WEED CONTROL IN PEAS AND MAIZE

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SUMMARY

TRIALS conducted showed that peas tolerated 15 lb of sodium monochloroacetate (MCA) from the 4th node stage of growth. Promising results were obtained with the application of mixtures containing MCA and MCPB for the control of such weeds as fathen. In maize crops two chemicals of the triazine group gave excellent weed control, but this did not result in higher yields than with the amine salt of 2,4-D.

It was previously reported (1) that in preliminary trials promising results were obtained with MCA for weed control in peas. This paper gives the results of further work with MCA and other chemicals during the 1959-60 season. Results from two seasons' work with the chemicals of the triazine group for weed control in maize are also given.

EXPERIMENTAL

All trials were conducted at the Rukuhia Soil Research Station on Horotiu sandy loam. Treatments were replicated five or six times in trials of randomised block designs. All yields were taken from the centre rows of each plot, and are expressed in the subsequent tables as bushels of the shelled material per acre. Significant differences are indicated by the letters accompanying yield data. Except where otherwise stated, all treatments were applied to 30 gallons of water per acre by the Oxford Precision Sprayer at 30 lb pressure. The treatments on maize were applied by tractor pump and boom. In all pea trials the variety sown was Victory Freezer and in maize trials Pfister 360 was used. All liquid materials were the commercially available materials and were applied as lb of the active material per acre. All solid materials, except trietazine, were the commercially available materials, and the quantities given are lb of the actual material per acre.

PEAS

The promising results obtained in the 1958-59 season led to the laying down of a comprehensive series of pea trials in which were studied the effects of MCA at different rates, at various stages of growth, and in mixtures containing MCPB.

Comparison of MCA, MCPB, and Dinoseb

Two trials were laid down: (A) in early spring in a comparatively weed-free area, and (B) in early summer on an area known to be heavily infested with redroot (*Amaranthus retroflexus*) and willow weed (*Polygonum persicaria*). An unexpected heavy infestation of annual summer grasses, that is witchgrass (*Panicum capillare*) and crabgrass (*Digitaria sanguinalis*), occurred in this later trial. The following treatments were applied to both trials: MCA at 10, 15, and 20 lb per acre, and the sodium salt of MCPB at 1 lb per acre. The amine salt of dinoseb was applied at 1.1 lb phenol equivalent per acre in trial A and 1 lb in trial B. Differences between the two trials are indicated in the following tabulation:

	Trial A	Trial B
Weed infestation	Slight	Heavy
Sown	24/9/59	9/12/59
Sprayed	21/10/59	22/12/59
Stage at spraying	6 to 7 node	4 to 5 node
Date harvested	16/12/59	8/2/60
Sowing to harvest	83 days	60 days

Weed control: In trial A *Chenopodium pumilio* and flat weeds, mainly hawksbeard (*Crepis capillaris*), were 1 in. in diameter at the time of

spraying. In trial B, which was in the weedy area, the size of the weeds (mainly willow weed and redroot), ranged from cotyledons to one leaf, up to 1 in. in diameter. Annual summer grasses were $\frac{1}{2}$ to 1 in. across. The following table summarises the weed control obtained in the two trials:

		Redroot	Willow weed	<i>C. pumilio</i> & cress	Grasses
MCA 10 lb		Good	Fairly good	Good	Poor
MCA 15 lb		Excellent	Very good	Very good	Fair
MCA 20 lb		Excellent	Very good	Very good	Fairly good
Dinoseb		Very good	Excellent	Very good	Fairly good
MCPB		Excellent	Very poor	Fairly good	Nil

All treatments, except MCPB, gave very good control of flat weeds, with MCA at 10 lb giving slightly less control than 15 or 20 lb.

Effect on yield: Table 1 shows the yields from the two trials, in bushels (60 lb) of shelled peas per acre. Apart from the effect of weed competition the yields are lower in trial B, because of a fungal disease which attacked the crop in the early stages, and lower soil fertility in the trial area.

TABLE 1—YIELDS OF SHELLED PEAS IN BUSHELS PER ACRE

Treatment	Trial A	5 per cent	1 per cent	Trial B	5 per cent	1 per cent
Hand weeded	70.7	a	AB	57.8	a	A
Dinoseb 1 lb	68.9	a	AB	49.8	b	AB
MCA 10 lb	73.6	a	A	38.7	c	C
MCA 15 lb	65.2	ab	ABC	45.8	bc	BC
MCA 20 lb	58.6	bc	BC	41.8	c	BC
MCPB 1 lb	64.6	abc	ABC	26.9	d	D
Unweeded	56.0	c	C	25.1	d	D
C.V		9.9 per cent			12.9 per cent	

In trial A, plots which were treated with MCA at 10 lb outyielded (but not significantly) those with 15 lb, though the latter rate gave better weed control. This suggests that the 15 lb rate may have a slight toxic effect on peas. MCA at 20 lb gave even better weed control, but the low yield, which was similar to the unweeded control, indicates that this rate is too toxic to peas. MCPB had only a slight effect on the few weeds present and yielded neither significantly higher nor lower than the unweeded and hand weeded controls respectively.

In trial B, very poor pea yields were obtained from the unweeded plots, which suffered serious competition from the heavy infestation of weeds, while the maintenance of weed-free conditions on the hand weeded plots led to more than double the yield obtained on the unweeded controls. Better weed control was obtained whenever the rate of MCA was increased, but the three rates applied did not cause yields to be significantly different from one another. MCA at 10 lb considerably reduced the number of broad-leaved weeds, but those surviving, together with the many grasses, were sufficient to cause a fairly severe reduction in yield. The MCA 15 lb and dinoseb treatments yielded significantly less than the hand weeded control, because of competition from the annual grasses. Very good control of weeds was obtained by MCA 20 lb, and the significantly reduced yield, compared with that of dinoseb, must be due to a toxic effect. MCPB plots gave a similar yield to the unweeded plots, because of very poor weed control. In general, though grasses reduced pea yields, their effect was far less serious than that of broad-leaved weeds, such as willow weed, which tended to smother the crop.

Stages of Growth

A trial was laid down to determine the effect of MCA at various stages of pea growth. A crop sown on 20/11/59 and harvested 66 days later was treated with MCA 15 lb at the following stages:

No. of true nodes: 4 6 8 to 9
Days after sowing: 12 17 27

Treatment at the 8 to 9 node stage was duplicated, one application being on plots which were hand weeded up to the time of spraying, and the other on unweeded plots. Weed infestation throughout the trial area was fairly light and comprised willow weed, redroot, nightshade (*Solanum nigrum*) and *C. pumilio*, which at the time of the first spraying was up to 1 in. in diameter with one true leaf, while at the 8 to 9 node stage it usually had five to six leaves and was up to 6 in. in diameter.

Weed control: At the time of harvest unweeded control plots had a moderate infestation of weeds. Hand weeding, while fairly good, was below the standard usually obtained, due to wet soil conditions. Very good weed control was obtained with MCA at all times of application. Odd plants of all species survived the treatment, but these were too few to affect the yields, which are given in Table 2.

TABLE 2—EFFECT OF MCA ON PEAS AT DIFFERENT GROWTH STAGES

Treatment	Bushels. per acre	5 per cent	1 per cent
MCA 15 lb at—			
4 node	76.1	ab	AB
6 node	76.3	ab	AB
8 to 9 node	83.5	ab	AB
8 to 9 node plus weeding	84.1	a	A
Hand weeded	70.1	bc	AB
Unweeded	60.0	c	B

C.V.—14 per cent

Effect on yield: Though there were no significant differences in tolerance when peas were treated at any of the three stages of growth, there is some indication that the crop may be slightly more sensitive up to the 6 node stage than at the 8 to 9 node stage.

Apparently the few weeds present on the hand weeded plots were sufficient to reduce the yield to such an extent that it was not significantly better than unweeded control. Under conditions of heavy weed infestations MCA would give much better weed control if applied earlier than at the 8 to 9 node stage. Therefore it is probable that any possible gain due to an increase in pea tolerance would be entirely offset by the losses due to weed competition prior to spraying, and poorer subsequent weed control.

Mixtures of MCA and MCPB

It was considered that a mixture of MCA and MCPB might give better weed control if the crop contained weeds such as fathen (*Chenopodium album*) which are particularly resistant to MCA and yet susceptible to MCPB. Accordingly a trial was laid down to determine the tolerance of peas to mixtures of those two materials.

Peas sown on 29/10/59 were sprayed at the 5 node stage. The following were the treatments:

1. MCA at 15 lb
2. MCA at 10 lb + MCPB at $\frac{3}{4}$ lb
3. MCA at 10 lb + MCPB at $\frac{1}{4}$ lb
4. MCA at $7\frac{1}{2}$ lb + MCPB at $\frac{3}{4}$ lb
5. MCA at $7\frac{1}{2}$ lb + MCPB at $\frac{1}{4}$ lb
6. MCPB at 1 lb
7. Hand weeded control

Though weed infestation in the trial was very light, some useful information on weed control was obtained, as well as evidence on the tolerance of the crop to the treatments. Weeds present were mainly willow weed, with some *C. pumilio* and cress (*Coronopus didymus*), and in addition scat-

tered plants of fathen. All of these at the time of treatment were very small, generally in the cotyledon to first leaf stage, and less than 1 in. in diameter.

Weed control: The most efficient treatment was MCA 10 lb + MCPB $\frac{3}{4}$ lb, which gave very good control of all species present. Mixtures which contained $\frac{3}{4}$ lb MCPB gave better control of the *Chenopodium* spp. and cress than those with $\frac{1}{2}$ lb; while those containing 10 lb of MCA were more effective on willow weed than those with 7 $\frac{1}{2}$ lb. MCA alone at 15 lb gave very good control of willow weed and *C. pumilio* some control of cress, but had no effect on fathen, and it was generally better than either of the mixtures containing 7 $\frac{1}{2}$ lb MCA. MCPB alone at 1 lb gave some control of *C. pumilio* and little control of willow weed.

Yields: There were no significant differences in yields, which ranged from 79 bushels to 85.1 bushels per acre. The coefficient of variation was 10.8 per cent. MCPB at 1 lb caused some slight wilting soon after treatment, which later disappeared, and apparently had no effect on the yield.

It appears that suitable mixtures of MCA and MCPB could safely be used for weed control in peas, since there is no evidence from this trial of increased toxicity to the crop or a reduced effect on the weeds.

MAIZE

Two trials (A and B) were conducted with maize over two consecutive seasons, using chemicals of the triazine group. In trial A, CIPC at 4 lb and simazine at 1, 2, and 4 lb were applied pre-emergently in 36 gallons of water per acre. The next year, in trial B, pre-emergent treatments included simazine and trietazine at 4 lb and a mixture containing 2 lb of each. The amine salt of 2,4-D at $\frac{3}{4}$ lb and MCA at 20 lb were applied post-emergently when the maize had four to five years and was 8 to 10 in. high. The main weed redroot had four leaves and was 2 in. in diameter. Other weeds were willow weed at the two-leaf stage and spurrey (*Spergula arvensis*), both up to 2 in. high. Other differences between the two trials are indicated below:

	Trial A	Trial B
Sown	14/11/58	24/11/59
Pre-emergence spraying	18/11/58	30/11/59
Rainfall (week later)	42 pts.	33 pts.
Post-emergence spraying	—	11/12/59
Rainfall (two days later)	—	100 pts.
		(over three days)
Harvested	27/4/59	17/5/60

Trial A (1958-59 season)

Weed control: The unweeded control plots were heavily infested with redroot and with an undergrowth of *C. pumilio* and annual grasses.

Simazine at 1, 2, and 4 lb gave respectively fair, fairly good, and excellent control of redroot. CIPC at 4 lb gave slightly less control than simazine at 1 lb. On the simazine plots there were bad infestations of *Panicum* spp. which varied inversely with the amount of redroot. These grasses apparently did not affect yields, but as there was no hand weeded control for comparison, their competitive effect cannot be determined.

Yields: The cobs were harvested from the two centre rows of each plot, the total length harvested being 80 ft. Yields are given in Table 3 as bushels of grain dried to constant weight.

TABLE 3—EFFECT OF SIMAZINE ON MAIZE AND REDROOT

Treatment	Bushels per acre	5 per cent	1 per cent	Control of redroot
Simazine 4 lb	107	a	A	Excellent
Simazine 2 lb	86	b	AB	Fairly good
Simazine 1 lb	85	b	AB	Fair
CIPC 4 lb	79	b	BC	Fair
Unweeded	61	c	C	Nil
C.V.—16.7 per cent				

It appears that the yields varied inversely with the amount of redroot present. Excellent weed control by simazine at 4 lb resulted in a 70 per cent increase in yield over unweeded control. There was no significant difference between CIPC and the two lower rates of simazine.

Trial B (1959-60 season)

Weed control: The unweeded control plots had a very heavy infestation of redroot, resulting in the reduction of the crop generally. The hand weeded control plots were kept entirely weed free and the crop was thus very good. The following tabulation summarises the effect of the treatments on redroot and *Panicum* grasses:

Treatment	Control of redroot	Amount of <i>Panicum</i>
Hand weeded	Excellent	Nil
Simazine 4 lb	Excellent	Odd
Simazine 2 lb plus trietazine 2 lb	Excellent	Few
Trietazine 4 lb	Very good	Some
Amine 2,4-D $\frac{3}{4}$ lb	Fairly good	Much
MCA 20 lb	Some	Some
Unweeded	Nil	Some

Simazine was generally better than trietazine for the control of annual grasses and broad-leaved weeds.

Yields: The crops on all triazine treated plots were very good. MCA caused slight initial damage, from which the crop soon recovered. The cobs were harvested from the two centre rows of each plot, the total length harvested being 60 ft.

TABLE 4—YIELD OF MAIZE FROM TRIAL B

Treatment	Bushels per acre	5 per cent	1 per cent
Hand weeded	141	a	A
Simazine 4 lb	141	a	A
Simazine 2 lb plus trietazine 2 lb	138	a	A
Trietazine 4 lb	130	a	A
Amine 2,4-D $\frac{3}{4}$ lb	133	a	A
MCA 20 lb	127	a	A
Unweeded	64	b	B

C.V.—13.9 per cent

All treatments yielded significantly higher than the unweeded control. Though the treated plots were not significantly different from one another, the yields obtained are in ascending order, according to the degree of weed control obtained. It thus appears that the weed control given by the triazine compounds is unnecessarily good. The little extra yield gained would hardly compensate for the very high cost of the materials. Apparently, the relatively poor weed control given by $\frac{3}{4}$ lb of amine, 2,4-D was sufficient to ensure a very good yield. Though MCA had no apparent adverse effect on the crop, weed control was disappointing, in spite of an initial good kill. Weeds killed by this treatment were soon replaced by a second generation.

CONCLUSIONS

(1) Victory Freezer peas tolerated 15 lb of MCA when applied between the 4th and 8th node stages of growth. This is about the minimum rate of MCA required for effective weed control, particularly in heavy weed infestations.

(2) 10 lb of MCA was too low to control completely any heavy infestations of weeds; and 20 lb of MCA, though giving very good weed control, was too toxic to peas.

(3) It appears that MCA and MCPB are compatible, and the weed control obtained from such mixtures is additive. A combination of 10 lb of MCA plus $\frac{3}{4}$ lb of MCPB gave a more satisfactory control of a wider range of weed species than did MCA at 15 lb or MCPB at 1 lb and with no adverse effect on peas.

(4) These, and other trials, indicate that MCPB at 1 lb alone is unsatisfactory, where willow weed occurs in any quantity in pea crops.

(5) The amine salt of dinoseb at 1 lb per acre gave very good weed control and was not toxic to peas.

(6) Maize tolerated 4 lb per acre of simazine and trietazine.

(7) Simazine at 1, 2, and 4 lb per acre gave respectively fair, fairly good, and excellent control of redroot.

(8) In maize, trietazine at similar rates to simazine, was less efficient in the control of broad-leaved weeds and annual grasses.

(9) Though giving excellent weed control, the triazines used gave no significant increase in yield over that of either $\frac{3}{4}$ lb of amine 2,4-D or 20 lb of MCA, which gave only fairly good and some control respectively of redroot.

(10) Trials on both maize and peas show that grassy weeds depress yields far less than such broad-leaved weeds as redroot and willow weed.

ACKNOWLEDGMENTS

Messrs F. B. and A. E. Thompson assisted in the preparation of this paper. The biometrics section of the Department of Agriculture supplied statistical analyses.

REFERENCE

1. Thompson, F. B. Proc. 12th N.Z. Weed Control Conf., 1959, pp. 99-103.

DISCUSSION

Q.—Did MCPB cause any difference in maturity dates of peas?

A.—There was no difference in maturity dates from the use of MCPB and MCA.

Comment: In the principal maize growing areas in New Zealand barnyard grass is common and simazine may not give adequate control, but atrazine post-emergence may be a better proposition.

Comment: Grass weeds are now common in the maize growing areas, because of good control of redroot.

Comment: In my experience the main weeds in maize in the Gisborne area are redroot, Apple of Peru, and nightshade.

Q.—Was there any damage on roots of maize from $\frac{3}{4}$ lb of 2,4-D?

A.—2,4-D produced a swelling at roots, but no significant increase in lodging of crop.

Q.—Have you any experience of mixing dinoseb and MCPB for peas?

A.—No. MCA at 15 lb gives at least equal control to dinoseb and is not so subject to weather.

Comment: Use of MCA with MCPB is of interest, but MCA should be used without wetting agent to maintain crop tolerance, and hormones do contain wetting agent as marketed.

Comment: Though no significant difference in yield between simazine and 2,4-D, there is a great difference between the cost of the two.