MIXTURES OF BIFENOX, DICAMBA AND MCPA FOR POST-EMERGENCE BROADLEAVED WEED CONTROL IN CEREALS

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Summary. In trials conducted over three seasons, there were synergistic effects from tank mixes of bifenox with dicamba, MCPA or dicamba/MCPA on four weeds - fumitory (*Fumaria* spp.), tree hogweed (*Polygonum patulum*), corn gromwell (*Buglossoides arvensis*) and yellow burrweed (*Amsinckia* spp.). Bifenox produced transient chlorotic spotting of the leaves of wheat.

INTRODUCTION

A number of herbicides are available in Australia for post-emergent control of weeds in cereals. The more common compounds are dicamba, terbutryne, metribuzin, bromoxymil and in Western Australia diuron. These herbicides are recommended either alone or in mixture with the phenoxy herbicides, some of which are in specially formulated product mixes. Dicamba/MCPA mixture at 80/340 g L^{-1} is available under several trade names and is relatively cheaper than the other mixture treatments. Whilst dicamba/MCPA is highly active against most cruciferous weeds, its efficacy on other broadleaved species is variable. Trials were commenced in 1978 to evaluate bifenox for post-emergence control of broadleaved weeds in wheat in the southern states of Australia, following reports of its applicability to cereals in northern USA and Canada.

MATERIALS AND METHODS

Herbicides. In 1978 two formulations of bifenox, an emulsifiable concentration (ec) containing 240 g L^{-1} and a suspension concentrate (sc) containing 480 g L^{-1}, were used in tank mixture with MCPA sodium salt. Only the sc was used in the 1979 and 1980 trials. The dimethylamine salts of MCPA and dicamba were used in 1979 and 1980, except that MCPA sodium salt was used in one trial in Western Australia in 1979.

Trial locations and layouts. The trials were conducted in Western Australia, Victoria, South Australia and New South Wales in order to cover a wide range of broadleaved weeds found in wheat. Sites were selected for uniformity and density of the desired broadleaved weeds. All trials were laid out using a randomised complete block design with 3 or 4 replicates. Plot sizes ranged from 2.5 by 20 m to 2.5 by 30 m.

Herbicide application. Herbicides were applied in a volume of 100 L ha^{-1} using a Halflinger boom and Rega pump or gas-pressured prototype sprayer specially designed for small plot work. Treatments were applied when the crops were at the 5 leaf to early tillering stage and the weeds were at the cotyledon to 5 leaf stage. Growth stages of the weeds varied between species.

Assessments. Assessments consisted of 3 or 4 pre-spray weed counts per plot using 0.1 to 0.25 m^2 quadrats. Weed control and crop phytotoxicity were assessed at regular intervals after spraying using a linear scale of 0 to 100 or 0 to 10 where 0 = no weed control or crop damage and 100 or 10 = complete weed control or total crop kill. Crop yields were assessed by header harvesting. All data were analysed using the Duncan's Multiple Range Test; factorial analyses of the results were also conducted to determine responses and interaction effects.

RESULTS

In 1978, bifenox at 240 to 960 g ha^{-1} plus MCPA at 340 g ha^{-1} gave satisfactory control of fumitory, yellow burrweed and corn gromwell but poor control of the hogweeds *(Polygonum patulum* and *P. aviculare)* (Table 1). Bifenox + MCPA was more effective than MCPA alone and dicamba/MCPA on fumitory and yellow burrweed. The ec of bifenox was more active than the sc formulation, particularly on black bindweed (*Polygonum convolvulus*) and was phytotoxic to wheat (Table 1). The sc formulation caused some chlorotic spotting but the wheat recovered well within 3 weeks of application. All the treatments except dicamba alone increased the yield of cv. Songlen but did not affect the yield of cv. Halberd.

In 1979, bifenox alone as the sc formulation at 400 g ha^{-1} gave good control of yellow burrweed but its activity on other species was generally poor (Table 2). Mixing dicamba or MCPA with bifenox generally resulted in large increased in the control of fumitory, tree hogweed, corn gromwell and deadnettle compared with the effect of each herbicide alone. For these four species, tank-mixing bifenox with dicamba/MCPA resulted in higher control values compared with those from bifenox + dicamba, bifenox + MCPA and dicamba/MCPA, but many of the differences were not significant. Control of black bindweed and hogweed was unsatisfactory even with this triple component treatment in trials in northern New South Wales (Table 2). Chlorotic leaf spotting of wheat was recorded with the bifenox based treatments but the crop recovered within 3 weeks. Grain yields were either unaffected (three out of six trials) or were increased by the herbicide treatments (data not presented).

In 1980, dicamba/MCPA was less effective than in 1979 on fumitory, corn gromwell, deadnettle and tree hogweed, whereas bifenox plus dicamba/MCPA still gave a high level of control (Figure 1). Thus, a significant synergistic effect was evident. Some transient crop damage was again observed in 1980. Grain yields were unaffected by the treatments in 4 of 5 trials; in one trial bifenox at 600 g ha^{-1} reduced yield (data not presented).

Table 1. The effect of post-emergence herbicides on weed control, crop phytotoxicity and wheat yields in 1978 (2 trials).

Treatment	Rate ($g\ ha^{-1}$)	Weed control rating[1] (4 weeks after treatment)					Crop phyto-toxicity rating[2]		Grain yield ($t\ ha^{-1}$)	
		Hogweed (Two species)	Black bindweed	Fumitory	Yellow burrweed	Corn gromwell	Songlen	Halberd	Songlen	Halberd
Untreated	-	0f[3]	0f	0e	0c	0e	0c	0	1.58d	2.1
Dicamba	140	-	9.2a	-	-	-	0c	-	1.67cd	-
MCPA (Na salt)	340	0f	2.6ef	0.5e	0.2c	5.0d	0.8ab	0	1.75abc	2.3
Dicamba/MCPA	80/340	3.0cde	8.4abc	4.8d	1.0c	6.0cd	0c	0	1.78abc	2.2
Bifenox (sc) + MCPA	240+340	2.8cde	3.5de	7.5be	7.8b	8.0abcd	0c	2.0	1.93a	2.2
	480+340	4.5bcd	3.3de	8.2b	9.0ab	7.2abcd	0.3be	2.3	1.79abc	2.1
	960+340	5.2bc	5.9cd	8.0bc	9.5ab	6.8abcd	1.3a	2.7	1.85abc	2.1
Bifenox (ec) + MCPA	240+340	6.5b	2.3ef	9.3ab	9.0ab	8.7abc	0.8ab	3.7	1.78abc	2.2
	480+340	6.7b	8.3abc	10.0a	10.0a	8.3abcd	1.2a	4.0	1.88ab	2.3
	960+340	-	9.1ab	-	-	-	0.3bc	-	1.82abc	-
Terbutryne	400	1.7ef	-	7.4bc	10.0a	9.8a	-	0	-	2.3
Bromoxynil/MCPA	280/280	9.7a	-	7.5bc	8.8ab	9.3ab	-	0	-	2.3
Picloram/MCPA	25/400	-	8.6abc	-	-	-	0c	-	1.75abc	-
C.V. (%)		57.0	20.6	28.2	34.8	41.1	99.7	37.4	5.3	6.6

1 0 to 10 scale; 0 = no control, 10 = total kill.
2 0 to 10 scale; 0 = no injury, 10 = crop killed.
3 Values with the same letter are not significantly different according to Duncan's Multiple Range Test at P = 0.05.

Table 2. Control of various weed species by bifenox and bifenox mixtures applied post-emergence in wheat in 1979. (6 Trials).

Treatment	Rate ($g\ ha^{-1}$)	Weed control (%)						
		Yellow burrweed[1]	Black bindweed[1]	Fumitory[2]	Tree hogweed[2]	Corn gromwell[2]	Dead-nettle[2]	Hogweed[2]
Untreated	-	0d[3]	3de	0e	0d	0f	0g	8cde
Bifenox	200	77ab	8cde	17de	8d	15f	47def	2e
	400	97ab	6cde	27de	20ef	27ef	53bcde	8cde
Dicamba	80	17cd	61a	20de	13d	20ef	17efg	22abc
MCPA	340	3cd	3de	28d	27cd	13f	10fg	8cde
Bifenox + dicamba	200+80	70b	46ab	67bc	77a	20ef	92abc	27ab
	400+80	90ab	63a	77abc	90a	57cd	100a	27ab
Bifenox + MCPA	200+340	95ab	8cde	53c	37bcd	47de	73abcd	15bcde
	400+340	92ab	10bcde	93ab	60abc	73abcd	97a	12bcde
Bifenox + dicamba/ MCPA	200+80/340	90ab	32abcde	100a	97a	90ab	90abc	10bcde
	400+80/340	98ab	41abc	98a	100a	88abc	100a	37a
Dicamba/ MCPA	80/340	33c	40abcd	73abc	87a	67bcd	73abcd	20bcd
Bromoxynil/ MCPA	280/280	87ab	4cde	68bc	65abc	77abcd	67abcd	3de
Terbutryne+ MCPA	225/340	100a	0e	100a	97a	98a	100a	12bcde
C.V. (%)		22	62	22	34	29	32	59

[1] Assessed 8 weeks after treatment; [2] Assessed 10 weeks after treatment; [3] Values with the same letter are not significantly different according to Duncan's Multiple Range Test at P = 0.05.

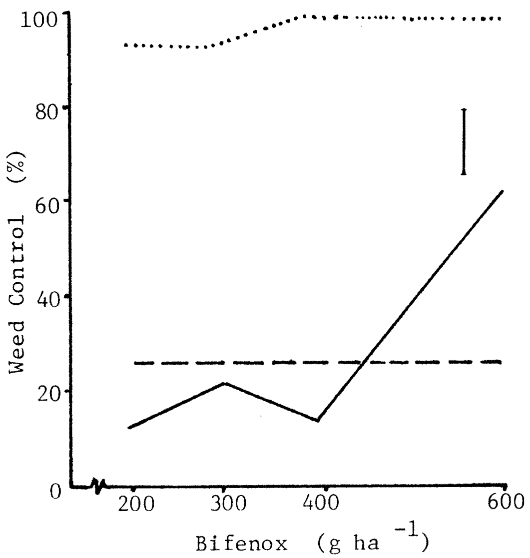

Figure 1a. Control of fumitory.

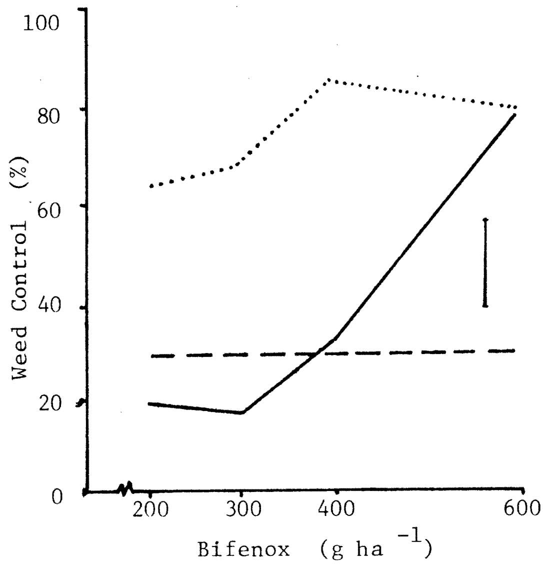

Figure 1b. Control of corn gromwell.

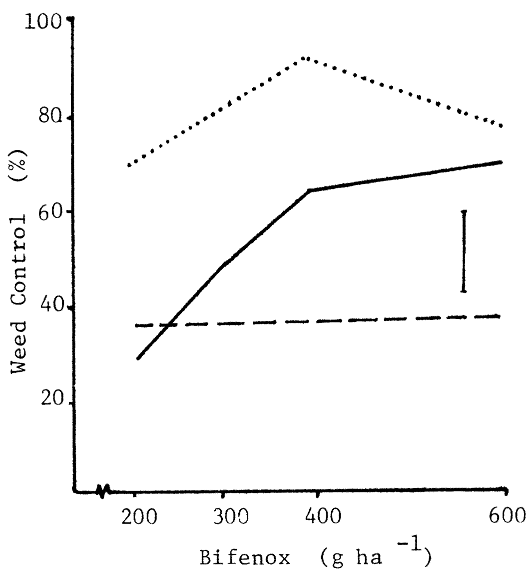

Figure 1c. Control of deadnettle.

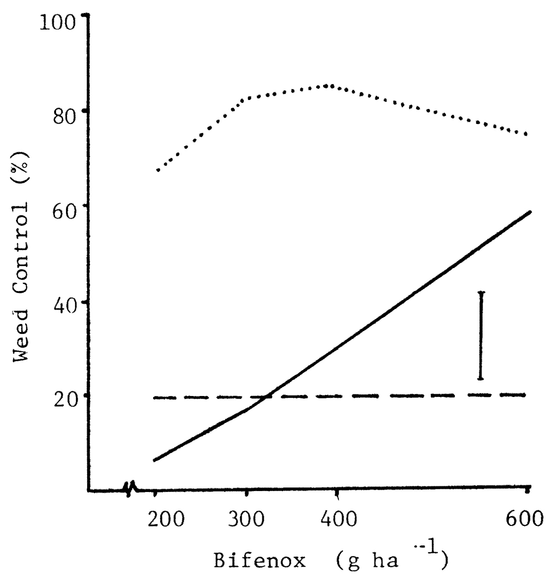

Figure 1d. Control of tree hogweed.

Figure 1. Efficacy of mixtures of bifenox + dicamba/MCPA on four weeds 4 weeks after treatment in 1980 (values from one trial); L.S.D. values for P = 0.05. (Key ——— bifenox; - - - - dicamba/MCPA at 80/340 g ha^{-1}; ..... bifenox+ dicamba/MCPA).

DISCUSSION

Bifenox alone is relatively ineffective against most broadleaved weeds common in Australian cereals. However, the control of four species in particular, fumitory, corn gromwell, deadnettle and tree hogweed, was increased when bifenox was mixed with dicamba, MCPA or dicamba/ MCPA compared with the effect of any of these herbicides alone. The optimum rate for bifenox appeared to be 300 g ha^{-1}, which gives sufficient margin for crop safety.

The lack of a significant yield response to effective weed control in many of the trials was due to either extremely good growing conditions or to drought when weeds were desiccated by the dry weather.

Trials conducted by several workers in Canada (Mobil Chemical Company, 1976) have shown that the bifenox sc formulation at 375 to 665 g ha^{-1} when applied in tank-mixtures with MCPA or 2,4-D at 250 to 500 g ha^{-1} caused temporary chlorotic spotting of the leaves of wheat and barley, as occurred in these trials.

ACKNOWLEDGEMENTS

The authors wish to thank Mobil Chemical Company for supplying the samples used in the trials. Thanks are also due to our colleagues in ICI Australia Operations Pty. Limited who have assisted in conducting the trials.

LITERATURE CITED

Mobil Chemical Company 1976 . 'Modown' Trials Results: technical document on bifenox, Mobil Chemical Company, USA.