MON 13200 - A NEW PRE-EMERGENT HERBICIDE FOR WEED CONTROL IN SUGAR CANE

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Summary. Pre-emergent applications of MON 13200 (thiazopyr) provided commercially acceptable control of a range of annual and perennial grass weeds in sugar cane including summer grass, *Digitaria ciliaris,* barnyard grass, crowsfoot grass, green summer grass, *Brachiaria subquadripara* and Guinea grass with rates of 0.5 kgai/ha providing 93, 88, 94, 89 and 96% control respectively. Control of certain broad-leaved weeds including bluetop, pigweed, *Portulaca oleracea,* blackberry nightshade, *Solanum americanum,* black pigweed and Star of Bethlehem was also demonstrated. Good crop safety was exhibited at rates of application up to 0.5kg/ha MON 13200.

INTRODUCTION

The herbicide MON 13200 (Methyl 2-difluoromethyl-4-isobutyl-5-(4,5-dihydro-2-thiazolyl)-6-trifluormethyl-3-pyridinecarboxylate) is a discovery of the Monsanto Company, USA. MON 13200 belongs to the pyridine chemical family and exhibits high unit pre-emergent activity against a range of grasses as well as certain small seeded broadleaf plants (1).

The primary mode of action of MON 13200 is the inhibition of cell division resulting from the disruption of microtubule formation (1). Seed germination is not inhibited by MON 13200 but subsequent plant development does not proceed normally.

Selectivity is exhibited in a range of annual and perennial crops including tree crops, vines, cotton, lucerne, peanuts, sunflowers and sugar cane. Thiazopyr is currently registered in a range of crops in Spain and South Africa.

Infestations of annual grass weeds in Australian sugar cane are a significant constraint to production in Australian sugar cane. Experimental work carried out by Chapman (3) in the Mackay district during the 1960's demonstrated that a severe infestation of *Echinochloa spp.* reduced plant cane yield by 12 tonnes/hectare. In a series of five experiments established in the Mackay and Tully districts over the 1985 and 1986 seasons, grass weed competition reduced ratoon cane yields from 7 to 30% (4). A loss of 7% yield on a crop having a potential of 80 tonnes/ha and a value of $25/tonne represents an economic loss of $140/ha. In the experiments referred to above, weeds exerted a significant competitive effect on yield until the top visible dewlap of cane reached 10-12 cm high (4).

Green cane trash-blanketing methods of production have had a major effect in reducing the impact of grass weed infestations in ratoon cane in the northern cane growing districts of Australia. However, the need for effective control of grasses in plant cane and in traditionally cultivated ratoon cane remains. A range of pre-emergent herbicides are available to growers including diuron, atrazine, ametryn, ametryn plus atrazine, metolachlor plus atrazine, trifluralin, pendimethalin, hexazinone plus diuron (5) though the directed application of the knockdown herbicide paraquat is commonly an integral part of in-crop weed control programmes.

The purpose of the experiments reported here was to evaluate the experimental herbicide MON 13200 for the pre-emergent control of annual grass and broad-leaved weeds in sugar cane compared to the commercial standard of atrazine plus ametryn. A second objective was to assess selectivity of treatments in both plant and ratoon cane.

METHODS

In all experiments reported here an emulsifiable concentrate formulation containing either 360 (MON 13232) or 240 g/L (MON 13211) active ingredient was used.

Efficacy experiments were established in commercial stands of plant or ratoon cane and subject to normal management practices up to the point of treatment application. Herbicide treatments were applied post-emergent to cane and pre-emergent to weeds (except where paraquat was added at 0.2 kg a.i./ha for control of emerged grass weeds in experiments 2, 9, 15 and 21) using a compressed gas sprayer equipped with flat fan (broadcast treatments) or flood jet (directed treatments) calibrated to deliver 80 to 120 L/ha with an operating pressure of 150 (directed) or 250 kPa (broadcast). Directed applications were used where cane exceeded approximately 80 cm in height (Experiments 2 and 15). Treatments were arranged in a randomised complete block design with three replicates. Plot size was 3 by 10 or 12 m. Site details for the efficacy experiments are summarised in Table 1.

Table 1. Site details for efficacy experiments in sugar cane

Expt. #	Location	Situation	Cane stage/height	Soil type
1	Woombye	plant (Q137)	pre-emergent	sandy clay loam
2	Yandina	ratoon (NC0-310)	out-of-hand; 140-180 cm	clay loam
3	Bundaberg	plant (H56-752)		grey forest soil
4	Yandina	plant (CP44-101)	pre-emergent	red podzolic
5	Tumbulgum	plant (Florida)	spike; 0-20 cm	river alluvial
6	Bingera	plant (Q145)	2-3 leaf; 10-40 cm	grey forest soil
7	Bingera	plant (Q145)	1-3 leaf; 10-35 cm	grey forest soil
8	Nambour	plant (Q110)	1-2 leaf; 10-30 cm	humic gley
9	Nambour	plant (Q137)	spike; 10-20 cm	alluvial clay loam
10	Gargett	plant (Q121)	1-4 leaf; 15-30 cm	loam
11	Tully	plant (Q122)	pre-emergent	clay loam
12	Tully	ratoon (Q130)	2-5 leaf; 20-60 cm	clay loam
13	Nambour	plant (CP44-101)	2-4 leaf; 15-40 cm	clay loam
14	Mackay	plant (Q124)	1-3 leaf;	sandy clay loam
15	Mackay	ratoon (H56-752)	out-of-hand; 85-100 cm	sandy clay loam
16	Sarina	plant (Q124)	4-7 leaf; 50-80 cm	sandy loam
17	Walkerston	plant (Q136)	pre-emergent	clay loam
18	Gargett	plant	pre-emergent	sandy loam
19	Ayr	plant (Q117)	pre-emergent	clay loam
20	Walkerston	plant (H56-752)	spike-2 leaf; 8-35 cm	clay loam
21	Walkerston	ratoon (Q135)	1-3 leaf; 10-30 cm	sandy clay loam
22	Rosella	plant (Q124)	8-12 leaf; 60-120 cm	sandy loam

Weed control was assessed using subjective assessments of control by individual weed species using a 0-100 scale where 100 represents complete control. Initial assessments were completed at 21 to 35 days after initial treatment (where weed growth in untreated plots was present) and thereafter at 45 to 70 days after treatment. In some experiments weed density in the cane drill was assessed using four one quarter or one square metre quadrats per plot.

Crop effects were assessed using a subjective 0 to 100 scale where a value of 0 indicates no effect and 100, complete crop destruction.

RESULTS AND DISCUSSION

Efficacy. Weed control assessments for the major grass weeds evaluated are summarised in Tables 2-5. MON 13200 applied at 0.5 kg a.i./ha provided a weed control or percentage control rating of 85 or greater (judged to be commercially acceptable) for summer grass, barnyard grass, crowsfoot grass, green summer grass and guinea grass in 33 of 37 assessments completed in 22 experiments 28 to 97 days after treatment. In contrast, within the same data set,the standard treatment of 4 kg a.i./ha ametryn plus atrazine provided this level of control in 14 of 37 assessments.

Of the grass weeds, summer grass and guinea grass appeared most susceptible to MON 13200 with 15 of 15 and 4 of 4 ratings reaching a value of 85 or greater for these two species respectively. Ametryn plus atrazine treatments provided commercially acceptable control of summer grass in 5 of 15 experiments while this was not achieved in any experiment where guinea grass was present.

Table 2. Pre-emergent control of summer grass *Digitaria ciliaris* in sugar cane

Treatment	Rate kg/ha	Control rating (frequency distribution)			Mean
		<75	75-84	>84	
MON 13200	0.25	1	1	3	82.8
MON 13200	0.375	0	1	3	93.2
MON 13200	0.5	0	0	15	92.9
MON 13200	0.75	0	0	8	92.8
MON 13200	1.0	0	1	14	95.8
atrazine+ametryn	4.0	7	4	4	80.5

Table 3. Pre-emergent control of barnyard grass in sugar cane

Treatment	Rate kg/ha	Control rating (frequency distribution)			Mean
		<75	75-84	>84	
MON 13200	0.25	1	2	0	71.5
MON 13200	0.375	0	0	1	91.5
MON 13200	0.5	0	2	5	87.5
MON 13200	0.75	0	0	2	94.0
MON 13200	1.0	0	0	7	94.3
atrazine+ametryn	4.0	4	1	2	72.1

Table 4. Pre-emergent control of crowsfoot grass in sugar cane

Treatment	Rate kg/ha	Control rating (frequency distribution)			Mean
		<75	75-84	>84	
MON 13200	0.25	1	0	1	80.0
MON 13200	0.375	1	1	0	78.0
MON 13200	0.5	0	0	6	93.8
MON 13200	0.75	1	0	1	87.5
MON 13200	1.0	1	0	5	95.8
atrazine+ametryn	4.0	2	0	4	85.6

Table 5. Pre-emergent control of green summer grass *Brachiaria subquadripara*

Treatment	Rate kg/ha	Control rating (frequency distribution)			Mean
		<75	75-84	>84	
MON 13200	0.25	1	0	1	78.0
MON 13200	0.375	0	1	0	82.0
MON 13200	0.5	0	2	3	89.2
MON 13200	0.75	0	0	2	97.5
MON 13200	1.0	0	2	3	91.8
atrazine+ametryn	4.0	1	2	2	80.0

Table 6. Pre-emergent control of guinea grass in sugar cane

Treatment	Rate kg/ha	Control rating (frequency distribution)			Mean
		<75	75-84	>84	
MON 13200	0.25	0	0	2	96.0
MON 13200	0.375	0	0	2	92.0
MON 13200	0.5	0	0	4	96.3
MON 13200	0.75	0	0	2	98.0
MON 13200	1.0	0	0	4	100.0
atrazine+ametryn	4.0	2	2	0	73.6

Dry weather conditions following application occurred frequently in the course of the experiments reported here, with 9 of 22 experiments having an extended period (>4 weeks) during which no rainfall or irrigation occurred in the period following application. MON 13200 performed well under these conditions with good control of grass weeds. In contrast, the activity of the atrazine plus ametryn standard appeared to be adversely affected by these conditions. Large losses in activity of atrazine over 10 days following application to a black earth soil and protected from rainfall have also been observed in a series of four experiments conducted by Marley and Robinson (6). While the significance of photodecomposition and or volatalization of atrazine from the soil is not fully understood, available data indicate that both occur to some extent if high temperatures and prolonged sunlight follow application before precipitation (7).

Crop injury. Only slight growth reduction occurred in cane treated with rates up to and including 0.5 kg/ha MON 13200 except in one experiment (Table 7). Treatments in this experiment (experiment 19) were applied prior to crop emergence and immediately prior to flood irrigation. Soil surface crusting occurred following irrigation causing a reduction in crop emergence which was exacerbated by the presence of herbicide treatments and the withholding of normal cultivation. Significant and unacceptable crop injury (injury rating >19) occurred in a relatively small proportion of trials at rates of 1.0 kg/ha and above.

Injury was characterised by crop stunting and appeared to be enhanced where wet soil conditions prevailed soon after application. Effects are attributed to soil uptake rather than foliar as there were no evidence of leaf symptoms attributable to post-emergence applications to the crop.

Notwithstanding, crop effects except at three times or greater than the proposed rates of application appeared to be transitory. A further study is currently underway to assess this more comprehensively on a range of cane varieties using crop yield as the final criterion for injury.

Table 7. Sugar cane phytotoxicity (efficacy experiments)

Treatment	Rate kg/ha	Injury rating (frequency distribution)			Mean
		<11	11-19	>19	
MON 13200	0.25	5	0	0	5.33
MON 13200	0.375	7	1	0	2.08
MON 13200	0.5	22	3	0	4.44
MON 13200	0.75	12	2	0	4.04
MON 13200	1.0	19	4	2	5.01
MON 13200	1.5	3	1	1	12.66
MON 13200	2.0	1	1	3	16.66
atrazine+ametryn	4.0	24	1	0	3.05

Note: injury rating on a 0-100 scale where 0 = no effect and 100 = complete crop destruction.

MON 13200 would appear to provide a significant opportunity to canegrowers seeking to reduce reliance on in-crop weed control with cultivation or post-emergence herbicide treatments by opening up the window of application of pre-emergent herbicide treatments in advance of the onset of initial weed germination without significant loss of activity associated with delayed activation by rainfall or irrigation.

Pre-emergent herbicides currently available are generally used once irrigation or rainfall has stimulated weed emergence. Whilst this approach is successful if herbicide treatments are then applied to relatively small weeds, weather conditions may be such that timely application is not always possible and weed escapes occur particularly in the plant line where spray coverage may limit effectiveness. Nevertheless, MON 13200 will also be effective in combinations with knockdown treatments such as paraquat where weed emergence has occurred prior to treatment.

ACKNOWLEDGMENTS

My thanks go to the farmers who cooperated by providing land used for experimental work.

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