FURTHER DEVELOPMENTS IN NON-SELECTIVE WEED CONTROL

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SUMMARY

THE efficiency of various ratios of amitrole/dalapon mixtures at varying rates of application is described and compared with dalapon and amitrole alone. The influence of certain wetting agents and volumes of spray liquid on the performance of a 5:1 dalapon/amitrole mixture is discussed. Three mixtures of soil residual weedkillers with foliage absorbed compounds are compared in their knock-down ability and end kill of vegetation. Conclusions are drawn from the trials described, taking into consideration evidence obtained from a further 20 trials, completed or still in progress.

TRIAL 1

In view of the apparent disagreement on the importance of various ratios and rates of dalapon/amitrole mixtures a trial was laid with the object of determining differences in the knock-down and end kill of vegetation, using mixtures comprising ratios of 5:1, 4:1, 3:1 and 2:1. These mixtures were applied at 15 and 10 lb a.i. per acre to plots 1/200th acre each and replicated 4 times. The Oxford Precision sprayer used at a constant pressure of 40 lb sq. in. and an application rate of 92 gallons per acre ensured a thorough coverage of the vegetation, which consisted of a balanced mixture of annual and perennial grasses, clovers, and broad-leaf weeds. The vegetation was 3 in. to 12 in. in height and representative of vegetation on roadside, drains, and waste land.

Observations were made at regular intervals and results recorded as a visual rating from 0 to 10. The mean rating of all replicates is tabulated below at the two critical periods four weeks and 12 weeks after application.

TRIAL 1—LAID AT BELL BLOCK, NEW PLYMOUTH, ON 27/9/60

Treatment lb a.i. per acre		Ratio	Mean rating		
dalapon	amitrole		4 weeks	12 weeks	
12.5	+	2.5	5:1	8.75	8.4
10	+	5	2:1	8.7	8.5
11.25	+	3.75	3:1	8.5	8.4
12	+	3	4:1	8.3	8.2
6.66	+	3.33	2:1	7.9	8.1
7.5	+	2.5	3:1	7.8	7.2
8	+	2	4:1	7.6	6.7
8.33	+	1.66	5:1	7.4	7.2
5				1.4	1.6
10				2.3	3.1
15				4.1	4.0
20				3.8	4.2
	2.5			3.6	1.4
	5.0			4.2	1.6

The above mean rating indicates that no significant differences are apparent in the ratio treatments at the higher rate of application (15 lb a.i. per acre) in either knock-down effect (four weeks after application) or the end kill of vegetation (12 weeks after application). However, in the more marginal dosage rate (10 lb a.i. per acre) there is a noticeable trend between the highest and the lowest dosage of amitrole per acre and therefore probably a significant difference between the extremes. This suggests that there is a marginal quantity of not less than 2½ lb a.i. per acre of amitrole required for adequate control of mixed vegetation. It is

also obvious that the ratio of dalapon to amitrole is meaningless and that results are more allied to the actual quantity of each active component applied per acre. The mean rating for dalapon and amitrole indicates that their spectrum of efficiency on a mixed vegetation is not wide enough for them to be useful for non-selective weed control purposes by themselves.

TRIAL 2

The object of the second trial was to evaluate the influence of the volume of water per acre and the addition of 0.1 per cent of six wetting agents on the knock-down and end kill of vegetation with a dalapon/amitrole mixture. The formulation selected for this trial was a 5:1 dalapon/amitrole mixture applied to give a deposit of 6.25 lb a.i. per acre of dalapon without wetting agent plus 1.25 lb a.i. per acre of amitrole.

This trial has not given any conclusive indication of the optimum volume of spray liquid required or of advantages gained by the incorporation of additional surface active agents. Volumes of 75 gallons of spray liquid per acre or more were observed to give thorough wetting of all foliage. Therefore, in the absence of further evidence, it appears that foliage absorbed non-selective weedkillers should be applied at rates sufficient to wet all foliage which may be achieved by applying 75 to 200 gallons of spray liquid per acre depending on the height and density of vegetation.

Among the surface active agents tested only ACP.M.424 and NL.346 have consistently either equalled or given superior results to the dalapon/amitrole mixture. It appears also that the addition of surface active agents to lower volumes of spray liquid per acre holds some promise, but no recommendation can be made until further results from trials with a wider range of surface active agents substantiate this.

TRIAL 3

Since it had been previously established from trials and large scale applications that most of the commercially available soil residual chemicals suffer drawbacks with regard to either their spectrum of species controlled or knock-down ability, trials were laid with three safe soil sterilants, the object being to determine their efficiency when combined with foliage absorbed weedkillers. The sterilants used in these trials were monuron, diuron, and simazine, each of them formulated to give 16 lb a.i. per acre of either monuron, diuron, or simazine plus 5 lb a.i. per acre of amitrole and 14 lb a.i. per acre of dalapon.

The mean ratings quoted in the tables below were recorded in two trials, one laid on the 23/7/60 and the other on 19/2/61. Each visual rating quoted represents a mean rating of three replicates.

TRIAL 3—LAID AT BELL BLOCK, NEW PLYMOUTH, ON 21-23/7/60

Material	Application rate (lb a.i. per acre)	Mean rating	
		5 weeks	26 weeks
Simazine/dalapon/amitrole	35	9.3	6.4
	17.5	9.0	3.0
Diuron/dalapon/amitrole	35	9.2	4.7
	17.5	9.0	2.5
Monuron/dalapon/amitrole	35	9.9	3.2
	17.5	9.2	1.1
Simazine	20	8.0	7.1
	10	6.5	5.7
Diuron	32	7.0	6.4
	16	6.5	2.3
Monuron	32	9.2	6.6
	16	7.7	2.7

TRIAL 4—LAID ON 18-19/2/61

Material	Application rate (lb a.i. per acre)	Mean rating	
		5½ weeks	13 weeks
Simazine/dalapon/amitrole	35	9.0	9.8
	17.5	6.5	6.8
Diuron/dalapon/amitrole	35	9.1	9.6
	17.5	9.0	8.9
Monuron/dalapon/amitrole	35	8.9	9.3
	17.5	6.9	6.3
Simazine	20	8.5	8.6
	10	6.1	7.3
Diuron	32	8.0	8.3
	16	4.7	5.2
Monuron	32	9.0	9.1
	16	7.0	7.5

In these trials the high rate of diuron/dalapon/amitrole mixture showed up satisfactorily, though slightly inferior in the sterilisation period to the simazine mixture. At the lower rate of application, particularly in the second trial, the performance of the diuron/dalapon/amitrole mixture was superior to its equivalent based on simazine and monuron. The excellent knock-down properties of simazine experienced in these trials have been probably due to relatively high initial rainfall conditions which normally could not be guaranteed during the usual treatment period for soil sterilants during the spring. Therefore the knockdown ability of the simazine alone may not normally be quite as complete as that reported in these trials.

Due to a severe infestation of paspalum (*Paspalum dilatatum*) and plantain (*Plantago lanceolata*) in one part of the trial area, variable results have been recorded between the replicates. Paspalum, particularly, tends to dominate once the residual action of the sterilant declines and because the competition from the other annual species has been eliminated.

These trials have highlighted the drawbacks and advantages of the sterilants under trial. Monuron and diuron when used alone seem to be more reliable than simazine in the initial kill of vegetation, particularly of perennial and summer germinating grasses, but give limited or no control of plantains (*Plantago* spp.), Californian thistle (*Cirsium arvense*), fennel (*Foeniculum vulgare*), perennial buttercups (*Ranunculus* spp.), water couch (*Paspalum distichum*), and cocksfoot (*Dactylis glomerata*). Though satisfactory in the control of plantains, simazine gives only slightly better control of the other species listed. It gives inferior control of paspalum and summer grasses (*Panicum* and *Digitaria* spp.). This deficiency cannot be fully compensated for by its longer soil life, but can be off-set by the addition of further specific weedkillers.

It appears that the three soil sterilants studied are not sufficiently complimentary to be useful for non-selective weed control mixed with each other. It must also be stressed that soil sterilants alone become useful for total vegetation control only if they are capable of destroying a wide variety of vegetation initially and at an economic level. None of the sterilants under test has fulfilled this need, monuron being superior to both diuron and simazine in this respect.

Linked with this consideration is the main conclusion which may be drawn from these trials. A better performance was recorded per pound of active sterilant where these chemicals were applied in conjunction with foliage absorbed weedkillers, as compared with applications on their own. When applied without additives the active sterilant applied was up to twice as high and yet the residual control six months after application was comparable. The knock-down effect of the vegetation with the mixtures, particularly within the first four weeks, was distinctly superior and possibly more apparent under drier soil conditions than that experienced in the trials. In view of the prolific growth conditions in New Zealand it is inadvisable to aim at more than six months' complete control of vegetation,

and therefore it appears wasteful to try to smother existing vegetation with heavy rates of relatively expensive soil sterilants, particularly so if quicker acting and cheaper weedkillers may be used. Furthermore, irrespective of the economic quantity of soil sterilant applied, resistant or semi-resistant plant species (inevitably there are some) will commence to cover the treated area probably within the first six months, and certainly within a year, thus defeating the purpose of their application, that is, the maintenance of bare grounds.

In the trial under discussion and further trials conducted during the last 18 months additional sterilants have been evaluated. Among these were fenac, 2,3,6-TBA, 2,6-DBN, and triazine compounds. None of these compounds proved to date to be in general as effective as the three sterilants described earlier. Further work, however, will be undertaken to evaluate their usefulness in mixtures, with the object of widening the spectrum of efficiency of total vegetation control weedkillers at present available.

ADDITIONAL TRIALS

Trials consisting of a range of products similar to those described in the third trial were laid in various parts of New Zealand on roadsides, waste land, and drains to gain further knowledge under varying plant, growth, and climatic conditions. The following summary may be given on the basis of results recorded to date.

(a) Drains

For constant control the minimum rate of application of dalapon and amitrole was found to be 10 lb a.i. per acre of dalapon and 2½ lb a.i. per acre of amitrole. Autumn applications were found to be superior to spring and early summer applications, particularly where perennial grasses such as tall fescue (*Festuca arundinacea*), water couch (*Paspalum distichum* and *P. vaginatum*), and reed sweet grass (*Glyceria maxima*) were present in quantity. An important difference was observed between the knock-down of reed sweet grass with dalapon at 20 lb a.i. per acre and dalapon at 10 lb a.i. per acre plus amitrole at 2½ or 5 lb a.i. per acre, the latter giving much superior results. 2,4-D in the form of the sodium salt used in conjunction with the dalapon/amitrole mixture has given control as effective as the esters of 2,4-D, where 2,4-D was required to give satisfactory control of drain weeds such as water cress (*Nasturtium officinale*), monkey musk (*Mimulus guttatus*), water plantain (*Alisma plantago aquatica*), tiger weed (*Bidens vulgata*), willow herb (*Epilobium* sp.), buttercups (*Ranunculus* spp.), and smart weed (*Polygonum* spp.).

It is also suggested that the use of dalapon/amitrole/sodium salt of 2,4-D mixtures has resulted in less change of vegetation which sometimes occurs following repeat applications of dalapon alone or less complex mixtures.

Where an endeavour was made to maintain drains bare of vegetation for excessive periods of time submerged water weeds appeared, even though they were practically non-existent at the time of spraying. It appears, therefore, unwise to employ chemicals for drain maintenance in such a way as to maintain the banks all the year round in a condition comparable to that obtained for relatively short periods of time following mechanical or manual cleaning.

To gain the maximum advantage of the foliage absorbed chemicals and to obviate the danger of creating new problems they ideally should be used in the autumn period and reapplied in the spring only if the drains were previously neglected or if the flow of the water is impeded by a prolific spring growth of floating sweet grass (*Glyceria fluitans*) or other species growing profusely at that time.

Water pepper (*Polygonum hydropiper* and other *Polygonum* spp.) appear to be more susceptible to 2,4-DP, and it may be advantageous therefore to add this compound to the dalapon/amitrole spray liquid in replacement of 2,4-D where these weeds become predominant.

Soil residual chemicals (sterilants), particularly if combined with foliage absorbed weedkillers, need further evaluation. It appears that they could be used to advantage for restoring very weedy drains by early autumn applications while the drains are dry, ensuring that the spraying is restricted to the ditch bottom and only a few feet up the banks. A repeat application during the following spring, if required, should be made with foliage absorbed weedkillers only.

It must be stressed again that the use of soil sterilants is meaningless if the vegetation present at the time of application cannot be eliminated completely and as quickly as possible.

(b) Roadsides, Footpaths, Industrial Areas, and Waste Land

The selection of the most suitable type of weedkillers is largely dependent on the composition of vegetation to be controlled. Because the usual object of spraying is to destroy all vegetation and to maintain the ground bare as long as possible, it is only logical that one chemical alone, whether leaf absorbed or root absorbed, is not likely to control all vegetation present. Mixtures offer far greater chance of success, but even so the composition of the vegetation must be studied to obviate unsatisfactory results. In paspalum dominant areas it is advisable to use foliage absorbed weedkillers in preference to soil residual chemicals in the autumn or the late autumn period. Alternatively, the use in the autumn of a soil residual chemical in conjunction with dalapon, followed up with an application of dalapon or dalapon/amitrole mixtures as required is advisable until good control of paspalum has been achieved. It must be pointed out, however, that dalapon or dalapon/amitrole mixtures will give effective control of paspalum during the autumn period only. A mixture of soil residual and foliage absorbed chemicals can then be used in either spring or autumn.

In areas where paspalum is absent the maximum length of bare ground can be obtained from spring applications. The logical procedure under such conditions would be to use dalapon or dalapon/amitrole in the autumn to control perennial grasses, and in such a way create the best conditions for a follow-up treatment with a residual chemical in the spring. Where summer germinating grasses are abundant monuron or diuron will give superior results even though simazine normally gives the longest sterility of the ground.

Vegetation growing through a sealed surface is best controlled by foliage absorbed chemicals, because soil sterilants could not be applied to ensure adequate penetration of the root zone of the plants.

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