NON-SELECTIVE VEGETATION CONTROL WITH KARBUTILATE

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Summary

Trials are reported where karbutilate has been evaluated for non-selective vegetation control. Karbutilate was superior to bromacil in the presence of paspalum (*Paspalum dilatatum*), more similar in the absence of paspalum, but poorer when couch (*Agropyron repens*) was present. Karbutilate at 7.8 kg/ha and 11.2 kg/ha was markedly superior to a mixture of 9 kg simazine plus 5.6 kg 2,2-DPA plus 2.8 kg amitrole. Species susceptibility data show a broad spectrum of weed control with some resistant species such as dandelion (*Taraxacum officinale*). Results from a follow-up re-treatment trial show that acceptable weed control was maintained when an initial rate of 11.2 kg/ha karbutilate was followed annually with 4.5 kg/ha.

INTRODUCTION

THE urea-carbamate herbicide, karbutilate, has been evaluated for non-selective vegetation control in a trials programme that commenced in 1969. Karbutilate had shown promise in overseas work (Hargood, 1969) as a non-selective, providing broad-spectrum pre- and post-emergence weed control, coupled with long-term sterilant activity. The work reported here compares karbutilate with other materials used for non-selective vegetation control, such as bromacil, simazine, 2,2-DPA and amitrole, over a range of locations, species and times of application. Trial sites were selected where a large number of species were present, including paspalum (*Paspalum dilatatum*), yarrow (*Achillea millefolium*), and plantains (*Plantago* spp.) which were regarded as "problems" when using current standard materials. Subsequent annual re-treatment on some of the trials with lower rates of karbutilate had the object of maintaining treated areas at an acceptable level of weed control.

METHOD AND EXPERIMENTAL

Most of the trials in the series were located on waste land and railway sidings. The design of each trial was a randomized block with three to six replicates. The size of plots was from 2 to 3 m wide by 10 to 15 m long. The treatments were boom applied using a plot sprayer delivering 670 to 900 l/ha. In the case of the simazine/2,2-DPA/amitrole treatments, the water rate was increased to 1550 l/ha. At the time of spraying, the vegetation height varied from 23 to 50 cm.

Prior to the application of treatments, a record was made of the species present, and subsequently, at each routine assessment, the presence of any surviving plants and new seedlings was recorded.

Treatments were also visually scored for non-selective vegetation control at 6- to 8-week intervals. The scale used was 0 = no control to 10 = complete control (bare ground). A score of 7 was considered to represent an "acceptable level" of weed control. Two independent assessors scored the trial and recorded the species present at each assessment.

Annual follow-up treatments were applied as a strip down one side of each block, leaving one half without re-treatment for comparison.

All rates of chemical shown are expressed as kg a.i. per hectare.

RESULTS

Results are divided into four sections: Treatment effect; species susceptibility; time of application; and follow-up treatment.

Treatment Effect

Results from four trials are shown in Tables 1 to 4.

On the 1969 Palmerston North trial (Table 1), 7.8 and 11.2 kg karbutilate gave the best non-selective vegetation control. Both rates were similar, providing 6 to 8 months' acceptable weed control. At this site, where paspalum was the main species recovering following treatment, bromacil and the mixture of simazine/2,2-DPA/amitrole gave poor control. There was an effect due to the rate of karbutilate, the 7.8 and 11.2 kg rates gave a higher level of control than the 4.5 kg rate, which was not sufficient to control paspalum. There was an upsurge in activity particularly from the two higher rates of karbutilate during the summer one year following treatment.

TABLE 1: 1969 PALMERSTON NORTH TRIAL

(Date of application: December 6, 1969)

Treatment (kg/ha)	*Score* Months after Treatment*							
	2	*4*	*6*	*8*	*10*	*12*	*14*	*18*
karbutilate 4.5	8	7	7	5	5	5	6	2
karbutilate 7.8	9	9	8.5	7	6	6	7.5	3
karbutilate 11.2	9	9	9	8	6	8	8	4
bromacil 7.8	5.5	6	6	5	5	6	4	1
bromacil 11.2	6	6	7	7.5	7	7	6	1
simazine 9/2,2-DPA 5.6/amitrole 2.8	6	6	5.5	3	2	2	2	0

*0 to 10 scale (10 = maximum kill).

The 1970 Longburn trial (Table 2) was located on a site containing virtually no paspalum but considerable couch (*Agropyron repens*) and tall fescue (*Festuca arundinacea*). Couch was the main species recovering on this trial and in this situation the 11.2 kg bromacil treatment gave the best results. Couch was only partially controlled by 7.8 and 11.2 kg karbutilate and 7.8 kg bromacil, and after 6 months was recovering on these treatments. The mixture of simazine/2,2-DPA/amitrole and the 4.5 kg karbutilate treatments gave poor control, particularly of couch.

TABLE 2: 1970 LONGBURN TRIAL

(Date of application: October 30, 1970)

Treatment (*kg/ha*)	*Score** *Months after Treatment*					
	2	*4*	*7*	*9*	*12*	*14*
karbutilate 4.5	7	5	3	2	1	1
karbutilate 7.8	8.5	8	6	6	5	2
karbutilate 11.2	9	9	6	6	3	1
bromacil 7.8	8.5	8	6	6	5	2
bromacil 11.2	9	9	8	8	6.5	5
simazine 9/2,2-DPA 5.6/amitrole 2.8	7.5	7	3.5	3	1	0

*0 to 10 scale (10 = maximum kill).

The 1970 Palmerston North trial (Table 3) was located on a railway-land site containing a wide range of species including some paspalum. All rates of karbutilate and bromacil gave a very high level of weed control. The small difference in favour of the two higher rates of karbutilate was due to the better control of paspalum provided by these treatments. The mixture of simazine/2,2-DPA/amitrole gave poorer control.

TABLE 3: 1970 PALMERSTON NORTH TRIAL

(Date of application: December 21, 1970)

Treatment (*kg/ha*)	*Score** *Months after Treatment*					
	1	*3*	*7*	*10*	*12*	*14*
karbutilate 4.5	9	9	9	8	6.5	6
karbutilate 7.8	9	9	10	9	8	7
karbutilate 11.2	9	9	9	9	8	7
bromacil 7.8	8.5	8.5	8.5	8.5	7.5	5
bromacil 11.2	9	8.5	9	9	7.5	6
simazine 9/2,2-DPA 5.6/amitrole 2.8	8.5	9	8	6	4	2

*0 to 10 scale (10 = maximum kill).

On the 1970 Hamilton trial (Table 4), karbutilate was markedly superior to bromacil at equivalent rates and to the mixture of simazine/2,2-DPA/amitrole. This difference was due to the greater effect of karbutilate on paspalum.

TABLE 4: 1970 HAMILTON TRIAL

(Date of application: October 20, 1970)

Treatment (*kg/ha*)	*Score** *Months after Treatment*				
	1	*2*	*3*	*4*	*9*
karbutilate 11.2	7.5	9	9	8.5	6
bromacil 11.2	5	5	3.5	2.5	1
simazine 9/2,2-DPA 5.6/amitrole 2.8	6.5	5.5	3	1.5	1

*0 to 10 scale (10 = maximum kill).

Species Susceptibility

The treatment effects shown in Tables 1 to 4 are a consequence of the reaction of the various weeds on each trial to the rates of karbutilate used. A summary of the species susceptibility data from these trials is shown in Table 5.

Table 5 shows the control expected from karbutilate on any of the species present. For example, paspalum which was present at spraying was controlled for 8 months by 11.2 kg karbutilate, but was not controlled by 4.5 kg. Seedling paspalum appeared on the 4.5 kg rate at 4 months and on all treatments after 8 months. By 8 months following the use of 11.2 kg karbutilate, treated areas characteristically contained some of the original couch, although this was stunted, Indian doab (*Cynodon dactylon*) and Mercer grass (*Paspalum paspaloides*) if these were present at spraying, and a few surface germinated seedlings of paspalum, browntop (*Agrostis tenuis*) and Yorkshire fog (*Holcus lanatus*). The only flatweeds present were docks (*Rumex* spp.), some seedling oxtongue (*Picris echioides*) and dandelion (*Taraxacum officinale*), the latter being a real resistant. Greater bindweed (*Calystegia sepium* agg.) successfully reinvaded treated areas, if present in the surrounds, after 8 months.

Time of Application

On a predominantly paspalum site in Hamilton, karbutilate at 11.2 kg was applied at four times from September to March. The results from this trial are shown in Fig. 1.

Karbutilate acted more rapidly and provided a higher level of weed control when applied in September and November than when applied in December or March. In similar trials in Palmerston North, karbutilate consistently gave poorer weed control when applied in the late autumn to early spring period than when applied to plants making active growth during late spring to early autumn.

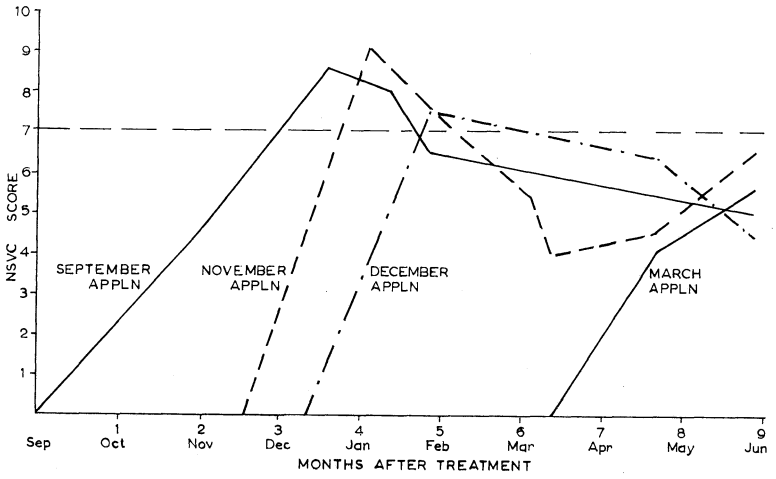

FIG. 1: *Paspalum site, 1970 Hamilton time of application trial (11.2 kg/ha karbutilate).*

TABLE 5: EFFECT OF RATES OF KARBUTILATE ON INDIVIDUAL SPECIES

(+ = present, — = absent. Parentheses denote seedlings)

Species Present at Treatment	*Species Present at Times after Treatment*					
	Rates of Karbutilate (kg/ha)					
	4 months		*8 months*		*12 months*	
	4.5	*11.2*	*4.5*	*11.2*	*4.5*	*11.2*
Mercer grass (*Paspalum paspaloides*)	+	+	+	+	+	+
Paspalum (*Paspalum dilatatum*)*	+(+)	—	+(+)	(+)	+(+)	+(+)
Tall fescue (*Festuca arundinacea*)	+	+	+	—	+	—
Couch (*Agropyron repens*)	+	+	+	+	+	+
Browntop (*Agrostis tenuis*)	+	—	(+)	(+)	(+)	(+)
Yorkshire fog (*Holcus lanatus*)	—	—	(+)	(+)	—	—
Timothy (*Phleum pratense*)	—	—	(+)	—	(+)	—
Perennial ryegrass (*Lolium perenne*)	—	—	(+)	—	(+)	(+)
Prairie grass (*Bromus unioloides*)	+	—	+	—	+	—
Indian doab (*Cynodon dactylon*)	+	+	+	+	+	+
Sweet vernal (*Anthoxanthum odoratum*)	—	—	—	—	—	—
Barley grass (*Hordeum* spp.)	—	—	—	—	—	—
Early hair grass (*Aira praecox*)	—	—	—	—	—	—
Meadow foxtail (*Alopecurus pratensis*)	—	—	—	—	—	—
Crested dogstail (*Cynosurus cristatus*)	—	—	—	—	—	—
Bromus mollis (*Bromus mollis*)	—	—	—	—	—	—
Kikuyu grass (*Pennisetum clandestinum*)	+	—	+	—	+	—
Rushes (*Juncus* spp.)	+	—	+	—	+	—
Nut grass (*Cyperus rotundus*)	—	—	—	—	—	—
Summer grass—bristle grass†	—	—	—	—	—	—
Docks (*Rumex* spp.)	+	+	+	+	+	+
Fireweeds (*Erechtites* spp.)	—	—	—	—	—	—
Yarrow (*Achillea millefolium*)‡	—	—	—	—	—	—
Oxtongue (*Picris echioides*)	+	—	+(+)	(+)	+(+)	(+)

Plantains (*Plantago* spp.)	—	—	—	—	(+)	(+)
Dandelion (*Taraxacum officinale*)	+	+	+	+	+	+
Hawkbit (*Leontodon taraxacoides*)	—	—	—	—	(+)	(+)
White clover (*Trifolium repens*)	—	—	+	—	+	+
Greater bindweed (*Calystegia sepium*)	—	—	+	+	+	+
Buttercup (*Ranunculus repens*)	+	—	+	—	+	—
Sow thistles (*Sonchus* spp.)	—	—	(+)	—	(+)	—
Cleavers (*Galium aparine*)	—	—	+	—	+	(+)
Sorrel (*Rumex acetosa*)	+	—	+	—	+	(+)
Black nightshade (*Solanum nigrum*)	—	—	—	—	—	—
Scarlet pimpernel (*Anagallis arvensis*)	(+)	—	(+)	—	(+)	—
Lotus spp.	—	—	—	—	(+)	—
Cudweed (*Gnaphalium collinum*)	+	—	+	—	+	—
Wild portulaca (*Portulaca oleracea*)	—	—	(+)	(+)	(+)	(+)
Wild turnip (*Brassica campestris*)	—	—	—	—	—	—
Spurge (*Euphorbia* spp.)	—	—	(+)	(+)	(+)	(+)
Toadflax (*Linaria vulgaris*)	—	—	(+)	—	(+)	(+)
Pennyroyal (*Mentha pylegium*)	—	—	—	—	—	—
Chickweed (*Stellaria media*)	—	—	—	—	—	—
Speedwell (*Veronica arvensis*)	—	—	—	—	—	—
Hemlock (*Conium maculatum*)	—	—	—	—	—	—
Fumitory (*Fumaria officinalis*)	—	—	—	—	—	—
Medicago spp.	—	—	—	—	—	—
Birdsfoot trefoil (*Trifolium arvense*)	—	—	—	—	(+)	(+)
Mayweed (*Anthemis matricaria*)	—	—	—	—	(+)	—
Scotch thistle (*Cirsium vulgare*)	(+)	—	(+)	—	(+)	(+)
Cut-leaved geranium (*Geranium dissectum*)	(+)	—	+	—	+	—
Daisy (*Bellis perennis*)	—	—	—	—	—	—

*Paspalum has required 14 kg/ha for control in some Waikato trials.
†*Setaria* spp. and *Digitaria* spp.
‡Yarrow has been controlled for 9 months by 14 kg/ha in South Island trials. Trials with lower rates are under way.

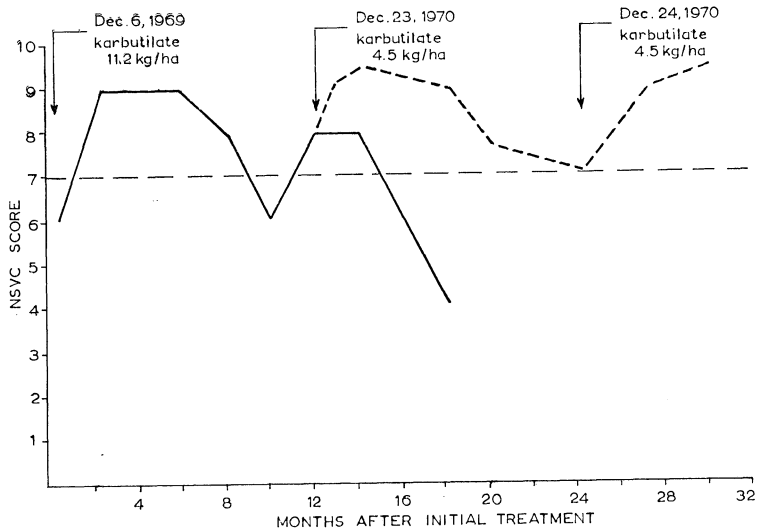

FIG. 2: *Follow-up treatment, 1969 Palmerston North trial.*

FOLLOW-UP TREATMENT

To maintain an acceptable level of weed control, there was a need for re-treatment (refer Tables 1 to 4). On the 1969 Palmerston North trial, the initial treatment of 11.2 kg karbutilate was followed by annual applications of 4.5 kg karbutilate. The results from this follow-up are shown in Fig. 2.

On this trial, long-term acceptable weed control was maintained by the programme used, apart from a short period in the first winter following the initial application. The follow-up treatment completely controlled any recovering paspalum, oxtongue and docks.

DISCUSSION

When applied during periods of active plant growth, karbutilate provided broad-spectrum non-selective vegetation control for a period of 6 to 9 months. This material controlled paspalum at rates of 7.8 kg and above and was, from this point of view, superior to bromacil at similar rates, and markedly superior to the mixture of simazine/2,2-DPA/amitrole. This result has considerable practical importance when viewed against the background of increasing paspalum in non-selective vegetation control areas. In the absence of paspalum, karbutilate and bromacil were more similar, and both were superior to the mixture of simazine/2,2-DPA/amitrole. Where couch was present, however, bromacil was superior to karbutilate.

The species susceptibility table shows a broad spectrum of weeds controlled. There were some exceptions, notably dandelion which was a real resistant and others such as docks and oxtongue which, although controlled by subsequent annual re-treatment, survived the initial application of 11.2 kg. Indian doab, Mercer grass and couch were not well con-

trolled by the rates of karbutilate used. Trials evaluating the role of additives to karbutilate for increasing both the spectrum of weeds controlled and the length of control obtained are continuing. The time of application trials suggest that karbutilate works best when plants are making active growth. Karbutilate acts almost entirely by root absorption and this time of application effect is probably related to poorer uptake during the winter months, particularly from summer-growing species such as paspalum.

The follow on re-treatment trial has demonstrated that long-term acceptable weed control can be maintained by a programme involving the initial application of a high rate of karbutilate, followed by subsequent annual summer applications of a lower rate.

ACKNOWLEDGEMENTS

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REFERENCE

Hargood, E. S., 1969. *FMC Corp. Bull.*

LUCERNE

CHAIRMAN'S SUMMARY

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D. J. Musgrave's paper, which establishes basic principles for weed control in seedling lucerne, was an important contribution. It would be interesting to see these controlled studies extended to include comparisons in the presence of weeds, and at various cutting heights. The discussion exposed a wide range of opinion on control of weeds in seedling lucerne and there is a definite need to obtain more documented evidence on the relative merits of chemical and management control in several localities.

C. G. Janson and J. H. Hoglund both presented excellent papers, highlighting the importance of sound cultural practices in control of weeds in lucerne. When a farmer or farm adviser is confronted with a weed problem in lucerne the first question should not be "What shall I spray it with?" Rather, he should examine the management practices: Is it defoliated at the correct stage of growth? Has the fertilizer programme been adequate? Is weed seed being returned in hay? Is there a disease or pest problem?

Chemical control is not the answer to poor lucerne management. It is very useful to control weeds after bad management has occurred, but it must be used in combination with a change to correct management.

The paper by F. A. Meeklah *et al.* was rather disappointing, particularly after the three papers on cultural weed control. The reason for conducting the trial was rather weak. Surface cultivation was not the only method of weed control in lucerne in the past—nor is chemical control the main method today. The description of the trial itself was quite sketchy.

In the last 25 years the area of lucerne has risen from 16,000 to 140,000 hectares and is likely to continue to rise as lucerne increases in importance, particularly for processing. Hand in hand with this rise seems to be an increase in disease and pest problems. The discovery of bacterial wilt by Dr R. C. Close in 1970 was a salutary lesson, showing that we cannot be complacent and assume that the major diseases and pests of lucerne overseas are not likely to occur in this country. It is pleasing to have the results of current work in this field reported in three very good papers. But increased research effort is certainly very necessary. I would hope that DSIR are aware of this increasing problem and can be persuaded to direct funds accordingly.