb DM per acre) suggest that lucerne yield can be greater in the second year after spraying. The results therefore emphasize the importance of controlling weeds in lucerne at an early stage before growth is appreciably reduced by competition. Only when weeds

are controlled during both the early stages of growth by pre-emergence herbicides (Taylor, 1969) and at later stages can the full potential growth of lucerne during the summer dry period be realized.

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