Review of Discussion

CEREALS SESSION

Sessional Chairman: C. E. IVERSEN

We have had two very useful papers — drawing our attention to conditions where standard chemicals (2,4-D) may prove of little value or even harmful by reducing competition for the tolerant weed.

Mr. Allen has made a valuable contribution to our knowledge of wild oats and his recommendations for control are most useful.

CONTROL OF "DIFFICULT" WEEDS IN WHEAT

F. A. H. MEEKLAH

Department of Agriculture, Mosgiel

Summary

Three trials are reported observing the effect of mecoprop, a MCPA/TBA mixture and SMCA on certain Polygonaceae — redshank (*Polygonum persicaria*), wireweed (*P. aviculare*), and bindweed (*P. convolvulus*) — chickweed (*Stellaria media*), and spurrey (*Spergula arvensis*). The advantages of mecoprop and MCPA/TBA over MCPA were limited. SMCA was highly effective against redshank, bindweed, spurrey and chickweed, but did not control wireweed and fathen (*Chenopodium album*). Wheat yield increases of up to 27% followed treatment. Their magnitude appeared related to seasonal growing conditions. Both Arawa and Aotea wheat varieties were fully tolerant to MCPA, MCPA/TBA and mecoprop when grown under weed-free conditions.

INTRODUCTION

IN NEW ZEALAND weed control in wheat has largely centred around the use of 2,4-D and MCPA. However, experience in wheat-producing areas overseas indicates that weed populations susceptible to these materials are being replaced by resistant populations. To control these difficult species three new materials have been introduced, mecoprop, 2,3,6-TBA and SMCA.

The activity of mecoprop in cereals has been studied by Lush (1956) who reported that 2 lb a.i. per acre of a mixture of *d* and *l* isomers was broadly equivalent to MCPA but gave better control of cleavers (*Galium aparine*) and chickweed (*Stellaria media*). (Quantities of chemicals throughout are expressed in terms of a.i. per acre.) Further work was reported by Lush *et al.* (1958), Wheeler (1958), Elliott (1958) and Lhoste *et al.* (1958). These reports are of particular interest as the action of mecoprop on several weed species common in New Zealand is described:

Good control: Docks (*Rumex* spp.), Californian thistle (*Cirsium arvense*), fathen (*Chenopodium album*), chickweed.
 Variable control: Redshank (*Polygonum persicaria*).
 Checked: Wireweed (*Polygonum aviculare*), bindweed (*Polygonum convolvulus*).

Considerable attention was also paid to the tolerance of cereal varieties to mecoprop. It was found that, provided the wheat was sprayed on or after the 5-leaf stage, few abnormalities or yield effects occurred. Leafe (1956) reported that mecoprop could be used with safety at earlier stages of growth than MCPA.

Pfeiffer (1958) reported the use of 2,3,6-TBA in a proprietary mixture with MCPA. Control was extended to the following weeds normally resistant to MCPA: Some mayweeds (*Matricaria* and *Anthemis* spp.), redshank and chickweed. Early spraying—i.e., between tillering and jointing stages—appeared important for best results. The high cost of 2,3,6-TBA suggested its most effective economic use as an additive to MCPA.

Breese and Wheeler (1956) and Wheeler (1958) reported good control by SMCA of cleavers, redshank, bindweed and to a lesser extent chickweed but no control of fathen or wireweed. Crop tolerance to SMCA appeared very good, 20 lb in 20 gal water per acre being the optimum dose.

An evaluation of the above materials in wheat crops made at Invermay Research Station in four successive seasons is reported here.

EXPERIMENTAL METHOD

Four separate experiments are reported. Details of the treatments in each trial are set out in Table 1.

TABLE 1: DETAILS OF EXPERIMENTS

Experiment	1	2	3	4
Wheat variety	Arawa	Arawa	Arawa	Aotea and Arawa
Date sown	Sept. 2, 1957	Sept. 12, 1958	Aug. 29, 1959	Oct. 7, 1960
Date treated	Nov. 18, 1957	Nov. 4, 1958	Oct. 30, 1959	Nov. 22, 1960
Stage of development	6-leaf	5-leaf	6-leaf	3 to 4 tillers
Treatment (lb)	SMCA 20 Mecoprop $\frac{1}{2}$ Mecoprop 1	SMCA 20 Mecoprop $\frac{1}{2}$ Mecoprop 1	SMCA 20 Mecoprop 1 Mecoprop 2	Mecoprop 2 MCPA 1 Amine salt of 2,4-D 1 MCPA/TBA 1
	MCPA $\frac{1}{2}$	MCPA $\frac{1}{2}$ MCPA 1 MCPA/TBA 1 2,4-DB 1	MCPA $\frac{1}{2}$ MCPA 1 MCPA/TBA 1 2,4-DB 1	

Treatments were applied with an "Oxford" precision sprayer to spring sown wheat sown in 7 in. drills. Randomized block designs of four replicates were used.

In Experiments 1, 2 and 3 visual gradings for weed control were made. In two experiments (1 and 3) numbers and weight of the major weed species were recorded after treatment from 12 or 16 quadrats each 1 sq. ft from each treatment. Plots were direct headed for the determination of yield. The weed seed content of bulked samples was determined and header yields corrected to clean grain yields.

RESULTS

EXPERIMENT 1

Apart from a severe but temporary contact scorch caused by SMCA to the terminal portion of the wheat leaves, treatments had no visible effect on the crop. The dominant weeds were wireweed and bindweed with a lesser population of redshank, fathen, spurrey (*Spergula arvensis*), fumitory (*Fumaria officinalis*) and chickweed.

A visual assessment made on December 11, 1957, showed that mecoprop 1 lb and MCPA gave good control but the other treatments were not satisfactory. No treatment was effective against wireweed the vigour of which was increased by the removal of susceptible species.

SMCA eliminated bindweed and redshank and was highly effective against spurrey but did not control wireweed, fumitory and fathen.

Mecoprop checked all weeds with the exception of wireweed and spurrey.

MCPA checked and stunted all weeds except wireweed and redshank.

TABLE 2: WEED NUMBERS AND TOTAL WEIGHTS
PER SQ. FT AT DECEMBER 10, 1957

	SMCA	Meco- prop ½ lb	Meco- prop 1 lb	MCPA	Control
Wireweed	360	333	214	302	240
Bindweed	0	58	60	57	147
Fumitory	21	10	9	24	4
Spurrey	6	21	37	36	34
Fathen	46	14	27	6	30
Redshank	0	12	9	12	15
Chickweed	27	12	28	25	27
Others	3	3	2	8	9
Total	463	463	386	470	506
Total wet weight	34.9 g	28.2 g	22.4 g	24.4 g	33.7 g
Relative control = 100 ...	104	84	66	72	100

The trial was harvested on April 2, 1958. Yields and visual grading are shown in Table 3.

TABLE 3: VISUAL GRADINGS AND GRAIN YIELD:
EXPERIMENT 1

Treatment (lb)	Visual Grading* 11.12.57	Yield (bu./ac.)	Relative Control =100	Weed Seed Content (%)
SMCA	2.2	87.7	106	0.1
Mecoprop ½	2.8	88.6	107	0.7
Mecoprop 1	4.2	91.0	110	0.1
MCPA	3.5	88.9	108	0.1
Control	1.3	82.6	100	1.0

* Visual grading scale: 1—very poor; 2—poor; 3—fair; 4—good; 5—very good.

Treatments increased grain yields 6 to 10% and all differed significantly from control.

EXPERIMENT 2

Apart from leaf scorch with SMCA, treatments had no visible effects upon the crop. The dominant weeds were bindweed and wireweed. SMCA completely controlled bindweed and MCPA/TBA was highly effective, but control of this weed by the other treatments was only fair. Wireweed was largely unaffected by any treatment. Mecoprop was slightly more effective than MCPA at comparable concentrations. Visual gradings taken January 23, 1959, are given in Table 4.

The trial was harvested on March 14, 1959. Yields are given in Table 4.

TABLE 4: VISUAL GRADINGS AND GRAIN YIELD:
EXPERIMENT 2

<i>Treatment</i> (lb)	<i>Visual</i> <i>Grading*</i> 23.159	<i>Yield</i> (bu./ac.)	<i>Relative</i> <i>Control</i> =100	<i>Weed Seed</i> <i>Content</i> (%)
MCPA ½	1.7	54.7	117	5.1
MCPA 1	2.2	55.9	120	4.8
Mecoprop ½	2.6	52.2	112	5.3
Mecoprop 1	2.9	58.4	125	2.0
2,4-DB	2.3	53.9	116	4.0
SMCA	3.8	55.3	119	1.1
MCPA/TBA	3.5	59.1	127	2.2
Control	1.8	46.6	100	5.7

* Visual grading scale: 1—very poor; 2—poor; 3—fair; 4—good; 5—very good.

All treatments gave significant increases in yield over control. The yields of SMCA, MCPA/TBA and mecoprop 1 lb treatments appear to reflect their higher efficiency as herbicides.

EXPERIMENT 3

The variety Aotea was used in this trial but apart from a temporary leaf scorch with SMCA no visible effects on the crop were noted. Bindweed, wireweed, redshank and fathen were the dominant weeds. Quantitative data of weed numbers and wet weight per square foot were taken on December 21, 1959. These are given in Table 5.

TABLE 5: NUMBER AND WEIGHT (g) OF WEEDS
IN 16 QUADRATS OF 1 SQ. FT: EXPERIMENT 3

<i>Treatment</i> (lb)	<i>MCPA ½</i>		<i>MCPA 1</i>		<i>Mecoprop 1</i>		<i>Mecoprop 2</i>	
	No.	Wt.	No.	Wt.	No.	Wt.	No.	Wt.
Bindweed	31	13.9	13	2.5	4	17.4	1	Tr
Wireweed	99	29.7	57	10.8	96	47.4	104	34.4
Fathen	0	0	0	0	2	0.2	0	0
Spurrey	7	2.5	16	3.0	10	4.2	15	5.1
Redshank	32	27.0	52	41.1	49	34.4	36	31.4
Chickweed	25	8.4	43	21.7	4	0.2	2	Tr
Others	2	0.4	3	0.3	2	Tr	4	0.2
Total	196	81.9	184	79.4	167	103.8	162	71.1
Relative control = 100		18		18		23		16

<i>Treatment</i> (lb)	<i>2,4-DB</i>		<i>SMCA</i>		<i>MCPA/TBA</i>		<i>Control</i>	
	No.	Wt.	No.	Wt.	No.	Wt.	No.	Wt.
Bindweed	1	Tr	0	0	46	12.5	77	60.3
Wireweed	55	11.9	276	377.4	104	28.4	188	183.6
Fathen	8	1.5	26	76.4	0	0	41	99.3
Spurrey	17	9.8	0	0	8	1.8	11	4.7
Redshank	37	28.4	1	Tr	10	18.0	61	83.5
Chickweed	22	18.7	4	0.4	17	12.8	10	4.0
Others	4	Tr	1	0.1	2	Tr	4	7.5
Total	144	70.3	308	454.3	187	73.5	392	442.9
Relative control = 100		16		103		17		100

Tr = trace

SMCA completely controlled bindweed and redshank and was highly effective against spurrey and chickweed. Fathen and wireweed, however, were unaffected. MCPA/TBA gave excellent control of redshank, bindweed and fathen and adequate control of wireweed and spurrey. Mecoprop gave complete control of bindweed and was highly effective against fathen and chickweed. Control of wireweed was acceptable. On a visual grading made on January 14, 1960 (Table 6), the overall efficiency of mecoprop and MCPA/TBA, 2,4-DB and MCPA were similar. SMCA, however, proved ineffective on a weed population in which wireweed and fathen were dominants.

The trial was harvested on March 14, 1960. Yields are shown in Table 6.

TABLE 6: VISUAL GRADINGS AND GRAIN YIELD:
EXPERIMENT 3

<i>Treatment</i> (lb)	<i>Visual</i> <i>Grading*</i> 14.1.60	<i>Yield</i> (bu./ac.)	<i>Relative</i> <i>Control</i> =100	<i>Weed Seed</i> <i>Content</i> (%)
MCPA ½	3.5	94.6	106	8.1
MCPA 1	3.9	92.5	104	9.3
Mecoprop ½	4.0	91.0	102	8.4
Mecoprop 1	4.1	96.0	108	4.9
2,4-DB	4.2	93.8	105	8.6
SMCA	1.9	91.0	102	3.2
MCPA/TBA	4.3	96.0	108	5.4
Control	1.2	89.3	100	8.4

* Visual grading scale: 1—very poor; 2—poor; 3—fair; 4—good; 5—very good.

Yields increases averaging 5% followed treatment but these did not differ significantly from control.

EXPERIMENT 4

To determine the tolerance of two wheat varieties, Arawa and Aotea, to some of the materials used in this series, this trial was sown on a relatively weed-free area. In this way the interaction of true tolerance and weed competition effects on yield were minimized.

Following establishment, occasional plants of sheep's sorrel (*Rumex acetosella*), fathen, dock, chickweed and spurrey were present and the area was harrowed one month after sowing to control these weeds. The trial then remained essentially weed-free until harvest.

The trial was harvested on March 30, 1961, and yields are shown in Table 7. MCPA, mecoprop and MCPA/TBA had no effect on yields while the amine salt of 2,4-D gave a slight but non-significant depression. These effects were similar in both varieties. A baking quality test carried out by the Wheat Research Institute showed that baking quality was unaffected by treatment.

TABLE 7: GRAIN YIELD: EXPERIMENT 4

<i>Treatment</i>	<i>Yield (bu./ac.)</i>	
	<i>Aotea</i>	<i>Arawa</i>
MCPA	62.3	81.0
Amine salt of 2,4-D	58.9	77.0
Mecoprop	62.5	80.7
MCPA/TBA	60.5	79.4
Control	62.5	80.4

DISCUSSION

A general assessment of the performance of the materials can be derived from the data from Experiment 3. The overall effectiveness of MCPA, 2,4-DB, mecoprop and MCPA/TBA was similar both on

visual grading and weight of surviving weeds. Each exerted some degree of control over all species except spurrey and chickweed, although in Experiments 1 and 2 wireweed also was not controlled. SMCA was inferior to these for overall effectiveness as it did not control fathen and wireweed but was superior on some important "difficult" weeds.

Specific effectiveness was as follows:

SMCA: Redshank, bindweed, spurrey, chickweed.
Mecoprop: Chickweed.
MCPA/TBA: Redshank.

SMCA thus appears a useful material where difficult weeds are dominant. However, partial control of weed populations can result in an increase in the vigour of resistant species and a resumption of competitive pressures. This is well illustrated by the elimination of bindweed, redshank, spurrey and chickweed by SMCA in Experiment 3, only to permit a strong growth of wireweed to dominate. In mixed populations of "difficult" weeds, therefore, a material which will check a wide range of species is preferable to one which completely eliminates a limited number.

Those weeds not controlled satisfactorily by MCPA, namely, spurrey, chickweed and redshank, were completely controlled by SMCA, suggesting that a mixture of these materials may be highly effective.

The advantages of mecoprop and MCPA/TBA over MCPA were limited.

In three experiments where the weed population was appreciable, treatment resulted in increased grain yields generally, although not always in direct relationship to the effectiveness of weed control.

The small increases (5 to 8%) recorded in Experiments 1 and 3 were associated with high grain yields (80 to 100 bu./ac.). These yields obviously reflect very favourable growing conditions which minimized the competitive effect of weeds. In Experiment 2, dry conditions led to low wheat yields and strong competitive effects from weeds, presumably for soil moisture. Large increases in yield, averaging 20%, followed treatment.

Measurable yield responses under highly favourable conditions of crop growth probably justify weed control under all conditions of cropping.

Crop tolerance was difficult to assess in the presence of yield increases due to weed control, and no consistent indications of tolerance, particularly in respect to SMCA, can be derived from Experiments 1, 2 and 3. Apart from a temporary leaf scorch, SMCA did not appear to affect the crop. In Experiment 4, two of the new materials under review, mecoprop and MCPA/TBA, were fully tolerated. The slight yield depression of the amine salt of 2,4-D was consistent with general experience.

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