THE EFFECT OF MEFLUIDIDE ON THE GROWTH OF PERENNIAL RYEGRASS

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Summary

The effect of plant growth retardant, mefluidide, on the vegetative and reproductive growth of perennial ryegrass (*Lolium perenne*) has been investigated. Mefluidide significantly inhibited ryegrass shoot growth and dramatically reduced seedhead production. The growth inhibition was associated with initial tiller mortality followed by suppression of tiller development and a reduction in leaf lamina and sheath extension. The optimum rate for maintaining growth suppression, over an 8 week period, was between 0.5 and 0.75 kg/ha although the higher rate caused some temporary phytotoxic symptoms.

INTRODUCTION

The suppression of vegetative and reproductive growth in grasses by use of chemicals has a number of distinct advantages both from a practical viewpoint and in terms of potential energy conservation. Although maleic hydrazide and a limited number of other chemicals have shown potential (Weaver 1972; Nielsen and Wakefield 1975), no chemical has yet fulfilled the two basic criteria of prolonged growth inhibition following a single application and retention of the cosmetic appearance of mown grass.

Mefluidide is a new product that has growth retardant characteristics that may make it useful for controlling the vegetative and reproductive growth of turf and grasses in difficult to mow areas (Bushong *et al* 1976). Of special significance to the latter application is the reported inhibition of seedhead development in grasses when the chemical is applied in early spring. The present set of experiments was carried out to evaluate mefluidide as a growth retardant for perennial ryegrass, a common component of turf and waste areas, and to ascertain the morphological and physiological bases of the growth retardation.

METHOD

Two field trials were established on a perennial ryegrass dominant sward in the spring of 1978. Both trial areas were sprayed with mefluidide (plus 0.25% atlox as surfactant) at four rates (0, 0.25, 0.50, 0.75 kg/ha) on 10 October 1978. Four days prior to spraying the trial areas were trimmed to 5 cm in height. Application to 5 x 2 m plots was made with a 2 m boom delivering 250 litres/ha. Both trials were completely randomised block designs, the first, to measure total yield 8 weeks after spraying had four replicates while the second trial, to investigate the effect of mowing, had six replicates. In the latter trial plots were mown to 5 cm in height at 1 and 4 weeks after spraying. The sampling of plots from both trials was accomplished by hand cutting four 0.12m² quadrats per plot which were bulked prior to botanical analysis and dry weight determinations of the components. At final harvest in the first trial a second series of quadrats were taken to determine seedhead density, spikelets per seedhead and for collection of seed. The seed was subsequently germinated at 25 °C in the dark.

An experiment using container grown plants was established on 28 March 1979 by sowing perennial ryegrass ('Grasslands Ruanui') into a soil potting mixture in 15 cm diameter plastic pots. The plants were grown outside prior to transfer to a glasshouse on 20 June 1979, which was 2 weeks prior to spraying with mefluidide, at the same rates as used in the field experiments. The experiment was a completely randomised block

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design with six replicates. Plants were harvested every two weeks after spraying and dissected into a number of components for determination of dry weight, length or leaf area. The leaf area determinations were carried out on the leaf lamina fraction only, while for dry weight determinations the sheath fraction included leaf sheaths plus any additional above ground plant material.

RESULTS AND DISCUSSION

The growth suppression induced by mefluidide in the first field experiment was considerable. Perennial ryegrass and minor sward components showed a significant reduction in growth at the 0.25 kg/ha rate of mefluidide, (Table 1). The growth retardation at the highest rates of mefluidide was associated with a considerable reduction in seedhead production. The seedheads that formed were apparently normal although with a reduced spikelet number, and formed seed with a similar germination to that from untreated plants. The lack of total seedhead suppression suggests that the timing of mefluidide application was critical. Spraying earlier, in late September, may have produced superior control. The optimum rate of mefluidide for effective suppression of vegetative and reproductive growth was between 0.5 and 0.75 kg/ha, although some temporary phytotoxic symptoms were apparent after application of the higher rate. At 0.5 kg/ha and below the sward assumed a darker green colour than in the control plots.

TABLE 1: Effect of mefluidide on the growth, seedhead production, spikelet number and seed germination of ryegrass from a field sward.

Mefluidide kg/ha	Total herbage g/m ²	Ryegrass g/m ²	Seedheads /m ²	Spikelets /seedhead	Seed germination %
0	736	610	2312	19.7	45.6
0.25	452	396	976	18.0	37.5
0.50	284	219	564	16.7	43.4
0.75	290	237	472	16.1	51.3
LSD 5%	172	154	288	4.0	7.8
CV %	24.5	26.3	37.4	32.2	27.8

TABLE 2: Effect of mefluidide and cutting to 5 cm on shoot growth of ryegrass from a field sward.

mefluidide kg/ha	ryegrass dry weight (g/m ²)		
	weeks after spraying		
	1	4	7
0	67.8	100.4	23.6
0.25	75.7	62.6	35.6
0.50	70.9	42.1	31.0
0.75	72.6	39.3	36.5
LSD 5%	16.4	9.1	6.6
CV %	18.6	12.1	16.9

In the second field experiment (Table 2), the objective was to investigate the influence of cutting on the longevity of the suppression induced by mefluidide. Previous experience has shown that trimming turf just before or after spraying improved growth suppression and appearance (Hield *et al* 1979). Both treatments would presumably remove grass apices that were at various stages of reproductive development and hence provide enhanced control of seed-head production. Trimming ryegrass to 5 cm 1 week after spraying indicated that there was no growth suppression at

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that stage but at a subsequent cut taken after 4 weeks there was a significant reduction in vegetative growth, proportionately similar to that in the first experiment. However, the cutting to 5 cm at 4 weeks removed any subsequent effects and by week seven there was a slight stimulation of growth in the mefluidide treated plots. The physiological basis for these observations may include a stimulation of tillering following cutting at 4 weeks, whereas prior to this there may have been tiller mortality and reduced tillering. This point is discussed later in relation to changes induced in container grown plants.

In order to establish the morphological basis for the growth suppression induced by mefluidide, an experiment was conducted using container grown plants. Application of mefluidide to plants that had 35.5 tillers and a partitioning of dry matter as indicated in Fig. 1, resulted in a dramatic change in total plant dry weight and in a number of other growth parameters over an 8 week period, (Fig. 1). The greatest reduction in dry weight was in the leaf lamina fraction although there was a corresponding reduction in leaf sheath weight. Although the leaf fractions in mefluidide treated plants weighed less than the controls, the differences between the mefluidide concentrations were not great. Of the three dry weight components measured the root fraction was the most stable, significant differences only becoming apparent by the time of the final harvest.

Fig. 1 The effect of mefluidide on the distribution of dry weight in container grown perennial ryegrass plants at varying intervals after treatment. Data on plants at time of treatment are not included in the analysis.

There was a suspension of growth, in mefluidide treated plants, between weeks four and six but growth had started to recover by week eight (Fig. 1). In order to examine more closely the morphological changes associated with the dry weight changes induced by mefluidide a detailed analysis of certain growth parameters for plants at week six is provided in Tables 3 and 4.

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TABLE 3: Effect of mefluidide on the growth of certain plant organs in container grown plants 6 weeks after treatment.

Mefluidide kg/ha	Tillers /plant	Tiller dry weight (mg)	Leaf area /plant (cm ²)	Leaf area /tiller (cm ²)	Longest sheath (mm)	Longest lamina (mm)
0	38.7	86.4	329.6	8.5	157.5	332.5
0.25	34.3	51.6	133.4	4.0	67.8	241.5
0.50	29.3	59.9	120.7	4.2	66.3	247.5
0.75	23.1	70.8	91.4	4.5	60.8	188.5
LSD 5%	8.5	20.0	68.6	1.7	28.9	33.2
CV %	22.2	24.3	33.0	26.6	26.7	10.7

TABLE 4: Effect of mefluidide on certain growth parameters in container grown plants 6 weeks after treatment.

Mefluidide kg/ha	Root/shoot dry weight ratio	Leaf area ratio cm ² /g	Leaf weight ratio g/g	Specific leaf area cm ² /mg
0	0.35	73.8	0.41	0.18
0.25	0.43	57.0	0.30	0.19
0.50	0.44	46.5	0.25	0.18
0.75	0.44	40.2	0.28	0.16
LSD 5%	0.11	17.8	0.05	0.04
CV %	22.8	26.6	13.7	19.4

Mefluidide induced mortality of young tillers and prevented additional tiller development when applied at high rates (Table 3). At 0.25 kg/ha there was evidence of secondary tiller development by week six and this accounted for the low weight of individual tillers at this rate. Although the dry weight and leaf area of individual tillers increased marginally there was no evidence of major additional growth to compensate for the reduced number of tillers in mefluidide treated plants. The reduction in total leaf area in treated plants was very significant and associated with a reduction in the length of individual leaf laminae, while the major parameter responsible for the reduction in plant stature was the shorter leaf sheaths in treated plants.

The data from the present experiments indicated that the primary affect of mefluidide was on various shoot growth parameters and that changes to root development did not become apparent until the final harvest at week eight (Fig. 1). By the time of the final harvest the reduction in total photosynthetic area may well have been expected to bring about a reduction in root dry weight rather than for such reductions to be explained as direct effects of mefluidide. Calculation of the root/shoot ratio at week six (Table 4) indicated that if anything the root mass of mefluidide treated plants, in relation to shoot dry weight, was greater than for control plants. The fact that mefluidide did not specifically inhibit root development could be of practical significance, first, in terms of the survival of treated plants under water stress and secondly, their ability to show growth recovery following mefluidide treatment.

It is possible to derive a number of simple quantities that describe how the growth of morphological characteristics of leaves changed with mefluidide treatment (Table 4). Thus the leaf area ratio represents the area of foliage in relation to total plant dry weight and was significantly reduced by application of mefluidide. Similarly, the leaf weight ratio is an index of the leafiness of the plant on a dry weight basis and was reduced by mefluidide treatment, while the specific leaf area as a measure of relative leaf thicknesses did not change significantly.

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CONCLUSION

Mefluidide applied to perennial ryegrass plants in the field inhibited total plant growth and seedhead production considerably by 8 weeks. The timing of mefluidide application in relation to stage of reproductive development is likely to affect the degree of suppression of seedhead production. Mowing 4 weeks after mefluidide treatment removed the growth suppression affect, apparently by stimulating tillering. A detailed investigation into the morphological basis of growth retardation by mefluidide suggested that the primary effects involved were tiller mortality, reduced tiller formation, reduced leaf area and lamina expansion and inhibition of sheath extension. The reduced growth of roots was a secondary affect associated with the reduction in photosynthetic area of the shoot system. The optimum rate of mefluidide for vegetative and reproductive growth suppression in perennial ryegrass was between 0.5 and 0.75 kg/ha.

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