WEED CONTROL IN FODDER CROPS WITH MONOCHLORACETATE

By F. B. THOMPSON, Rukuhia Soil Research Station, Hamilton

SUMMARY

SODIUM monochloracetate at 15 lb per acre may be used for weed control in chou moellier and swedes if the crops have four or more leaves. Soft turnips are more susceptible and should have six or more leaves. MCA may be used satisfactorily to control willow weed and redroot in brassica crops, but fathen and grassy weeds are resistant and are not controlled. Promising results were obtained with MCA on peas. Fodder beet is susceptible to MCA. Disturbance of the soil during mechanical planting of fodder beet made pre-planting applications of CIPC unsatisfactory. Post-planting applications of CIPC were more promising.

It was previously reported (1) that sodium monochloracetate (MCA) was promising as a post-emergence weedkiller for brassica crops, except possibly soft turnips, and that applications of TCA and CIPC immediately before planting out fodder beet both gave good weed control. This paper gives the results of further trials in various districts with MCA on brassica crops. The object of the trials was to determine the earliest stages at which the crops would tolerate rates of MCA which gave satisfactory weed control. Results are also given of trials with MCA on peas and fodder beet and pre- and post-planting applications of CIPC on fodder beet.

EXPERIMENTAL

The trials at Rukuhia Soil Research Station were conducted on Horotiu sandy loam. Plots were 5 or 6 ft wide and 14 to 24 ft long according to the crop, and the treatments were replicated four to six times in randomised blocks. Yields were taken from the central portions only of the plots. All treatments were applied with an "Oxford" precision sprayer, using size 0 nozzles, 30 lb pressure, and, unless otherwise stated, 30 gallons of spray mixture per acre.

The rates of MCA quoted are the weights of commercial material applied per acre.

RESULTS

Chou Moellier

Yield trials were conducted at Rukuhia on two crops sown at different times. To obtain data on various combinations of rates of MCA and sizes of the crop at spraying two rates of MCA were each applied at two stages of growth on each trial. The yield data showed that when MCA was applied to the crop at the three to four leaf stage there was some reduction in yield compared with hand-weeded plots, but this reduction did not reach significant levels. Results were also available from four other trials, two in Auckland Province and two in Otago. The results from all these trials indicate that there is risk of damage if the crop is sprayed when it has less than four leaves, but after the fourth leaf has expanded the crop will tolerate applications of 15 lb and 20 lb of MCA. At the five leaf stage the crop will tolerate up to 30 lb, but it should not be necessary to apply such heavy rates of MCA.

Swedes

In a yield trial swedes were sprayed with 10 lb and 20 lb of MCA at the five to six leaf stage. Though the 20 lb in particular caused appreciable burning of the leaves, the crop made a good recovery. The yields showed that there was no significant reduction in the weight of leaves or roots.

These results and additional information from four other trials indicated that the crop tolerated 15 lb and 20 lb of MCA if it had four leaves or more at the time of treatment.

In two of the trials the effects of MCA on different varieties of swedes were compared. As all varieties tolerated the rates applied, the results did not prove that there was any appreciable difference in the tolerance of the varieties tested.

Soft Turnips

More attention was paid to the tolerance of soft turnips, since previous work showed that turnips were more susceptible to MCA than swedes or chou moellier. Yields were obtained from three trials which included the following combinations of rates of MCA and crop size:

Trial	Variety	lb/MCA	Crop size		Crop tolerance
			No. of leaves	Height in.	
1240	York Globe	10	6	3-5	Susceptible
	"	10	7-8	7-9	Tolerant
R90	Hardy Green	10	4	4-5	Susceptible
	Globe	15	4	4-5	Susceptible
	"	10	8-9	12	Tolerant
	"	15	8-9	12	Tolerant
R91	Green Globe	10	8	10	Tolerant
	York Globe	15	8	10	Tolerant
	Purple Top Yellow				
	Purple Globe				

In an observational trial soft turnips were damaged by applications of 10 lb and 15 lb of MCA when the crop had four to five leaves and was 3 in. high. Similar applications eight days later when the crop had five to six leaves and was 8 to 10 in. high were much less damaging. In another instance 15 lb of MCA caused very severe damage to a crop at the two to three leaf stage, but was tolerated at the six to eight leaf stage.

Unfortunately in both R90 and another variety trial wet weather delayed spraying until the crops were sufficiently far advanced for all varieties to tolerate the MCA. Therefore no clear indication of varietal differences in tolerance could be obtained.

The overall results from these trials suggest that there is a critical stage of growth when the soft turnips have about six leaves and are 5 in. high.

Applications of 10 lb or more of MCA before this stage are liable to decrease yields, but if the crop is more advanced, applications of 15 lb may be tolerated.

Peas

Two trials were conducted on Victory Freezer peas. The first crop was sown on 24/9/58 and sprayed seven weeks later when the peas were at the six to seven node stage. Continual wet weather had delayed spraying and there was a fairly dense cover of willow weed (*Polygonum persicaria*), and spurrey (*Spergula arvensis*) 4 to 8 in. high and some bottom growth of cress (*Coronopus didymus*). MCA at 10 lb and 20 lb gave good control of willow weed and spurrey, but the cress thrived after the taller weeds were killed. Fathen (*Chenopodium album*) resisted the MCA. Other treatments were the sodium salt of MCPB at 1 lb acid equivalent and the amine salt of dinoseb at 1.8 lb phenol equivalent. The latter was applied in 40 gallons of water. MCPB failed to control willow weed and spurrey, and these smothered the peas. Dinoseb controlled willow weed, cress, and fathen. Control of spurrey was good where the weed was small and sparse, but where it was thick and dense the control was very poor and not nearly as good as that obtained with 10 lb of MCA. No yields were taken. There was no evidence from observations that the MCA even at 20 lb had affected the peas.

The treatments in the second trial included two rates of MCA at two stages of growth and dinoseb and MCPB as in the first trial. Table 1 gives details of the treatments, yields of shelled peas, tenderometer readings, and visual estimates of weed infestation. The most weedy plot (one of the unweeded controls) was rated as 100 and the amount of weeds on all the other plots was estimated at a percentage of this.

TABLE 1—EFFECT OF WEEDKILLERS ON PEAS

Treatment	Crop size nodes	Shelled peas tons per acre	Tenderometer reading	Weed rating
Hand weeded	---	1.83 a	113 b	4
Dinoseb .1.8 lb	4-5	1.71 ab	114 b	15
MCPB 1 lb	4-5	1.64 ab	110 bc	36
MCA 10 lb	3	1.74 ab	113 b	22
MCA 20 lb	3	1.63 ab	117 ab	11
MCA 20 lb	8	1.35 b	118 ab	16
MCA 30 lb	8	1.32 b	123 a	15
Unweeded	---	1.32 b	103 c	84
Co-efficient of variations (per cent)	---	18.4	4.7	

Spraying dates and weather conditions were as follows:

	Date	Previous	Weather at spraying	Subsequent
Peas:				
Sown	12/11/58			
Sprayed				
3 node	28/11/58	Hot, dry	Sunny 70-73 degrees	Fine
4-5 node	1/12/58	Hot, dry	Dull 65-68 degrees	Fine
8 node	16/12/58	Warm, wet	Sunny 65-70 degrees	Heavy rain
Harvested	15/1/59			2-3 hours later

At the three node stage the peas were 4 in. high and the weeds 1 in. across and up to 1½ in. high. At the eight node stage the vines were 12 to 14 in. long and partly lying down. The main weeds were willow weed and redroot (*Amaranthus retroflexus*) which were about 7 in. high.

At the time of harvest the peas on the unweeded plots were smothered by a dense mass of willow weed up to 3 to 4 ft high. In spite of this the yields were 72 per cent of the hand weeded plots, whereas a similar infestation two years previously reduced yields to 50 per cent (2). Presumably the weed infestation in 1958-9 did not affect the yield so much because, owing to the wet season, there was little plant competition for soil moisture.

MCPB gave very poor control of willow weed, MCA at 10 lb was very good, and all the other treatments gave excellent control. The control of redroot was very good throughout except on one dinoseb plot where the growth was very thick and dense at the time of spraying. The MCA plots, particularly those sprayed on 16/12/58, had more bottom growth of witch-grass (*Panicum capillare*), crabgrass (*Digitaria sanguinalis*), and portulaca (*Portulaca oleracea*) than other plots.

The figures in Table 1 show that the yields from 10 lb and 20 lb of MCA at the three node stage are similar to those from dinoseb and MCPB and do not differ significantly from the hand-weeded control. The fact that the 20 lb rate is slightly lower in yield in spite of better weed control suggests a slight but not significant toxicity to the peas. An application of 15 lb would therefore be possibly better than either 10 lb or 20 lb. The lower yield from the 20 lb at the eight node stage suggests that MCA may be more toxic at the later stage. However, it has been previously shown (2) that in trials with MCPB, though late spraying gave good weed

control, the yields were little different from that of the unweeded control. It was concluded that the weeds had already retarded the crop before the late treatment was applied. Possibly the same applies to the late MCA treatments in the recent trial.

Fodder Beet

The effect of 15 lb of MCA on fodder beet was studied in two trials. In the first trial it was applied to a crop which had been drilled. At the time of treatment the beet had four leaves and was 2 to 3 in. high. The crop was severely affected by the MCA and many of the plants died. Weed growth was so rapid at the time of treatment that there would have been little chance of killing the cress and nightshade (*Solanum nigrum*) if treatment had been delayed until the beet was larger.

In the second trial the beet was planted by a mechanical planter on 25/11/58, and the MCA applied on 26/12/58 when the crop had eight leaves and was 6 to 8 in. high. The MCA slightly retarded the beet, but did not give satisfactory control of the willow weed which was present in a thick mass up to 8 in. high at the time of spraying. Grassy weeds infested the MCA plots and the final result was unsatisfactory.

In the latter trial the pre-planting treatments which were so promising on a hand-planted scale the previous year, namely TCA at 20 lb and CIPC at 4 lb, were repeated. TCA failed to control the willow weed and this was attributed to the unusually wet season. The good results with TCA the previous year were probably due to the right rainfall at that time. The pre-planting treatment with CIPC gave good control of willow weed between the rows of beet, but there was a thick infestation along the rows. Presumably the disturbance of the soil by the planter spoilt this treatment.

In order to avoid complications due to soil disturbance, CIPC at 4 lb was also applied the day after planting. It was the most promising treatment in this year's fodder beet trials. There was complete elimination of the willow weed and no indication of damage to the fodder beet. Four weeks after spraying the plots were fairly clean, but in the subsequent three weeks a crop of redroot up to 6 in. high appeared and spoilt the treatment.

SUSCEPTIBILITY OF WEEDS TO MCA

The degree of control of the various weeds observed in the trials is outlined below. The quantities of MCA quoted are the minimum rates to give good control of the weeds at the stated heights.

Willow Weed

MCA at 10 lb gave very good to excellent control on plants up to 4 in. With plants 4 to 8 in. control was sometimes variable, but usually very good. Excellent control was obtained at 20 lb on plants up to 8 in.

Redroot

Generally control was similar to that of willow weed, but not quite so good.

Spurrey

At Rukuhia good control was obtained with 10 lb on plants up to 6 in., but reports on South Island trials indicate failure to obtain control with rates from 15 to 25 lb, even when the spurrey was much smaller.

Nightshade

In general plants 2 in. high and 2 in. across were controlled by 10 lb, but in a very thick infestation on a high-fertility area plants of this size resisted 15 lb. Larger plants with 6 to 10 leaves and 6 to 7 in. high were not satisfactorily controlled with 20 lb.

Cress

Variable results were obtained with 10 and 20 lb, even on very small plants. In one trial 20 lb gave a 50 per cent kill of plants 1½ in. to 2 in. across and decreasing kills for larger sizes.

Fathen

Fathen was particularly resistant. In practically every trial where it was present it increased on plots sprayed with MCA irrespective of the rate

and time of application. Where infestations were thick the fathen dominated the crop after spraying due to lack of competition after suppression of the other weeds.

Grassy Weeds

Grassy weeds were not affected, and, like fathen, often increased after spraying. In one instance crabgrass and witch-grass dominated the crop after spraying, and the smothering effect of these grasses was equally or even more damaging to the soft turnips than the smothering by willow weed and redroot on the unsprayed plots.

CONCLUSIONS

1. Chou moellier, swedes, and soft turnips are sufficiently resistant to MCA to enable it to be used as a post-emergence weedkiller on these crops provided that high rates are not applied when the crops are very small. The following are suggested as reasonably safe minimum crop sizes for applications of 15 lb of MCA:

Chou moellier and swedes: 4 true leaves

Soft turnips: 6 true leaves

Chou moellier and swedes at a more advanced stage can tolerate higher rates of MCA.

2. MCA at 15 lb effectively controls willow weed and redroot up to 6 to 8 in. high; spurrey (in some districts) up to 6 in., and nightshade when very small. Resistant weeds are fathen, grasses, and cress.

3. Therefore, in those districts where the dominant weeds are susceptible to MCA 15 lb in 20 to 30 gallons of water per acre can be recommended for weed control in chou moellier and swedes provided the crops have reached the four leaf stage. In districts where fathen or grassy weeds are dominant MCA would not be suitable.

4. In view of the greater susceptibility of soft turnips more consideration has to be given to the timing of applications of MCA. By the time the crop is large enough to tolerate the MCA it may protect some of the weeds from the spray. In practice it would probably be better to spray when the weeds are higher than the crop. The weeds would then protect the crop and give it added resistance.

5. Recent trials failed to show that there is any appreciable difference in the tolerance of varieties of soft turnips and swedes to MCA.

6. MCA is very promising for weed control in peas and may prove better than MCPB, especially where willow weed is present. It is suggested that trials be conducted with 15 lb when the peas are in the three to six node stage.

7. Fodder beet is too susceptible to be satisfactorily weeded with MCA, unless it is used on crops where the weeds have been kept in check by other means until the fodder beet has reached a tolerant size.

8. Applications of CIPC before planting fodder beet were unsatisfactory when a mechanical planter was used in loose soil. Post-planting applications of CIPC were very promising, but under conditions favouring weed growth a supplementary follow-up treatment would be necessary to cope with subsequent weed infestation. Possibly MCA could be used if this treatment could be delayed until the crop had reached a resistant size.

9. MCA is quick acting when applied under sunny conditions and there is evidence that it is not rendered ineffective by heavy rain several hours after application.

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REFERENCES

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DISCUSSION

Q.—Is the 4-leaf stage you mention the two true leaf stage, that is, does it include the cotyledons?

A.—No, it is the four true leaf stage.

Q.—Have you carried out any pre-emergence weed control on fodder beet; for example, with PCP?

A.—Good initial weed control has been obtained in our work with pre-emergence applications, but fodder beet fails to make much leaf cover and a secondary infestation usually beats it. Pre-emergence chemicals could be used if followed by cultivation, that is, use the chemical to reduce the number of cultivations necessary.

Q.—Have you noticed any deleterious effect on effectiveness of MCA with rain soon after spraying?

A.—In one trial 60 points of rain fell in $\frac{1}{2}$ to 3 hours after spraying in peas and excellent results with MCA were still obtained. Withering of willow weed has been noted a few hours after spraying.

Q.—I am interested in the results obtained at Rukuhia on spurrey with MCA and would like to know where in the South poor results were obtained and to have any reasons why?

A.—The area was Balclutha in South Otago, but we do not really know why poor results have been obtained. We have had good control of spurrey 6 in. high with 15 lb of MCA, whereas in the South 25 lb failed to kill spurrey 2 in. to 3 in. high.

Comment: In South Taranaki we had a burn back of 6 in. high spurrey, but it regrew. Also, we have had rain soon after spraying which has considerably reduced the effectiveness of MCA.

Q.—Has temperature affected the effectiveness of MCA?

A.—No. We have not correlated effectiveness of MCA with temperature.

Comment: We have had variable results on spurrey and need to correlate effects on it under various temperatures.

Comment: Soft turnips are susceptible to MCA when small, but we can now wait until we see if the weeds get on top and then spray. Especially as the weeds then help to protect the crop.

Q.—What is the ideal stage to treat willow weed in peas and what is the latest stage one can wait to treat it and still get good results?

A.—We need to do much more work on peas. Perhaps 15 lb of MCA is the best rate, 10 lb is not quite enough. Spray as soon as possible after the 3 node stage of the peas. Further work may prove that we can spray earlier than the 3 node stage. As regards willow weed, it has been killed with 15 lb of MCA at 6 in. high and 8 in. high in one trial, but not in another trial. In general, spray when weeds are as small as possible, as crop damage occurs due to competition in the early stages of the crop, even when the weeds are killed later.

Comment: Sheep's sorrel and groundsel leaves have been burnt off with MCA, but they recovered. Ryegrass was not affected and subterranean clover suppressed in our experience. I think the use of high volume, high pressure might give better control of weeds such as spurrey.

Comment: We have found that MCA gave better results on spurrey than dinoseb.

Q.—Do you not think that much more work is required with MCA on peas, particularly under various climatic conditions before MCA can be recommended?

A.—I purposely mentioned the promise of MCA for weed control in peas in the hope that people will try it out and in that way we will sooner be in the position to recommend it or not. I did not give a firm recommendation for that reason. As in my paper on brassicas last year I just said MCA was promising.

Q.—What about trying mixtures of MCA and MCPB on peas?

A.—I agree that it would be worth trying.

Q.—In your yield tables where maturometer readings were given it would appear that MCA hastened maturity. This effect is very important for processing peas.

A.—Tenderometer readings:

HW control 113.

10 lb MCA 113.

20 lb MCA 117. No significant difference.

Only 30 lb late stage 123 was significantly different.

It is not necessary to go up to 30 lb rate and I do not think there is any danger.

Q.—Why is control significantly different from HW control?

A.—Weeds must have delayed maturity. Two years ago weeds in a trial on peas hastened maturity, but this was under dry conditions; weeds competed with the crop for moisture. This year with wet weather the weeds did not reduce yields much. Evidently they did not compete with the crop so severely for nitrogen and moisture.

Comment: We noted effects on maturity of peas in Hawke's Bay of weeds; for example, *Amaranthus* even in wet season delayed maturity.