Metolachlor plus atrazine - a combination pre-emergence herbicide for broad spectrum weed control in maize and sweet corn

J.M. Swain, R. Thomson, M. Chin and D.J. McQuinn
Ciba-Geigy Australia Limited
Lane Cove 2066, New South Wales

SUMMARY

Metolachlor is a new selective herbicide which has proved, in trials conducted in Australia, to be effective for the control of some important grass weeds infesting maize and sweet corn. Where broadleaf weeds are present, atrazine must be added to metolachlor to control these species. The results of the trials are discussed.

INTRODUCTION

Atrazine is presently the most important herbicide in Australia for weed control in maize and sweet corn. It controls a wide range of annual broadleaf weeds and certain annual grass species which infest maize and sweet corn. Because of its dependence on soil moisture to move it into the weed root zone, its performance against barnyard grass (*Echinochloa crus-galli*) and summer grass (*Digitaria sanguinalis*) can be variable, and against liverseed grass (*Urochloa panicoides*), its performance is unreliable in most areas, because of the apparent resistance of this species.

In order to achieve reliable control of the grass species, atrazine has to be applied at rates of application which can produce residual carryover problems to crops following maize and sweet corn.

In order to improve the reliability of atrazine, increase its weed control spectrum and reduce the residual carryover problem, Ciba-Geigy centred its research on finding a suitable herbicide to use in combination with atrazine which would overcome these deficiencies.

Such a compound was found in 2-chloro-N-(2-ethyl-6-methylphenyl) -N-(2-methoxy-1-methylethyl) acetamine (metolachlor). This compound was first described by Gerber, Muller and Ebner (1974). It has an acute oral LD_{50} of 2780 mg/kg for rats and shows only slight skin irritation, but no eye irritation to rabbits (Gerber et al, 1974).

In leaching studies, metolachlor showed a similar leaching behaviour to alachlor which is considerably less than that of atrazine. It shows markedly slower dissipation in the soil than does alachlor, but dissipates rapid enough not to leave any residues which may cause problems in the field (Gerber et al, 1974).

Metolachlor alone, and in combination with atrazine, is now registered for use as a pre-emergent herbicide for use in maize and sweet corn in countries such as U.S.A., New Zealand and South Africa.

During the seasons 1975/76 and 1976/77, metolachlor alone, and in combination with atrazine, was evaluated in seven replicated small plot trials and four large scale demonstration trials conducted in South Australia and New South Wales.

Results from only the small plot replicated trials are discussed.

MATERIALS AND METHODS

The small plot trials were designed as randomized blocks with four replications and were located in areas with a known history of a barnyard grass (*Echinochloa crus-galli*) problem. Application was made using pressurized experimental equipment which delivered 250 ℓ of spray mixture per ha over a swath of 1.8 m at constant speed and pressure.

Metolachlor was applied at varying rates of application, but in all cases where it was mixed with atrazine, the latter was applied at a rate of 1.2 kg a.i./ha, as this is the rate required to provide broadlead weed control without producing a carryover problem.

Weed control and phytotoxicity were assessed on a 1 to 9 scale according to the European Weed Research Council method of assessment. A rating of 4 or less is considered as acceptable weed control. Crop and weed counts were taken from three random quadrats per plot in the 1976/77 trials. In two trials, the fresh weight yields of cobs were taken from within each plot at harvest.

RESULTS

In 1975/76, three replicated small plot trials were conducted on sweet corn in South Australia and New South Wales. In all cases, crops were flood irrigated within 6 days of sowing. In Trial 2, the irrigation technique was variable which produced a wide variation in crop and weed growth.

Results of these trials indicated that metolachlor, at rates of 1.5 to 4.0 kg a.i./ha, in combination with 1.2 kg a.i./ha atrazine, would provide acceptable commercial control of barnyard grass which in Trial 1 was superior to the standard rate (3.2 kg a.i./ha) of application of atrazine (Table 1). The population of broadleaves present in any trial was insufficient to enable an assessment to be made. No phytotoxicity was recorded with any treatment.

In 1976/77, four replicated small plot trials were conducted in Central and Northern N.S.W., comparing metolachlor at 1.5, 3.0 and 5.8 kg a.i./ha alone and in combination with 1.2 kg a.i./ha atrazine. The standard treatment was atrazine at 3.2 kg a.i./ha. Seasonal conditions were dry, but adequate irrigation was applied throughout the growing season.

In Trial 4 (Central N.S.W.), the expected grass problem did not develop and the main weed species present were blackberry nightshade (*Solanum nigrum*) and pigweed (*Portulaca oleracea*) which were controlled by all treatments. In Trials 5 and 6 (Tables 2 and 3), metolachlor failed to control blackberry nightshade and *Amaranthus* spp., but its excellent effect on grasses was again clearly shown. The advantage of the addition of atrazine to metolachlor for the control of these broadleaf weeds is shown.

Table 1. Mean E.W.R.C. ratings for weed control 60 days after application from 3 trials

Treatment	kg a.i./ha	Trial number and weeds present			
		1 BYG	2 BYG	3 BYG	SG/PG
Metolachlor + Atrazine	1.5 + 1.2	-	4	1.3	1.5
Metolachlor + Atrazine	2.0 + 1.2	4.5	3.6	1.3	2.5
Metolachlor + Atrazine	3.0 + 1.2	3.8	2.0	1.5	1.0
Metolachlor + Atrazine	4.0 + 1.2	2.3	1.6	1.5	1.5
Atrazine	1.2	8	4.6	5.8	6.0
Atrazine	3.2	5.5	2.5	1.8	1.8
Untreated		9.0	5.9	8.25	8.25

BYG = barnyard grass

SG = summer grass

PG = pigeon grass

Trial 1 - South Australia

Trials 2 and 3 - Central N.S.W.

Table 2. Trial 5 - Central N.S.W. - weed counts recorded and yields at harvest

Treatment	kg a.i./ha	Mean Weed Counts from 3 quadrats per plot 49 days after application			Mean Yields (Fresh Wt. of cobs) from 3 x 2 m lengths of row per plot (kg)
		BYG	S	A	
Metolachlor + Atrazine	1.5 + 1.2	0.5	0.5	0.25	10.25
Metolachlor + Atrazine	3.0 + 1.2	0	0	0	10.68
Metolachlor + Atrazine	5.8 + 1.2	0	0	0	10.31
Metolachlor	1.5	1.2	1.2	0.7	8.25
Metolachlor	3.0	0.2	1.2	0.7	8.00
Metolachlor	5.8	1.2	0	0	9.87
Atrazine	3.25	0.7	0	0.2	8.25
Untreated		14.2	21.2	7.7	2.92

BYG = barnyard grass

S = blackberry nightshade

A = *Amaranthus* spp.

Table 3. Trial 6 - Northern N.S.W. - weed counts recorded and yields at harvest

Treatment	kg a.i./ha	Mean weed counts from 3 quadrats per plot 28 days after application				Mean yields (Fresh Wt. of cobs) from 2 x 1 m lengths of row per plot (kg)
		BYG	LIV	C	CT	
Metolachlor + Atrazine	1.5 + 1.2	5.7	3.2	5.0	5.7	2.49
Metolachlor + Atrazine	3.0 + 1.2	3.7	2.2	3.0	1.5	2.76
Metolachlor + Atrazine	5.8 + 1.2	3.5	0	1.7	0.7	3.03
Metolachlor	1.5	10.7	4.0	13.7	6.0	2.14
Metolachlor	3.0	4.5	1.2	9.7	9.2	2.10
Metolachlor	5.8	3.5	0.25	15.5	7.0	2.54
Atrazine	3.3	5.7	8.0	1.2	6.0	2.90
Untreated		271	186	19.0	14.2	1.42

BYG = barnyard grass

LIV = liverseed grass

C = caltrop (*Tribulus terrestris*)

CT = common thornapple (*Datura stramonium*)

In Trial 7, the necessity for rainfall or irrigation to provide effective control following application of metolachlor was obvious. In this trial, no rain fell for at least 8 weeks after application and control of barnyard grass, common thornapple (*Datura stramonium*) and *Amaranthus* spp. was poor for all treatments. The trial was cultivated and abandoned after 6 weeks.

DISCUSSION

In this series of trials, metolachlor has proved to be an effective pre-emergent herbicide for the control of barnyard grass, summer grass and pigeon grass (*Setaria* sp.). Its performance against broadleaf weeds is unreliable and as the results show, atrazine at 1.2 kg a.i./ha is required as a combination partner to control these species.

Metolachlor's performance is more reliable than atrazine for grass control, particularly against liverseed grass and this, coupled with its shorter residual life in the soil, makes it a promising compound in a pre-emergent weed control program in maize and sweet corn.

As with atrazine, soil moisture is important and must be sufficient to wet the soil throughout the weed root zone. Sufficient rainfall or irrigation is required, ideally within 10 days of application.

Soil type does not appear to influence, to any degree, the performance of metolachlor as in all cases, except Trial 7, acceptable weed control was obtained for the life of the crop.

The results of the large scale demonstrations have confirmed recommendations suggested for commercial usage. Metolachlor will be available commercially as a 720 g/ℓ emulsifiable concentrate, with suggested rates of application within the range of 2 to 4 ℓ/ha, as a pre-emergent application, for annual grass control and as a tank mix with atrazine, applied at 1.2 kg a.i./ha, where broadleaves are likely to be present.

REFERENCES

Gerber, H.R., Muller, G. and Ebner, L. (1974).- CGA 24705, a new grasskiller herbicide. *Proceedings 12th Brit. Weed Control Annual Conf.*