A REVIEW OF THE USE OF PHENOXYBUTYRICS IN NEW ZEALAND

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SUMMARY

THE development of the use of the phenoxybutyrics and their place in weed control practice in New Zealand are reviewed. Reference is made to the effect of MCPB on the germination of seed peas and to the alleged flavouring of processed peas. The effect of 2,4-DB distortion on mature lucerne is discussed together with information regarding the breakdown of MCPB in the soil by micro-organism activity.

Since the introduction of MCPB in 1956 and subsequently 2,4-DB the phenoxybutyric group have become established as weedkillers and are used extensively throughout New Zealand. MCPB and 2,4-DB were first mentioned at the New Zealand Weed Control Conference in 1956 by Allen (1) and Matthews (2). Since then further trial work and field experience have shown that the butyric group are a most useful adjunct to the already well known hormone weedkillers. Their most important feature is no doubt their selectivity to the legumes, enabling young pastures, clover crops, and lucerne to be sprayed where previously only limited means of weed control were available. It is not proposed to review all the experimental work carried out to date, but to summarise the position as to the use of the butyrics in present day spraying practice in New Zealand.

PASTURE

Pasture spraying is practised widely throughout New Zealand and in most instances, particularly with spring spraying, some clover check is inevitable with either 2,4-D or MCPA preparations, Maclean (3). Also there is one reported instance where the growth rate of fat lambs was depressed by the application of the ethyl ester 2,4-D in late spring causing clover suppression in pastures, Lewis (4). The selectivity of the butyric group toward clovers is a means of overcoming this clover suppression, but this has been limited by the higher cost per acre of the butyrics and the smaller range of weeds they control. However, their most important use on pasture has been the controlling of weeds in young and newly sown pastures. In many areas climatic conditions and a high weed seed population in the soil cause a high weed content in new grass. This is a major problem as the standard preparations of 2,4-D and MCPA are toxic to young clover seedlings, and dense weed growth can cause smothering of the grass and clover, resulting in a thin, sickly pasture. The use of MCPB or 2,4-DB here gives good control and has the added advantage that at this stage, a wider range of weeds is controlled, as most are in the seedling stage. In high-rainfall areas it is becoming an established practice to spray new grass, Thompson (5), but it must be pointed out that this is not intended to replace good cultivation and seedbed preparation.

CEREALS

Cereal crops such as wheat, oats, and barley are adequately treated with 2,4-D and MCPA preparations, but neither of these can be used where the crop is undersown with clovers or with a pasture mixture. While undersowing with clovers is not a recommended practice, it is used successfully where a cereal crop is undersown with Montgomery red clover, the latter usually being harvested for seed in the following season. Such undersown crops can be sprayed with MCPB, giving little or no check to the clover seedlings. Also spraying can be carried out at a much earlier stage, as MCPB can be applied with safety from the time the majority of the cereal seedlings are in the two-leaf stage until the crop is fully tillered, as opposed to spraying after tillering with 2,4-D or MCPA.

PEAS

Initial research work with the butyrics pointed to the legume crop plants as being tolerant whereas previously they would tolerate only very low rates of the sodium salt of MCPA. The first major use of MCPB was the spraying of garden pea crops both for seed production and green peas for canning, freezing, etc. Almost simultaneously with the first trial spraying carried out in the 1955/56 season several unconfirmed reports circulated that MCPB was causing loss of flavour and even tainting the processed peas. Trials to determine whether there was any basis to these claims were carried out by the Department of Agriculture and reported by Thompson (6). These trials showed that there was no evidence that applications of 1 lb or 1½ lb of the sodium salt of MCPB had any adverse effect on the palatability of the peas.

Field observations have shown that the application of MCPB has, in some cases, slightly delayed the maturity of peas. This is also reported in English work (7).

MCPB is used widely on pea crops in New Zealand today, but is used in conjunction with dinoseb, which gives very effective control of weeds when applied under optimum conditions. The point in favour of the use of MCPB is that it can be applied when pea crops are past the stage of spraying with dinoseb and in some seasons, due to high rainfall and windy conditions, MCPB is the only material that can be used.

The varieties of garden peas grown in New Zealand appear to be sufficiently resistant to applications of up to 2 lb acid equivalent of MCPB per acre. Most varieties, and particularly William Massey, show some slight distortion after treatment, but this is only temporary and the pea plants do not suffer any growth check. 2,4-DB has been used experimentally on pea crops in New Zealand, but it has proved to be too severe in its action, causing distortion and reduced yields (6).

Unconfirmed reports of MCPB affecting the germination of seed peas have come to hand recently and these have gained some weight among some seed pea growers. While there is no factual evidence to prove this, there is information (8) to show that it is highly doubtful if MCPB would affect pea seed germination. Experiments have been carried out by May and Baker Ltd., England, on the persistence of MCPB in pea plants applied at 2 lb per acre. The MCPB content of pea plants was shown to break down with a half life of 3 days and less than 1 ppm was detectable within 20 days. In each experiment the limit of detection of the acid was reached before the appearance of the pods and it was concluded that if MCPB is applied to pea crops at recommended rates of application and at the correct growth stage, seed formation and seed germination percentages are unlikely to be affected.

GRASS SEED CROPS

Ryegrass, cocksfoot, timothy, and dogtail crops can all be sprayed with MCPB and 2,4-DB at any stage except flowering. The use of MCPB or 2,4-DB is recommended with these crops where the clover content is valued, as these crops are often sprayed at a time when the clovers are making vigorous, succulent growth.

CLOVER CROPS

In New Zealand clovers are grown for seed production over extensive areas and weed control is a problem, particularly in wet seasons. White clover can be sprayed with MCPB and 2,4-DB after the first trifoliate leaf stage, but spraying should be carried out well before flowering commences. MCPB is not completely without effect on clovers and English workers have shown (9) that it is more toxic to red clover than white, and this was reported in New Zealand by Edmond (10), who showed that distortion on red clover plants persisted for a period after spraying. This effect is characteristic after spraying MCPB on red clover, but under normal grazing conditions where the leaf area is reduced it is doubtful whether

any significant growth check occurs. However, where red clover is grown for seed production and spraying is carried out after the area is closed from grazing this effect can often be observed. At normal application rates of 1½ lb of MCPB per acre very little distortion is seen, but it becomes more obvious with rates of 2 lb per acre and more. The application of 2,4-DB at 1 to 2 lb per acre causes quite severe distortion, and late spraying of a red clover seed crop could possibly affect early flowering and reduce seed yields (11). For this reason 2,4-DB is not recommended for use on red clover seed production areas. Also it is recommended that the spraying of MCPB be carried out in the spring months to avoid any risk of distortion at flower head formation. Cases have been reported where very late spraying of MCPB on red clover has retarded early flower head formation.

LUCERNE

Both MCPB and 2,4-DB formulations were tested on lucerne when these preparations were first available, but MCPB was found to be too severe in its effect on both seedling and mature lucerne plants (12). 2,4-DB can be used on lucerne with little effect and it was introduced into New Zealand primarily as a weedkiller to use on lucerne, though it is used on crops and pastures. Seedling lucerne can tolerate up to 2 lb of 2,4-DB per acre (13) without adverse effects, but strangely enough care has to be taken when treating mature lucerne. If lucerne is showing vigorous growth with luxuriant foliage at the time of spraying, a severe growth check can eventuate, often causing reduced hay yields. Spraying after grazing or when the leaf growth is short is recommended. Seedling lucerne can be sprayed at any time after the first trifoliate leaf has appeared, but maximum benefit to crop yield and most effective weed control are usually obtained by spraying the lucerne plants between the 1 and 4 trifoliate leaf stages. In some cases slight distortion is observed, but this is temporary and growth is not affected. Recent English work (14) on 2,4-DB distortion in lucerne has shown that stem distortion within three to four days of spraying seedling lucerne is slight, and effects are only noticeable at rates equivalent to 2 to 3 lb per acre on plants treated at the 2 to 4 trifoliate leaf stage. Also that the characteristic "claw" leaf distortion appears at a later stage after spraying and the extent of damage depends on the number of leaf buds present at the time of spraying so that the established plant will produce more claw leaves than one sprayed at the seedling stage. This would probably explain why severe leaf distortion after spraying is sometimes observed on mature rapidly growing lucerne plants.

WEED CONTROL

Perhaps the major criticism against the butyric group is that the range of weeds they control is narrower than the range controlled by MCPA and 2,4-D. Fortunately the weeds which are non-susceptible do not preclude the use of these chemicals, and moreover a large number of weeds are susceptible as seedlings and become more resistant as they mature. This is understandable from the mode of action of MCPB and 2,4-DB. Some plants possess an enzyme capable of bringing about β oxidation of MCPB to MCPA and similarly 2,4-DB to 2,4-D. Plants that do not have this enzyme system are resistant and the butyric group is ineffective against these. With plants that possess this system, as they mature their growth activity or assimilation processes slow down and the chemical is broken down much more slowly or even incompletely. This may explain why some weed plants are killed readily as seedlings and only partly checked when they are mature plants.

With the butyrics, timing of the spray application is very much more important than with the other hormone weedkillers. Fortunately early spraying can be carried out in young pasture, cereals, peas, and clovers, as these plants are also tolerant when small seedlings. With some of the semi-resistant weeds such as cornbind (*Polygonum convolvulus*) the control stage for spraying may be very short and once this stage has passed

later sprayings usually give disappointing results. All recommendations for the use of the butyrics must emphasise the need for spraying weeds when they are at the susceptible seedling stage and not when they are well established. Some weeds are readily controlled by the butyrics when they are large mature plants and a well known example of this is fathen (*Chenopodium album*). The control of docks (*Rumex* spp.), always a problem with 2,4-D and MCPA, can be partly solved with the use of the butyrics particularly 2,4-DB. They can be used to control seedling docks under conditions where the other hormone weedkillers cannot be used. Not because the sodium salt of 2,4-DB kills seedling docks any more effectively than the amine salt of 2,4-D, but because it can be used at a much earlier stage and does not harm other valuable seedlings present such as clovers, lucerne, etc.

SOIL REACTION

Spraying of MCPB on young pasture shortly after emergence has shown side effects where MCPB has reached the soil. This has been reported in New Zealand by Edmond (15), in one experiment where MCPB reached the soil either at spraying or by rain wash, white and red clover seedlings and short-rotation ryegrasses were all affected where spraying was carried out two weeks after emergence. All plants recovered and overseas workers (16) support that soil applications of 2,4-D, MCPA, 2,4,5-T, and MCPB have proved to be toxic and also that 2,4-DB was relatively non toxic. Thus it would appear that very early spraying, that is, two weeks after emergence, should not be carried out, but spraying delayed until foliage covers the soil. However, in conditions which produce weed growth, soil cover is normally complete at an early stage and it is doubtful if soil reaction would become a limiting factor in the use of the butyrics.

CONCLUSION

Whereas the use of the butyric group has not made any spectacular advances in recent years they have proved to be a most useful addition to the ever-widening number of weedkillers available for the farmer to use in combating his weed problems. It is a feature of weed control research in New Zealand that this group should have been so thoroughly tested here and that we have a solid basis of data to back up recommendations made for the use of these chemicals.

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DISCUSSION

Q.—How good in practice is MCPB on peas?

A.—It depends almost entirely on weeds present. Where weeds resistant to MCPB are present dinoseb is better.

Q.—What control of docks, particularly regrowth, can be obtained with butyrics, MCPB and 2,4-DB?

A.—Seedlings easily controlled. Butyrics kill foliage of root regrowths, but usually give poor control. If roots are well chopped up during cultivation, control is better.

Q.—Would the speaker recommend the use of butyrics to control mature docks in lucerne?

A.—Butyrics are severe on mature lucerne and poor on mature dock.

Q.—Can the speaker comment on the use of a mixture of MCPB and dinoseb for weed control in peas?

A.—This is not a standard or recommended practice. It may have some use where weeds resistant to one material but susceptible to the other occur together, but it is unlikely to be of widespread use.

Q.—Should spraying of young pastures be carried out at an early stage when weed and clover seedlings are small or is it better to delay spraying until complete ground cover is achieved.

A.—It is probably better to spray as early as possible, as soon as clovers have one true leaf, regardless of ground cover.

Q.—What is the maximum size of dock and cress seedlings successfully controlled by butyrics?

A.—A fair control of dock seedlings up to 6 in. high can be obtained. No experience with cress. Better results have generally been obtained in the North Island than in the South, except in Central Otago.

Q.—Are the genes of peas affected by the use of seed from sprayed crops?

A.—There is no evidence to show any carry-over of effect from seed obtained from crops sprayed at the correct time. Late spraying, that is, near flowering, may have some adverse effects on seed production.