GRASS - KILLING CHEMICALS: RECENT RESULTS IN THE CONTROL OF GRASS WEEDS IN NEW ZEALAND

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I wish to restrict this talk to the control of grass weeds with grass-killing chemicals. Their use in the control of mixed weed species in crops will not be considered except in the case of lucerne. Grass weeds are particularly serious in lucerne and much experimental work has been directed at finding means to control them. Only the more recently developed chemicals will be dealt with, in particular TCA, IPC, CIPC, Dalapon, CMU, and PMU and DCMU. Reference will also be made to the use of borates and chlorates. I will confine myself to results of trials of the Extension Division of the Department of Agriculture and their application to weed problems in this country.

TCA

Approximately 100 experiments have used TCA for grass control. The first grass to consider is kikuyu.

(a) Kikuyu (*Pennisetum clandestinum*)

Although many farmers have a contrary opinion, I do not believe that the eradication of kikuyu is necessary or desirable in many dairying pastures of Northland. However, in those places where kikuyu is not wanted trials have shown that it may be eradicated with about 50lb. TCA per acre, applied in autumn followed by spot treatment of surviving plants the following spring. Good results have been secured by spraying the upturned sod, but if this is not possible, it is necessary to mow closely or graze the kikuyu before treatment. Perennial ryegrass and clovers have recovered from applications of 50lb. TCA per acre. Better results have been secured with sprays than with dusts.

Failures with TCA have occurred when rank kikuyu has been treated, also on free-draining volcanic soil, particularly if application is followed by heavy rain. A follow-up treatment must be given in the spring or re-infestation from surviving plants will be rapid. Every endeavour must be made to stimulate the growth of desirable plants by sowing and top-dressing as soon as possible, say 2 months after treatment.

(b) Barley Grass (*Hordeum murinum*)

Barley grass has been already considered in this Conference and I will not go into any detail. TCA is promising, but not wholly satisfactory. Possibly the best treatment is 10 to 20lb. per acre applied on young

seedlings in autumn, followed by a lighter application on newly germinating plants in early spring. Both too much rain and not enough rain may give unsatisfactory control of barley grass.

(c) Couch (*Agropyron repens*)

Trial results show clearly that one cannot expect one application of TCA to give complete control of couch unless surviving rhizomes are killed by cultivation or a smother crop. In several experiments 20 to 40lb. TCA per acre, followed later by cultivation, has given good control. Nevertheless in a number of cases plots have been re-infested from surviving rhizomes, although they were treated with much higher rates of TCA. Unsatisfactory results have occurred as a result of very dry weather after application of TCA and from too much rain after the treatment was applied. In one trial control was poor probably because the TCA was mixed through too great a depth of soil shortly after application. In another case TCA and topsoil were both removed by wind.

The recommended method is to follow TCA treatment with a resistant smother crop to complete the elimination of the weed. Rape, chowmoellier, or potatoes are suitable crops. Intercultivated potatoes are, perhaps, one of the best crops; they may be damaged under dry conditions, but have recovered even from an 80lb. per acre application of TCA. TCA should be applied when the couch is making growth, particularly in spring. Prior cultivation should aim at chopping the couch into small pieces by discs so that there is a better chance of "saturating" the plants growing from these small pieces with TCA. The area should be left for 2 or 3 weeks if the soil is moist, then worked-up to sow the TCA resistant crop.

Much remains to be learnt concerning the best way of using TCA to control couch, but this seems likely to be one of the most promising uses for this chemical. Costs of treatment are often not unduly high in comparison with fallowing methods, if allowance is made for the loss of revenue during the time the land is out of production through fallowing for weed control.

(d) Grass Weeds in Lucerne (Annuals and Seedling Perennials)

Low rates, say 10 to 20lb. TCA per acre, are usually a safe and effective way of killing seedling grasses in established lucerne.

For established twitchy perennials such as browntop, however, up to 40lb. TCA per acre may be needed for effective control. Lower rates, say 15 to 30lb., may be quite satisfactory if the twitch is stimulated into growth by cultivation. Application must be made when the lucerne is dormant, preferably early in the dormant season, to avoid serious damage. The rates of TCA used will suppress lucerne growth in the following season, but recovery is usually complete after the first cut. TCA can be used with less chance of damage to lucerne in colder districts where the lucerne is more completely dormant in winter. It is, however, important to stimulate the lucerne into vigorous growth as soon as possible the following season so that it may have a better chance of suppressing the surviving browntop. In many trials re-infestation has followed a reasonable kill with the chemical.

The cause of browntop invasion was not removed and nothing else could be expected. Adequate lime and fertiliser and good lucerne management must follow chemical treatment with TCA.

Field experience must decide the point beyond which it is not worth while to use chemicals; the point where there is too much grass and too little lucerne. It is far better to keep a stand weed-free with low rates of TCA than to attempt to resurrect an old and weedy stand where the lucerne is weak and will be weakened still more by the high rates of TCA needed to kill the strongly established grass.

(e) Nassella (*Nassella trichotoma*)

Nassella has been considered in a previous Conference and is of less interest in this district. Good results have been secured with TCA from 25lb. per acre applied in spring, the following autumn, and again the following spring. At Blenheim one application during summer gave much better results than treatment at other times of the year. Fresh growth of nassella after burning is more susceptible. Even light rates of TCA will prevent seeding, and this has been achieved from aerial application over extensive areas. TCA cannot be considered entirely satisfactory for nassella control, but is the best chemical tested so far. However, preliminary trials have shown promising results from Dalapon.

(f) Weeds in Irrigation Ditches

Applications of 100 to 150lb. TCA per acre in winter to mixed grasses in irrigation ditches have given worthwhile control. Better results have followed where rough growth has been removed by burning or grazing before chemical treatment. TCA is only useful for grasses growing in the soil; not for floating aquatic weeds. Dry ditches must be treated.

(g) Tall Fescue (*Festuca arundinacea*)

Disappointing results have followed applications up to 200lb. TCA per acre on tall fescue, and its use is not recommended on this species.

(h) Sedges (*Carex* spp.)

A measure of control has resulted from 150 to 200lb. per acre of TCA but not sufficient to make the use of TCA worth while on sedges.

(i) Roadside Grasses

TCA is of little use in soil sterilisation, as its effect lasts for too short a period and is confined to grasses.

(j) Miscellaneous Species

TCA on other twitchy grasses has given results similar to those on couch. Paspalum is resistant. Manchurian rice grass at Dargaville, purua grass (*Scirpus maritimus*) at Thames, and *Pennisetum macrourum* at Kaikoura are all too resistant to TCA for economic treatment. In one trial good control of floating sweet grass (*Glyceria fluitans*) was secured with an application of 80lb. TCA per acre when the land had dried out.

Carbamates (IPC and CIPC)

Some 25 trials have included one or both of these chemicals. Their main use has been on barley grass and weeds in lucerne. On barley grass most success has followed application of 4 to 8lb. CIPC in Otago, but no real success has been obtained in North Island districts. Similarly it is only in southern districts that IPC has been used successfully on lucerne in the dormant season at 3 to 4lb. per acre. Lucerne can tolerate up to about 12lb. per acre IPC, which under good conditions will control grass, especially seedlings. However, carbamates have been less effective in the warmer districts, probably because they volatilise too readily. An emulsifiable form of IPC was used in a number of trials on lucerne, and this proved unsuitable for application in the growing season, as the solvent scorched the lucerne leaves severely.

Trials at Invermay showed that IPC severely inhibits or arrests grass growth for several months. It is much more effective than MH in this respect. For this reason IPC cannot be recommended for general application to pastures for the control of annuals such as barley grass. The usefulness of the carbamates for grass control is primarily on legumes, particularly lucerne, in colder districts. Here they will give reasonable control under conditions where TCA would be required at rates that would severely damage the lucerne. They have also proved useful chemicals in pre-emergence applications.

DALAPON

Trial work with this close relative of TCA has only recently been commenced, some 13 trials now being in progress. A rapid expansion of experiments including Dalapon is planned for the coming season.

Dalapon seems likely to be a very useful chemical for the control of grass weeds. As its action is mainly through the leaves, it is in many respects complementary to TCA and should be well worth trying on grasses resistant to TCA.

Preliminary results indicate successful grass control in lucerne, and promising results on nassella, *Carex lucida*, barley grass, Indian doud, couch, and drain weeds such as *Glyceria* species and raupo. Dalapon at 40lb. per acre has killed cocksfoot, Yorkshire fog, and paspalum. For control of all growth mixtures of Dalapon and 2,4-D are particularly promising. The only chemical approaching this in effectiveness in one series of trials was CMU at high rates, a much more expensive treatment.

Rates of application of Dalapon need be only about half those of TCA. Dalapon seems to be effective on a wider range of grass species than TCA. It has a severe scorching action on young clovers and lucerne, although mature white clover seems much more resistant. Applications above 4lb. per acre on lucerne when in leaf do serious damage and it may be better to restrict the use of higher rates on lucerne to the dormant season.

From these preliminary results there is every indication that Dalapon will find extensive use in New Zealand on a wide range of grass weeds.

CMU

Practically all work to date has been with CMU and only a few of the 25 trials in this category have included the more soluble PMU

or the less soluble DCMU. I will therefore consider only results from CMU.

CMU has proved easily the most potent chemical so far tested for the destruction of plant growth. Although boron compounds or mixtures such as TCA and 2,4-D or Dalapon and 2,4-D may be able to compete economically even at much the higher rates of application they require, none of these appears likely to approach CMU in lasting effect.

Complete kills of plant growth have usually been obtained with 40lb. CMU per acre, but CMU has been less effective if applied to rank growth. In some trials heavy rain soon after application has washed much CMU off the trial area, giving poor control of the area treated, but damage to plants in the path of this lateral wash. Some grass species seems fairly resistant to CMU and need up to 80lb. per acre before they are killed; paspalum and cocksfoot are two examples. Deep-rooted plants require heavy rates for control, as CMU moves very slowly in the soil. It is usually better to treat such species with the more soluble boron or chlorate compounds. CMU is a very expensive chemical if used to control broad-leaved species susceptible to hormone weedkillers.

For soil sterilisation purposes it seems best first to clear the site of rank growth, then apply 20 to 40lb. per acre of CMU and retreat with 5 to 10lb. as required for seedling re-infestation. When necessary 2,4-D should be used.

CMU has also been used in trials for the control of grass weeds in lucerne, of barley grass, weeds in irrigation races and drains, and for several other grass weed problems.

(a) Grass Weeds in Lucerne

Trials have used from $\frac{3}{4}$ to 8lb. per acre. About 2lb. CMU will give excellent control of annual grasses such as *Poa annua* or perennial grass seedlings, but established perennial grasses, although scorched, usually recover. Lucerne has been severely damaged by rates of 4lb. CMU per acre; 2lb. gives a severe check to foliage, and therefore application should be made in the dormant season.

Trials show clearly that perennial grasses should be eliminated before the lucerne is sown. If this is done, seedlings of both annuals and perennials may be kept in check satisfactorily by applications of 2 to 4lb. CMU per acre to lucerne in the dormant season.

(b) Barley Grass

Excellent control of barley grass has been secured from 2lb. CMU per acre, but this rate will also check or kill associated plants of value. For this reason chemicals like TCA have been found to give better results, as the bare spaces left after killing the barley grass are more quickly filled in with desirable pasture plants. In one case 2lb. CMU per acre destroyed all pasture plants present.

(c) Grasses in Irrigation Races

CMU has given very good results in water races. In some cases 20lb. per acre has given adequate control, and 40lb. per acre looks as if it may be effective for 2 years. In these races the complete destruction

of growth may be followed by the collapse of the sides of the race. Consequently only growth suppression not destruction from lighter rates applied more frequently may be more desirable. In one trial *Juncus* species proved to be resistant to CMU.

(d) Weeds in Drains

CMU at 60lb. per acre has given control of purua grass, and 30lb. killed floating sweet grass. More work is required on the drain weed problem, as chemical weedkillers may do much to reduce labour and costs of drain maintenance.

(e) Miscellaneous Trials

In a trial on kikuyu grass 75lb. TCA gave better results than up to 80lb. CMU, but it appears that very heavy rain may have washed the less soluble CMU off the trial area, where TCA was dissolved and carried into the soil. On nassella preliminary work indicates that up to 80lb. per acre may be needed for eradication. CMU will probably be too expensive for nassella control, except in small patches, and in any case is an unsuitable chemical for general application. CMU has been used for making lines on lawns, but though very effective, it spreads laterally under lawn conditions and may bare an area several feet wide. One trial has used CMU applied at pre-emergence to control grass weeds in potatoes. Rates up to 40lb. per acre gave quite good results, but 8lb. was too severe on the potatoes.

CONCLUSIONS

Each of the chemicals I have discussed has its place in the control of grass weeds. It is only a few years ago that nothing really suitable was in sight, and the discovery of TCA was therefore considered a major step forward. At present a variety of chemicals is available, and if the conditions for their use have not yet been fully determined, much has been accomplished in a short time. It is not too much to hope that in 5 years' time grass weed control will have reached the stage of commercial use that hormone weedkillers occupy at the moment.

DISCUSSION

Q.—Although TCA was effective against kikuyu in trials, it was unreliable in practice. What were the possibilities of Dalapon?

A.—Dalapon was a very promising chemical and trials with it should be carried out.

Q.—What is best way to control Indian doud?

A.—Dalapon at 25lb. per acre has proved successful.