INFLUENCE OF SOME FACTORS ON PERFORMANCE OF THE FATTY ACID HERBICIDE 'GREENSCAPE'

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SUMMARY

Glasshouse experiments were conducted in 1990 to study the efficacy of the fatty acid herbicide Greenscape under various conditions using a variety of plants as test species. Greenscape was more effective on young plants (i.e. up to two true leaves) than on larger plants. Clovers (*Trifolium* spp.) and some grasses recovered well from severe damage after treatment. Two applications made about 3 days apart significantly increased the effectiveness of Greenscape on most species tested. The most effective concentration of Greenscape varied between 3 and 10%. Volume of spray application (i.e. water rate) appeared to be less important than concentration of the herbicide. Efficacy was not altered significantly on plants growing under water stress.

Keywords: Greenscape, Topgun, fatty acid herbicide, organic herbicide, non-selective herbicide

INTRODUCTION

There has been a need for a fast acting, non-residual herbicide for use by farmers, orchardists and home gardeners that has been filled by paraquat for many years. However in many countries including New Zealand, paraquat has been removed from some markets (e.g. the home garden market) because of its toxicity. Thus it is no longer used by most Local Authorities and others who require a safer herbicide. There is also a growing demand for an organic alternative to the conventional herbicides.

Greenscape is an organically acceptable weed-killer formulated from C₈-C₁₀ fatty acids. It is fast acting, non-residual and controls a wide range of seedling and some mature weeds (Anon. 1991). After initial testing of this product in the USA, it has been fully developed for use in this country by Yates New Zealand Limited. The experiments reported here cover some of the developmental work conducted in the glasshouse at Ruakura Agricultural Centre.

MATERIALS AND METHODS

Six experiments were conducted under glasshouse conditions during the spring and early summer of 1990. For most of the experiments the following test species, were used: maize (*Zea mays*), forage sorghum (*Sorghum bicolor*), oats (*Avena sativa*), annual ryegrass (*Lolium multiflorum*), subterranean clover (*Trifolium subterraneum*), white mustard (*Sinapis alba*) and peas (*Pisum sativum*). The plants were grown in a sandy loam soil in 10-cm diameter pots and thinned to four plants per pot for peas and maize and eight plants per pot for the other species. Pots were bottom watered three times a week and were at 90 to 100% of field capacity at the time of treatment. For most experiments the treatments were applied with hand operated 1 litre plastic atomisers (trigger packs). The herbicide mixture was applied to plants until they were thoroughly wet. Each treatment was applied to four or six pots. Safer's Topgun, a fatty acid herbicide (30 g ai/litre) from Watkins Home and Garden Products Limited, was used for comparison. Visual assessments of plant damage and/or plant death were made at regular intervals after application. Due to the nature of the herbicide and its mode of action dry matter weights of the test species were not collected. Specific details for each experiment are given below.

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Experiments 1 and 2: Effect of herbicide concentration.

All seven test species were included in these experiments (Tables 1 and 2). The herbicide treatments were applied when the plants had two to four or six to eight true leaves and conditions at the time were sunny and 24°C (Experiment 1) or overcast and 20°C (Experiment 2).

Experiment 3: Effect of water rate.

Greenscape at 1, 3 and 5% and Topgun at 3% were tested at four water rates (100, 200 400 and 600 litres/ha) using mustard, maize, oats and peas as test species. Plants were treated 3 weeks after sowing at the three to four leaf stage. Treatments were applied with a CO₂ powered moving belt sprayer at 200 kPa. The different water rates were achieved by changing the nozzle size while keeping all other factors constant.

Experiment 4: Effect of repeat applications.

Test species used in this experiment were maize, ryegrass, oats, peas, sub-clover and mustard (Table 3). The treatments were a single application only, two applications 3 days apart, two applications 7 days apart and three applications at 7 day intervals. Greenscape was used at 1, 2, 3 and 5% concentrations and Topgun at 3%. The first treatment was applied 2 weeks after planting when plants had four to six leaves.

Experiment 5: Effect of soil moisture.

Greenscape at 2, 3, 5, and 10% and Topgun at 3% were used on maize, peas, oats and mustard plants. Thirty-six pots of each species were grown and a third of them were treated each week for 3 weeks, with the first application made when the plants were 2 weeks old. In the week before each application half of the test plants were not watered so that the soil was between 55 and 65% of field capacity (55% of field capacity is the wilting point in the soil used) at the time of treatment. The pots were surface watered lightly 2 days after application to stop the plants dying of drought.

Experiment 6: Susceptible and tolerant weeds.

Fresh soil from different field locations was laid out in 350 x 450 mm trays and left to allow weeds to germinate. After about 2 weeks, when the weeds had one to four true leaves, the trays were sprayed with a 3% solution of Greenscape. They were assessed for effectiveness of the treatment over the next 2 weeks. After this time the weeds had either recovered or died and a second generation of weeds had germinated. The trays were then treated again and the whole process repeated five times with each tray to find out what species remained after several applications of Greenscape.

RESULTS AND DISCUSSION

The initial knockdown by Greenscape was very quick with the plants showing symptoms of wilting and leaf collapse within hours of treatment. A rapid appearance of injury symptoms from a fatty acid herbicide was recently reported also by Senesac (1992). If the initial effect was severe then the affected leaves died completely within a few days. However insufficient chemical resulted in only temporary wilting and the plants soon recovered with no, or only slight, damage to the leaves. The level of initial activity of the herbicide was similar for all the species, hence in most of the experiments only an assessment of plant death, usually made about 2 weeks after treatment, is reported.

In the first experiment, with younger and smaller plants, oats, mustard and peas were completely desiccated by the 5% solution, while for sorghum, ryegrass and maize the 10% concentration was required (Table 1).

In the second experiment, where the plants were older and larger at the time of application, oat, ryegrass, pea and maize populations were reduced by about half with the 10% solution (Table 2). For maize, sorghum and mustard the 10% solution of Greenscape gave significantly higher plant mortality than the 5% solution. For the other species however, differences between the 5 and 10% concentrations were much smaller.

TABLE 1: Percent plant mortality at various concentrations of Greenscape 14 days after application to different test species planted 14.8.90 and sprayed after 2 weeks.

Test species	Greenscape concentration (%)					
	1	2	3	4	5	10
Sorghum	20	50	40	30	50	100
Oats	80	100	100	100	100	100
Mustard	40	100	100	100	100	100
Ryegrass	10	50	80	40	90	100
Sub-clover	0	20	20	30	30	50
Peas	0	10	60	10	100	100
Maize	0	40	20	20	60	100

Average SEM (excluding 0's and 100's) = 8.2

Based on these results an optimum concentration of between 3% and 10% depending on the species and stage of growth, would be recommended. In both experiments subterranean clover showed remarkable recovery from very severe damage.

In the water rate experiment (Experiment 3), a significant increase in activity of the 1% solution (from 5% to 50% desiccation) was observed with increasing water rates, 4 days after treatment. Plant mortality from the 3 and 5% concentrations was between 85 and 100% for the higher water rates and therefore increases in activity were observed only between the lower water rates viz, 100 and 200 litres/ha for

TABLE 2: Percent plant mortality at various concentrations of Greenscape 14 days after application to different test species planted 19.8.90 and sprayed after 3 weeks.

Test species	Greenscape concentration (%)					
	1	2	3	4	5	10
Sorghum	20	35	63	60	58	93
Oat	13	25	32	65	50	55
Mustard	0	65	58	45	68	98
Ryegrass	0	23	10	20	28	55
Sub-clover	0	0	0	0	0	0
Peas	0	25	0	25	20	40
Maize	0	0	8	20	15	63

Average SEM (excluding 0's and 100's) = 10.6

mustard and maize and between the 100, 200 and 400 litres/ha for oats and peas. For Topgun (3%) the 100 litres/ha rate gave excellent activity against all plants except oats where 600 litres/ha was required. At 14 days after application many of the treatment differences between the lower concentrations of herbicide had disappeared as the plants recovered. As high plant mortality was achieved with low water rates at the high concentrations of Greenscape, the concentration of chemical rather than spray volume would appear to be the critical factor.

The benefit of a repeat application of both Greenscape and Topgun to some species was demonstrated in Experiment 4 (Table 3). The repeat application was particularly effective on ryegrass and subterranean clover which were not readily controlled with one application. A repeat application of Greenscape after 3 days was more effective than after 7 days for ryegrass, peas and mustard, whereas for Topgun this was the case for all species. A third application gave no significant advantage over two applications.

TABLE 3: Effect of repeat applications of Greenscape and Topgun on plants sown on 4.9.90 and the first application made after 2 weeks - percent dead plants 14 days after the last treatment.

Applications		Dead plants (%)					
No.	Interval (days)	Maize	Ryegrass	Oats	Peas	Sub-clover	Mustard
Greenscape (5%)							
1	-	90	30	100	100	20	100
2	3	80	60	100	100	100	100
2	7	90	30	100	90	100	90
3	7	100	30	100	100	90	100
Topgun (3%)							
1	-	100	0	100	100	30	90
2	3	100	90	100	100	60	100
2	7	90	40	95	90	50	95
3	7	100	40	100	100	40	100
LSD (5%)		5	11	3	5	12	5

There were no consistent effects of soil moisture level on the activity of Greenscape (Experiment 5). Where differences in activity occurred they were not consistent, with different target plants and different times of application giving conflicting results.

All the broadleaf weeds tested (Table 4) were susceptible to Greenscape when less than 2 weeks old but were much more difficult to control when they had four to six true leaves. Grass weeds demonstrated greater tolerance to Greenscape at all growth stages (from newly emerged to older plants) with many of the plants surviving repeat applications. At the end of the experiment the trays were full of large grass weeds and a few broadleaf weeds that had survived up to five repeat applications at 2 week intervals. This indicates that in situations where Greenscape is used repeatedly, a dominance of grass weeds may become noticeable.

TABLE 4: Susceptibility of some weed seedlings to Greenscape (3%)**Susceptible weeds.**

Annual mouse-ear chickweed (*Cerastium glomeratum*), black nightshade (*Solanum nigrum*), chickweed (*Stellaria media*), fathen (*Chenopodium album*), oxalis corniculata (*Oxalis corniculata*), prostrate amaranth (*Amaranthus deflexus*), redroot (*A. hybridus* group), scotch thistle (*Cirsium vulgare*), scrambling fumitory (*Fumaria muralis*), sow thistle (*Sonchus oleraceus*), spurrey (*Spergula arvensis*), thorn apple (*Datura stramonium*), twin cress (*Coronopus didymus*), willow weed (*Polygonum persicaria*).

Tolerant weeds

Annual poa (*Poa annua*), smooth witchgrass (*Panicum dichotomiflorum*), summer grass (*Digitaria sanguinalis*).

Results from the experiments reported here have provided the basic information on the activity and efficacy of Greenscape and have been incorporated in the recommendations for use in the registration of Greenscape in New Zealand.

REFERENCES

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