CHEMICALS AND APPLICATION FOR THE CONTROL OF WEEDS IN BRASSICAS

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SUMMARY

ACCEPTED techniques for the control of weeds in brassica crops are described. Certain commercially available and experimental pre-emergence and post-emergence chemicals are briefly evaluated and the deficiencies in present methods and materials are enumerated. An investigation into band application methods with different types of spraying nozzles is described. The advantages of even and light-centre nozzles for CIPC and TCA applications are illustrated.

As a whole, it can fairly be said that despite recent advances, weed control in brassica crops still remains the enigma of researchers and farmers alike. Essentially, the fundamental weakness is that there is no comprehensive treatment for application to established crops. This is a very grave deficiency. Traditionally, chemical weed control in this country is regarded as a last ditch defence, a spectacular, if somewhat unreliable solution to a problem which could not be foreseen. The appearance of weeds is always a surprise, always the result of misfortune, and never a predictable occurrence. This attitude is a major hazard which will not easily be overcome and has a very restricting influence on the adoption and exploitation of available techniques.

At present post-emergence treatment is virtually restricted to sodium monochloroacetate (MCA) and the limitations of this material are legion. Basically it can be recommended for use on rape, chou moellier, and swedes and with distinct reservations on soft turnips. Thompson (1) very ably and authoritatively assessed the chemical as follows: rape, chou moellier, and swedes can be sprayed with 15 lb of MCA per acre at the four-leaf stage and up to 20 lb per acre if the crop is at a more advanced stage of growth. At these rates control of willow weed (*Polygonum persicaria*) and Prince of Wales feathers or redroot (*Amaranthus retroflexus*) can be achieved provided the weed plants are less than 8 in. in height. Spurrey (*Spergula arvensis*), nightshade (*Solanum nigrum*), fathen (*Chenopodium album*), and grass weeds cannot be controlled at these rates in the South Island. Spurrey and nightshade appear to be more susceptible as young plants in the North Island, but not consistently so. Soft turnips are best sprayed only when the weeds overtop the crop, but even this is not recommended if resistant weeds are present in number, as these latter may eventually dominate the crop due to the removal of competitive, susceptible weeds.

MCPB can and has been used successfully on chou moellier where fathen is a critical problem (2). Rates up to $\frac{3}{4}$ lb acid equivalent per acre do not seriously affect the crop provided it has reached the four- to six-leaf stage and provided it is growing vigorously at the time of treatment. Soil moisture and soil warmth should be such that rapid recovery of the chou moellier is guaranteed immediately after spraying. The use of MCPB during dry conditions is not advised. Under these circumstances crop recovery is slow and the fathen very often acquires a resistance to MCPB which is the direct antithesis of its normal susceptibility. At best the use of MCPB on chou moellier can only be regarded as an emergency treatment to be used when crop failure as the result of fathen infestation is a very real danger.

Sulphuric acid can be successfully employed as a post-emergence application and is so used on a limited scale overseas (3). However, the hazards and difficulties associated with its application preclude its use by the average farmer and it does not appeal as a likely solution to the problem. The same can be said for sodium nitrate, which commands a limited respect in other countries.

Objectively, then, post-emergence treatments are of such limited capacity as to be virtually no value in the South Island and though they are of greater import in the North Island, their contribution is still meagre and remains confined within strict limits; certainly not a situation likely to kindle great excitement.

Pre-emergence treatments are fortunately a little more encouraging. Not only is the choice of available chemicals much wider, but in many cases the individual chemicals are more comprehensive in the range of weeds they will control. Unfortunately, any advocate of pre-emergence techniques in this country immediately encounters an almost insuperable barrier. The concept of preventive weed control treatments does not come either kindly or easily to many farmers. The advantages of a chemical insurance against the inevitable or even the probable do not seem to register. Supreme optimism in regard to the magnitude of the eventual weed population combined with the problems associated with meeting the strict prerequisite conditions so necessary for successful pre-emergence treatments tend to make the whole tiresome operation not worth while.

Admittedly, pre-emergence treatments are generally more demanding of the operator than are post-emergence ones. The provision of optimum soil conditions is usually a difficult task and involves much greater reliance on nature than other weedkilling techniques. Careful planning, patience, and an element of luck are required, but the percentage of successful applications can be sufficiently high to warrant greater popularity of this method of chemical weed control.

Pre-emergence chemicals are essentially of two types, contact and residual. The contact materials are intended mainly for the control of weeds which emerge before the crop and are desiccated by chemical action. Chemicals such as PCP, sulphuric acid, and kerosene have been used with varying degrees of success, but all have a major limitation in respect of timing. Brassicas germinate very rapidly under favourable conditions and the time between planting and emergence can be extremely short. The possibility of unfavourable weather during this critical period is only too real in this country and the risk of failure is therefore rather great. The employment of the stale seedbed technique is some insurance against this, however. This method involves the early preparation of the ground to a planting standard followed by a waiting period during which the surface weeds are allowed to germinate. The crop is then drilled into the seedbed which is infested with establishing weeds with the minimum of soil disturbance to prevent the exposure of deep weed seeds. Spraying with a contact chemical immediately follows drilling, preferably on the same day, a day which has been chosen for its high temperatures and settled outlook. This technique can be most effective, provided certain rather restrictive conditions obtain. Obviously, the major weed threat must come from species which germinate rapidly and evenly, as a protracted period of emergence nullifies the advantages of the treatment. In addition, rapid growth of the crop is essential, as it is the direct competition from the crop, and this only, which prevents later emerging weeds from causing concern. Without doubt the employment of the stale seedbed technique is to be recommended if contact pre-emergence treatment is contemplated, for this method offers an infinitely greater margin of safety in regard to the vagaries of the weather.

The essential deficiency of the contact pre-emergence techniques is the short time for which control is effective. The residual type of chemical is therefore the one which appears to offer the greatest potential. Two trusty friends in CIPC and TCA have been used fairly widely over the past few years with some measure of success, but for neither chemical could it be claimed that perfection has been achieved.

The interesting claims made overseas for certain new pre-emergence weedicides thus aroused considerable interest and experimental investigation was deemed advisable. As part of this investigation a trial was laid down on ridged swedes at Wendonside near Gore, in which a number of these newer chemicals were compared with CIPC and TCA. Treatments are listed in Table 1.

TABLE 1

Treatment	Rate (lb active ingredient per acre)
1. Control	—
2. CIPC	2.0 lb
3. CIPC	4.0 „
4. CDEC	2.4 „
5. CDEC	4.8 „
6. CDAA	4.8 „
7. CDAA	9.6 „
8. Urea/carbamate mixture	0.6 „
9. Urea/carbamate mixture	1.2 „
10. EPTC	3.6 „
11. EPTC	7.2 „
12. TCA	10.0 „
13. TCA	20.0 „

All treatments were applied with water at 61 gallons per acre.

Note: Active ingredients of urea/carbamate mixture:

cyclooctyl-dimethyl-urea	16.5 per cent
butinyl-m-dichlorophenyl-carbamate	11.5 per cent

Concurrently with this trial another investigation was carried out using three different types of spraying nozzle for the actual application.

The area used for the experiment had a history of severe fathen infestation. The area was selected intentionally, as it was felt that fathen presented the greatest menace to South Island brassica crops. The known performance of CIPC on spurrey placed this weed in a different category, leaving fathen in pride of place as a problem weed. The trial was strictly observational, but chemical treatments were replicated twice as a precaution. Each replicate consisted of plots 2 chains long by two rows wide. Eight-inch band treatments were applied to the tops of each ridge, as it was felt that this method of application would be a practical way to reduce the high cost of some of the treatments. The chemicals were applied on 10 December 1959, some three days after ridging. The soil was very moist and more than 2½ in. of rain fell in the following four weeks. The soil type was a free draining, sandy loam.

All treatments exercised some weed control, but only TCA at 20 lb per acre, CDEC at 4.8 lb per acre, and CIPC at 4 lb per acre gave results of a practical standard. Tolerance of the crop to the chemicals used was variable.

Three entirely different types of nozzle were used for the application of each chemical. Each nozzle had exactly the same output in gallons per minute and each covered exactly the same band width; that is, they had a common included angle, in this case 80 degrees at 40 lb pressure per square inch. The only difference, but a very critical one, lay in the actual distribution of the spray pattern within the band. The standard fan-type nozzle gives a pattern which is heavy over the centre portion, but diminishes toward the edges. This is specifically designed to permit an even coverage where two or more tips are used together for overall spraying as in a standard spray boom. This is obviously a disadvantage when the tips are used singly for band application.

The second type of nozzle employed was an even-spray type which has an oblong pattern of equal density from edge to edge. The even-spray type is designed specifically for band application.

The third type employed was also a special band-spray nozzle, but in this case is the direct reverse of the fan type in that it is heavy on the edges and light in the centre. This light-centre nozzle is intended to give a low concentration of spray over the actual row of seed, with approximately twice as much in bands on each side. The very marked effect that the various

types of nozzle exerted on the performance of the chemicals and the tolerance of the crop demands some comment.

Of the treatments used CIPC at 4 lb per acre gave the most satisfactory control of fathen. Similarly, it was the one which showed most clearly the effects of the various methods of application. In the early stages and up to a month after treatment complete mortality of the crop on the fan nozzle plots appeared a very real possibility. Survival of some plants did occur, however, and by May the final story was clear. It could be fairly assessed that the yield was reduced by about two-thirds. In direct contrast the even and low centre nozzles caused only a very slight check to the crop and this setback was of a very temporary nature. Fathen control was approximately equal between the fan and even-spray tips, but was slightly inferior in the case of the light-centre type. This was probably due to the lower concentration of herbicide in the centre of the ridges. However, it must be remembered when considering the performance of these light-centre nozzles that fathen is notoriously resistant to low rates of CIPC, probably the greatest deficiency of this otherwise versatile chemical.

At the 2 lb per acre rate CIPC gave significantly less fathen control with all nozzle types, but even at this minimum rate crop damage resulting from the fan type was quite severe and was probably sufficient to reduce the yield substantially. At this rate the even and light-centre nozzles gave no evidence of causing crop damage.

The same pattern emerged with the TCA at 20 lb per acre treatment, but difference was less marked. Results obtained did indicate, however, that there was distinct merit in using even-spray tips, as crop damage was completely eliminated. A marked check to the establishing crop was noted with this application of TCA applied with the fan-type nozzles. Fathen control from 20 lb per acre of TCA was of a very reasonable standard.

The performance of CDEC for the control of fathen was quite encouraging in this trial, but it would be unwise to make positive claims on such limited evidence. At the rates used no observable differences were obtained from the various methods of application and it would be reasonable to assume that the swede crop exhibits a high degree of tolerance to this chemical. There was evidence, however, of a better level of fathen control from fan tips, which would indicate that higher rates than those employed in the trial may be necessary for the control of this weed.

The other treatments did not appear to exert any real control on fathen under the conditions obtaining in this particular trial.

What, then, is the present situation regarding pre-emergence chemicals? Though TCA at 20 lb per acre can give good control of fathen and other weeds, it is well known that it requires adequate soil moisture for activation and is completely ineffective under dry conditions. CDEC appears promising, but infinitely more knowledge of its behaviour is required before positive recommendations can be made. The known susceptibility (4) of the carbamate herbicides to soil type suggests that very widespread experimentation will be necessary before the true value of this chemical can be assessed.

However, from the evidence obtained here and, more important still, from the many other experiments conducted over recent years CIPC emerges as the most promising material for use in the South Island. The high soil temperatures so often experienced in the North Island do appear to increase crop damage to some extent and its usefulness in that part of New Zealand is consequently rather circumscribed. I cannot hope to discuss the whole complex of the merits and demerits of CIPC, but I feel that this particular factor plus the fact that fathen is not readily controlled by the low rates tolerated by brassicas has tended to restrict the usage of this chemical. However, certain interesting possibilities concerning these two deficiencies are raised by this investigation into application techniques and it does appear that the tolerance of swedes at least can perhaps be extended. Whether the problem of high soil temperatures in the North Island can be overcome remains to be seen, but it does now seem feasible in the South Island to apply CIPC at a sufficient rate to control fathen adequately. The

use of band spraying using the appropriate nozzle is sufficiently promising to warrant further investigation.

That is the present situation regarding chemical weed control in brassica crops as I see it. Post-emergence applications do not appear to have any significant place in the South Island and only limited scope in the North Island. CIPC can play a valuable part in the control of spurrey and many other weeds in the South Island, and where band spraying is possible the control of fathen does seem within reach. Recommendations for the control of fathen under high soil temperatures must remain uncertain, with the use of MCPB a rather extreme emergency measure.

It is obvious that there is an urgent need for a comprehensive post-emergence treatment. However, it is equally true that there are chemicals at present available capable of making a very valuable contribution. The situation is not entirely hopeless, but neither does it engender complacency.

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REFERENCES

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DISCUSSION

Q.—What variety of swede was involved in this trial?

A.—Sensation.

Q.—Which weedicides were used in the stale seedbed technique?

A.—Sulphuric acid, kerosene, and oktone. I had no experience with MCA on stale seedbed technique.

Q.—What climatic conditions were experienced in the trial, and what is the effect of weather on pre-emergence treatments?

A.—Treatments were applied on 10 November two days after ridging. Two and a half inches of rain fell within four weeks after treatment; 80 points were registered within 48 hours of chlorpropham application. Chlorpropham in this trial reacted the same as I would expect under dry conditions.

Q.—Did soil temperatures play any part?

A.—I consider soil temperatures were average for that district.

Comment: One factor does not alter the residual life of chemicals. Moisture and temperature affect volatility and must be considered together.

Comment: Crop damage can occur with chlorpropham due to high soil temperature regardless of soil moisture levels.

Q.—What is the difference in distribution using a fan type nozzle?

A.—It appears that about 30 per cent more material is deposited over and above that deposited by an even spray nozzle.

Comment: I found that post-emergence application of chlorpropham gave control of spurrey which had emerged before the crop.

A.—Post-emergence application of chlorpropham is no good on fathen.

Comment: Post-emergence application of chlorpropham on wild turnip affected the crop severely, but eventually killed the spurrey.

Q.—Would the operator give details of spray angle of nozzles?

A.—Eighty degrees at 40 lb to the square inch.

Q.—Did you use TCA this year and if so with what result?

A.—Yes—with good results. Control strip left had much fathen. TCA at 20 lb in 8 in. band gave fairly good results.

Q.—Would MCP be useful on wild turnip in chou moellier crops?

A.—No, it is ineffective on wild turnip.