CONTROL OF WEEDS IN CEREALS WITH IOXYNIL/MECOPROP, BROMOXYNIL AND BROMOXYNIL/MCPA

D. C. ISAACS and K. B. MILES
May & Baker (New Zealand) Ltd.

Summary

Eleven farm trials with ioxynil/mecoprop have shown that this product gives excellent control of most of the annual weeds in cereals which are not well controlled by MCPA or 2,4-D. Ioxynil 6 oz + mecoprop 18 oz was superior to normal doses of 2,4-D or MCPA on most weeds but less effective on wireweed (*Polygonum aviculare*) than dicamba/MCPA. Wheat and barley crops suffered some spotting and scorch after spraying with ioxynil/mecoprop, but quickly recovered. Yields were measured in two trials and showed no significant difference between the standard MCPA treatment and rates of up to 9 oz ioxynil + 27 oz mecoprop per acre. Results from sixteen sites in Australia showed that bromoxynil and bromoxynil/MCPA gave excellent control of cornbind (*P. convolvulus*) and wireweed, respectively.

INTRODUCTION

TRIALS with ioxynil and bromoxynil in the 1964-5 season (Isaacs, 1965) showed that both these herbicides give good control of many of the important weeds which occur in cereal crops in New Zealand.

The success of ioxynil/mecoprop mixtures in England (Carpenter, *et al.*, 1964) led to its being tested in New Zealand under farm conditions against the more difficult weeds.

EXPERIMENTAL WORK

SCOPE OF PROGRAMME

Two types of trial were laid down using farmers' equipment in all cases.

(a) Weed Control

The object was to test ioxynil/mecoprop on cereal weeds which are not well controlled with MCPA and 2,4-D. Nine sites were selected which included the following weeds: Wireweed (*Polygonum aviculare*), cornbind (*P. convolvulus*), redshank (*P. persicaria*), mayweed (*Anthemis cotula*), spurrey (*Spergula arvensis*), fathen (*Chenopodium album*).

(b) Crop Tolerance

Two sites were chosen where weeds were of minor importance and where the farmer was willing to harvest the plots separately. The object was to confirm that ioxynil/mecoprop does not affect the crop any more than the standard herbicide.

SEASONAL CONDITIONS

The weather up till the end of the year was wetter than normal in all districts. While this delayed spraying on some sites, it also

encouraged vigorous crop growth, which contributed to the suppression of weeds.

FORMULATIONS USED

Only one experimental material was used — a mixture of ioxynil and mecoprop containing 12 oz ioxynil and 6 oz mecoprop per gallon (all rates in active ingredient per acre). This was applied at 6 oz ioxynil and 18 oz mecoprop and 7½ oz ioxynil and 22½ oz mecoprop at all sites and 9 oz ioxynil and 27 oz mecoprop at six sites including those where yields were taken. The standard comparison treatments included:

<i>Compound</i>	<i>Dose (oz)</i>
MCPA	12—24
Dicamba/MCPA	2+12
Amine 2,4-D	12—16
TBA/MCPA	4+12

APPLICATION METHODS

In all cases the treatments were applied by the farmer with his own boom sprayer at volumes ranging from 11 to 25gal/acre.

ASSESSMENTS

(a) *Weed Control*

At most sites weed counts were made in 4 × ½ sq.yd fixed quadrats per plot before spraying and 3 to 4 weeks after spraying. At some sites weather caused the postponement of spraying with the result that some pre-spraying counts were made up to 10 to 14 days before application.

At sites 301 and 302 no pre-spraying assessments were made. On site 305 weed populations were rated but not counted and at site 309 visual assessments only were made.

(b) *Crop*

Observations were made of the effect of all treatments on the crop 4 to 10 days after treatment.

At sites 306 and 304 a single strip was harvested from each plot with a header-harvester.

RESULTS

WEED CONTROL

Excellent control was given by ioxynil/mecoprop over cornbind, mayweed, fumitory, redshank, fathen, nettle, twincress, shepherd's purse and staggerweed. Control of chickweed and red deadnettle was good.

The control of wireweed in terms of numbers was poor, but the treatment severely checked all plants and the weed did not offer any serious competition. This was well illustrated at site 301 where the reduction in numbers was only 20% but reduction in weed bulk was 85%. In two trials when dicamba/MCPA was used, this product gave better control of wireweed than ioxynil/mecoprop.

Against spurrey, ioxynil/mecoprop gave variable results, the best control being obtained with the smaller plants. In one trial dicamba/MCPA was not better than ioxynil/mecoprop.

TABLE 1: PERCENTAGE REDUCTION OF WEED NUMBERS AT GIVEN DOSES (oz/acre)
(Percentage Reduction of Bulk in Parentheses)

Species	Site	Growth Stage at Spraying	No. sq. yd at Spraying	Ioxynil/Mecoprop 6+18 7½+22½ 9 27	Dicamba/ MCPA 2+12	2,4-D 12-16	TBA/ MCPA 4+12	MCPA 12-24
Wireweed (<i>Polygonum aviculare</i>)	301	6 leaf	200	24 (86)	20 (85.5)	—	—	20 (48)
	302	4-8 leaf		76 (88)	62 (81)	68 (90)	—	—
	308	2-8 leaf	117	48	28	0	—	—
	310	2-5 leaf	11	0	0	—	—	—
	312	4-8 leaf	34	43	35	—	—	4
Cornbind (<i>Polygonum convolvulus</i>)	302	2-5 leaf	136	99	85	85	—	—
	307	1-3 leaf	14	100	100	—	25	—
	310	1-2 leaf	19	100	100	84	—	—
	312	2-6 leaf	19	100	96	—	—	68.5
Mayweed (<i>Anthemis cotula</i>)	301	1-3 leaf	7	82	94	85	—	—
	307	2-4 leaf ½-1½ in.	65	90	96	—	44	—
Fumitory (<i>Fumaria officinalis</i>)	310	2-6 leaf	106	96	95	0	—	—
Spurrey (<i>Spergula arvensis</i>)	303	2-3 in.	33	100	100	100	—	—
	305	6 in.	100	0	0	24	—	—
	308	1-2 in.	37	77	57	—	—	—
	310	1-2 in.	44	31	94	7.5	—	—
	312	2-3 in.	23	4	23	—	—	71

TABLE 2: YIELD DATA

TRIAL No. 304

Grain yields (lb/115 sq. yd) per plot
Barley variety: Carlsburg

<i>Treatment (oz)</i>	<i>Block A</i>	<i>Block B</i>	<i>Mean</i>
Ioxynil 6/Mecoprop 18	64	62	63
Ioxynil 7½/Mecoprop 22½	55	59	57
Ioxynil 9/Mecoprop 27	61	60	60.5
MCPA 12	65	65	65

LSD between treatment means 5.9 at 5% level
10.9 at 1% level

CV: 3.0%

TRIAL No. 306

Grain yields (lb/505 sq. yd) per plot
Wheat variety: Gemenya

<i>Treatment (oz)</i>	<i>Block A</i>	<i>Block B</i>	<i>Mean</i>
Ioxynil 6/Mecoprop 18	346	359	353
Ioxynil 7½/Mecoprop 22½	352	308	330
Ioxynil 9/Mecoprop 27	354	303	328
MCPA 12	335	352	344

LSD between treatment means 81.6 at 5% level
149.7 at 1% level

CV: 7.6%

In general ioxynil/mecoprop performed better than amine salt of 2,4-D, MCPA and TBA/MCPA mixture. Results are summarized in Table 1.

CROP TOLERANCE

Light to moderate scorch or spotting of leaves was noted on all sites at the time of the post-spraying observations (4 to 10 days). Three or four weeks after application all signs of crop damage had disappeared.

On sites 308 and 310, the barley on the 2,4-D and dicamba/MCPA plots matured about two weeks later than that on the ioxynil/mecoprop plots. No yield measurements were made at these sites so the effect on yield of this delay in maturity is not known.

Yields from sites 304 and 306 are shown in Table 2.

DISCUSSION

These trials have shown that ioxynil/mecoprop at 6 to 7½ oz ioxynil and 18 to 22½ oz of mecoprop will give good control of the important annual weeds in cereals and that wheat and barley readily tolerate 9 oz ioxynil and 27 oz mecoprop.

The performance of ioxynil/mecoprop on weeds such as wireweed, cornbind, redshank, mayweed and fumitory was consistently better than that of MCPA or the amine salt of 2,4-D. Only moderate control of spurrey was obtained with ioxynil/mecoprop but in all but one trial spraying had been delayed because of bad weather and the weed was too big for good results to be expected.

The apparently poor control of wireweed caused some concern in the earlier stages of the trials. This weed is becoming much more common in South Island crops and it was disappointing to see such a high rate of survival. However, it soon became apparent that the wireweed was very severely checked and, in terms of bulk, control was much more satisfactory. In none of the trials was recovery noted. The dicamba/MCPA mixture gave excellent control of wireweed, so in areas where this weed is dominant it could be the preferred product if its safety to the crop can be conclusively demonstrated.

The results in Australia with a bromoxynil/MCPA mixture on wireweed are most encouraging and suggest that this mixture should also be tested in New Zealand. It would also be suitable for controlling other problem weeds such as redshank and cornbind. It would be less effective against chickweed than an ioxynil mixture but this would not be a major disadvantage as the weed is of only minor importance in New Zealand.

M. J. van de Loo (pers. comm.) carried out a programme of trials covering sixteen sites in cereal crops in Australia during the 1965-6 season, with the object of selecting the most suitable formulation for the control of *Polygonum* species. His treatments were applied by means of a self-propelled small plot sprayer on to plots 10 ft × 25 ft in a randomized plot design replicated four times. Weed control was assessed by counts taken in 2 × ½ sq. yd quadrats, approximately three weeks after spraying. The results are summarized in Tables 3 and 4.

Excellent control of cornbind was obtained with bromoxynil ester at 4 and 6 oz per acre and, while both dosages appeared to give commercially acceptable control in most instances, the higher rate was desirable where the weed had reached the more advanced stages of growth. Speed of weed kill was somewhat different for the various formulations, straight bromoxynil ester acting more rapidly than the mixture. The first compound killed by causing necrosis followed by complete leaf destruction, while the mixture produced a combined effect of epinasty and leaf destruction. Quite different from the action of these two formulations was the performance of 2,4-D which caused severe epinasty of cornbind and only temporary growth inhibition in terminal and axial buds.

Wireweed was less susceptible to bromoxynil than cornbind. Although seedlings and young plants, up to 3 in. high, were well controlled at rates varying between 6 and 9 oz the activity was increased considerably by the addition of MCPA and at most sites the mixture gave adequate control at a dosage of 4 oz active ingredient of each component. Similarly mintweed (*Salvia reflexa*) and cruciferous weeds such as turnip weed (*Rapistrum rugosum*) and hedge mustard (*Sisymbrium orientale*) were more susceptible to the mixture than to a straight bromoxynil ester formulation while fathen was equally well controlled by both formulations. Trials on various soil types of variable fertility indicated that, for wireweed in particular, the dose response was dependent on growth vigour and on brown sandy loams a slightly higher dosage was required to obtain equal results as on black self-mulching clays.

Comparisons were made between treatments applied at 10 and 20 gal per acre and detailed weed counts indicated that there is a slight advantage in using the higher volume.

Cereal tolerance of bromoxynil ester and bromoxynil/MCPA was satisfactory and no crop depression has been recorded. In a number of instances wheat and barley were slightly scorched which was aggravated at some sites by hot and dry weather following the application though generally the scorched crops recovered within

TABLE 3: HERBICIDAL ACTIVITY OF BROMOXYNIL AND BROMOXYNIL/MCPA MIXTURE ON CORNBIND
(Spray volume 10 gal/acre)

	Site 2	Site 5	Site 7	Site 11	Site 3	Site 4	Site 12	Site 1	Site 9
No. days before assessment	20	22	27	27	19	18	26	17	27
Population at spraying (per sq. yd)	180	1,002	262	53	376	44	14	78	116
Population at count (per sq. yd)	120	788	207	42	454	29	13	62	72
Growth stage at spraying*	1-8L (4)	Cot-9L (Cot)	Cot-4L (2-3)	1-6 (4)	Cot-4L (1-2)	1-5L (2)	2-6L (3)	1-5L (3)	Cot-3L (1)
Growth stage at count	3L-6"	2L- flowering	3-6L	2-16"	1-7"	2-15"	3-20"	2-20"	flowering

Treatment (oz)	PERCENTAGE CONTROL OF NUMBERS									
	Site 2	Site 5	Site 7	Site 11	Site 3	Site 4	Site 12	Site 1	Site 9	
Bromoxynil ester 4	99.3	91.6	100	88.3	99.7	97.4	93.2	88.4	94.6	
Bromoxynil ester 6	100	97.0	100	74.1	100	100	94.5	96.0	99.3	
Bromoxynil ester 9	**	**	**	**	100	100	98.6	97.6	100	
Bromoxynil 4/ MCPA esters 4	99.0	89.2	99.8	90.2	98.3	100	94.5	71.5	86.3	
Bromoxynil 6/ MCPA esters 6	99.8	83.0	99.9	90.2	100	99.2	95.9	87.6	100	
Bromoxynil 9/ MCPA esters 9	**	**	**	**	100	100	94.5	96.8	99.8	
2,4-D amine 8 + wetter	36.2	38.5	50	0	48.4	0	71.3	0	13.9	
PERCENTAGE CONTROL OF BULK (= nos. × mean height)										
Bromoxynil ester 4	99.4	95.2	100	96.1	99.7	99.1	93.8	95.0	98.2	
Bromoxynil ester 6	100	95.6	100	93.9	100	100	97.5	98.6	99.8	
Bromoxynil ester 9	**	**	**	**	100	100	99.8	99.5	100	
Bromoxynil 4/ MCPA esters 4	99.4	88.4	99.7	98.0	97.5	100	98.5	88.3	94.8	
Bromoxynil 6/ MCPA esters 6	99.9	70.5	99.9	97.7	100	99.5	95.4	95.6	100	
Bromoxynil 9/ MCPA esters 9	**	**	**	**	100	100	98.5	98.9	99.5	
2,4-D amine 8 + wetter	51.2	47.5	48.2	83.5	48.2	10.7	78.0	38.4	85.2	

* Numbers in parentheses indicate growth stage of majority of weeds.

L = leaves.

** = Treatments excluded from sites 2, 5, 7, 11.

TABLE 4: HERBICIDAL ACTIVITY OF BROMOXYNIL AND BROMOXYNIL/MCPA MIXTURE ON WIREWEED

(Spray volume 10 gal/acre)

	Site 3	Site 4	Site 10	Site 12
No. days before assessment	19	18	26	26
Population at spraying (per sq. yd)	22	162	170	50
Population at count (per sq. yd)	15	139	146	44
Growth stage at spraying* (in.)	2-8 (2)	½-5 (2)	1-7	1-3 (1)
Growth stage at count (in.)	2-8	1-8	2-10	2-15

* Numbers in parentheses indicate growth stage of majority of weeds.

PERCENTAGE CONTROL OF NUMBERS

Treatment (oz)	Site 3	Site 4	Site 10	Site 12
Bromoxynil ester 4	49.2	86.7	35.8	92.1
Bromoxynil ester 6	71.4	96.4	79.0	85.3
Bromoxynil ester 9	98.4	99.6	77.0	97.7
Bromoxynil 4/MCPA esters 4	76.2	99.6	92.7	98.8
Bromoxynil 6/MCPA esters 6	100	100	90.3	99.4
Bromoxynil 9/MCPA esters 9	100	100	96.6	100
2,4-D amine 8 + wetter	35.0	30.3	54.4	83.6

PERCENTAGE CONTROL OF BULK

	Site 3	Site 4	Site 10	Site 12
Bromoxynil ester 4	62.6	89.4	61.2	95.8
Bromoxynil ester 6	70.2	97.4	89.2	93.4
Bromoxynil ester 9	97.1	99.7	88.3	99.0
Bromoxynil 4/MCPA esters 4	81.9	99.4	97.1	99.5
Bromoxynil 6/MCPA esters 6	100	100	96.4	99.9
Bromoxynil 9/MCPA esters 9	100	100	98.7	100
2,4-D amine 8 + wetter	43.9	34.7	76.0	91.2

two to three weeks. Vigorously growing crops appeared to be slightly more susceptible than crops growing under moisture stress or in soils of low fertility.

Van de Loo concluded that the results confirmed earlier findings that bromoxynil ester gives considerable improvement over 2,4-D in the control of cornbind. The first compound has been shown to rapidly desiccate the weed while the hormone enabled some control of weed bulk but did not satisfactorily reduce weed numbers. Straight bromoxynil ester has its limitations, however, and, to improve its spectrum of weed control, the addition of MCPA ester is necessary. Although MCPA slightly detracted from brom-

oxynil's activity against cornbind, the enhanced efficacy against other broadleaved weeds more than compensated for a slight antagonism in the mixture on cornbind.

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