CONTROL OF COUCH (*ELYTRIGIA REPENS*) AND MERCER GRASS (*PASPALUM DISTICHUM*) IN MAIZE WITH NICOSULFURON

T.K. JAMES and A. RAHMAN

AgResearch, Ruakura Research Centre, Private Bag 3123, Hamilton

ABSTRACT

Eight field trials were conducted between 1993 and 1996 in Waikato to evaluate the sulfonylurea herbicide nicosulfuron for control of couch and Mercer grass in maize. The recommended rates (60 - 80 g/ha) gave only moderate control of Mercer grass, but efficacy improved considerably at 160 g/ha or by use of Ethokem or Weedmaster CT Surfactant with the 80 g/ha rate, with little regrowth from the stolons. Nicosulfuron was more effective on couch, providing >90% control with or without an adjuvant at 80 g/ha. Very little regrowth occurred from rhizomes of treated plants. The herbicide did not cause any apparent damage to the crop, but showed some phytotoxicity in combination with Ethokem.

Keywords: nicosulfuron, weed control, *Elytrigia repens*, *Paspalum distichum*, maize

INTRODUCTION

Perennial grass weeds have shown an increase in both distribution and abundance in maize fields under the weed management regimes used in New Zealand (Rahman 1988). They are efficient utilisers of water and can become serious competitors to the maize crop. At present, seven herbicides are registered for control of annual grasses in maize, but only one is registered for a perennial grass weed, viz. primisulfuron for suppression (rather than control) of couch (O'Connor 1996). Glyphosate is sometimes used for control of perennial grasses before planting the crop and EPTC, one of the grass specific selective herbicides, provides some control of both couch and Mercer grass (Rahman 1985). Control of these two weeds with post emergence herbicides is difficult because their leaves usually emerge slowly, well after the maize has been planted and by the time they have sufficient leaf material to treat, the crop is well advanced. For foliar acting herbicides, the level of weed control achieved usually relates directly to the amount of leaf present at application.

The sulfonylurea herbicide nicosulfuron has shown promise for control of certain troublesome perennial grasses such as couch and Johnson grass (*Sorghum halepense*) at rates similar to those required for annual grass weeds (Kimura *et al.* 1989; Obriga *et al.* 1990). It can be used post emergence to either supplement or replace certain pre-emergence treatments or as an alternative to high application rates of pre-emergence herbicides on high organic matter soils. The objective of this work was to evaluate the crop tolerance and efficacy of nicosulfuron for control of couch and Mercer grass in maize.

MATERIALS AND METHODS

Eight field trials were carried out from 1993 to 1996 in Waikato to evaluate nicosulfuron at rates between 60 and 160 g/ha for control of couch and Mercer grass in maize crops. Information on individual trials is presented in Table 1. The soils described as peaty were sandy or silt loams with a high organic matter content (10 - 20% organic carbon). Nicosulfuron (SL - 950, 4% SC) was used alone and in combination with several adjuvants: Pulse (Silwet L-77, organo-silicone copolymer penetrant), Ethokem

(polyethanoxy alkyl amine, cationic surfactant) and Weedmaster CT Surfactant (60% tallow amine ethoxylate). Primisulfuron (Beacon, 75% WDG), another sulfonylurea with activity on couch, was included for comparison and was always used with the adjuvant Citowett (alkylaryl polyglycol ether).

TABLE 1: Details of trial sites and conditions at the time of treatment.

Trial no.	Soil type	Weed	Date sprayed	Spraying conditions	Maize height (cm)	Weed growth
1	peat	Mercer	30.11.93	19°C part cloud	40 - 45	stolons up to 25 cm
2	silt	Mercer	30.11.94	19°C overcast	30 - 35	stolons up to 30 cm
3	peaty	Mercer	6.12.95	33°C sunny	35 - 45	stolons up to 25 cm
4	sandy	couch	24.12.93	24°C sunny	60 - 100	up to 40 cm tall
5	peaty	couch	29.12.94	26°C sunny	35 - 50	up to 25 cm tall
6	sandy	couch	30.11.95	23°C sunny	15 - 25	up to 4 leaves/tiller
7	silt	couch	6.12.95	29°C sunny	40 - 45	up to 20 cm tall
8	peaty	couch	7.12.95	20°C overcast	40 - 45	up to 20 cm tall

All trials were of a randomised block design with individual plots of 8 - 10 m x 3 m, containing four crop rows, and treatments were replicated four times except for Trial 4 which had three replicates. All treatments were applied with a CO₂ powered precision sprayer in 300 litres/ha water at 210 kPa. The sprayer was set up with TeeJet 11004vp nozzles at 75 cm spacing and during operation the nozzles were centred over the inter-row area to effect maximum coverage of the target with minimum contact to the maize plants. Pre-emergence treatments of alachlor and atrazine (Trials 1, 2, 4 - 6) or acetochlor (Trials 3, 7 and 8) were applied by the growers to the trial areas for control of annual grass and broadleaf weeds.

In all trials the target weeds were generally well developed with many fully developed leaves on each stolon (Mercer grass) or tiller (couch). However, in most cases there were also some less developed shoots present that were late emerging (probably from rhizomes/stolons buried at a greater depth) and therefore had only a few small leaves. There was no significant rainfall in any trial for the first week after the treatments were applied. Trial 5 was treated at the beginning of a dry period with only 5.5 mm rain for 4 weeks and Trial 8 was sprayed early on a foggy, overcast morning with a heavy dew.

Visual assessments were made at regular intervals on all trials with regard to the treatment effect on growth and vigour of weeds, and any crop damage. In the case of couch, data included percent foliar brownoff and regrowth from rhizomes. For Mercer grass, weed dry matter harvests were taken in Trials 2 and 3 by harvesting plants in duplicate 0.5 m² quadrats from each plot. As the killing of the top growth of perennial weeds is not an adequate measure of their control, stolon material of Mercer grass or rhizome material of couch was collected about 3 months after treatment. Subsamples of 20 pieces of stolon or rhizome from each plot were planted in vermiculite in trays to test their viability. After approximately 1 month all shoot material was harvested from each tray, dried and weighed. Maize grain yields were determined for Trials 3, 5 and 7, by harvesting 25 cobs from each of the two central rows of each plot. The cobs were then shelled, weighed and the moisture content of the grain measured. Grain yields were adjusted to 14% moisture content.

All data were subjected to analysis of variance (ANOVA). The Mercer grass dry matter weights in Trials 2 and 3 and the stolon regrowth scores in Trial 3 were square root transformed.

RESULTS AND DISCUSSION

Visual effects of herbicides

The two herbicides evaluated in these trials often appeared slow acting but closer observation showed that all shoot growth stopped soon after treatment. The speed of brownoff was dependent on the conditions after spraying. In hot dry conditions after treatment, weed top growth shrivelled and became necrotic within 3 to 4 weeks, while under cooler and moist conditions, the top growth stayed green for up to 8 weeks. However, irrespective of the conditions, after about 3 weeks the emerging shoots could be pulled from the ends of the tillers revealing that they were brown and dead at the nodes.

Mercer grass

When used alone at the proprietors' proposed use rates (60 - 80 g/ha), only moderate control was achieved (Table 2). More acceptable levels of control were obtained by using a suitable adjuvant with the 80 g/ha rate or by doubling the herbicide rate to 160 g/ha. Of the adjuvants evaluated, Ethokem gave consistently better results than Pulse. Ethokem also resulted in the most damage to the foliage and was similar to the high rate of nicosulfuron alone. Both these treatments allowed very little regrowth from the stolons. Stolon regrowth in the glasshouse from Trial 2 (not presented) was similar to that in Trial 1 (Table 2). However, in Trial 3, where the stolons were collected earlier, there was much less regrowth with very few stolons collected from any of the nicosulfuron treatments regrowing in the glasshouse. As stolon material was sometimes difficult to obtain due to the overall reduction in Mercer grass, these data are not a measure of control but rather the potential for the remaining plants to recover. Regrowth in the field was measured by the weed dry matter harvest (Table 2). Nicosulfuron with either Ethokem or Weedmaster CT Surfactant resulted in the least amount of regrowth which did not appear for many weeks. By this time the crop was well established and the spindly regrowth looked unlikely to result in any crop suppression. The other treatments gave only temporary suppression of the top growth and had no long term effect on the stolons. In Trial 3 the adjuvant Weedmaster CT Surfactant was included as a possible substitute for Ethokem as in glasshouse experiments (James and Rahman 1997) it demonstrated similar efficacy to Ethokem and was less damaging to maize plants. These results were confirmed in the field where Weedmaster CT Surfactant showed similar effectiveness to Ethokem.

TABLE 2: Foliar brownoff, stolon regrowth¹ and dry matter (DM) production (kg/ha) of Mercer grass from various treatments.

Herbicide	Rate g ai/ha	Trial 1		Trial 2		Trial 3		
		%	%	%	%	%	%	
		foliar	stolon	foliar	foliar	stolon	stolon	
		brownoff	regrowth	brownoff	DM	brownoff	DM	regrowth
		26.1.94	22.4.94	20.12.94	7.3.95	15.1.96	21.2.96	14.3.96
untreated	-	0	100	0	1330 d ²	0	3120 c ²	100
nicosulfuron	60	42	120	46	995 cd	-	-	-
nicosulfuron	80	83	78	53	723 c	76	475 b	4
nicosulfuron	160	91	46	78	209 b	85	440 ab	3
nicosulfuron ^a	80	94	5	91	53 a	93	127 a	3
nicosulfuron ^b	80	81	94	68	500 bc	80	414 ab	8
nicosulfuron ^c	80	-	-	-	-	93	175 ab	2
primisulfuron ^d	30	68	67	38	949 cd	55	2449 c	27
LSD 5%		11	40	8		9		10

¹ Total DM of foliar regrowth from 20 lengths (> 20 cm each) of stolon material in the glasshouse expressed as % of untreated.

² Numbers followed by a different letter are significantly different (5%) from each other.

^a+ Ethokem 3 L/ha; ^b+ Pulse 0.2%; ^c+ Weedmaster CT Surfactant 0.5%; ^d+ Citowett 0.1%

Couch

With the exception of Trial 4, all nicosulfuron treatments, with or without an adjuvant, resulted in severe damage to the foliage of couch plants (Table 3). Trial 4 was

treated when the maize was tall and the couch was well advanced (Table 1) and foliage brownoff was very slow. Although nicosulfuron ultimately provided control of couch, the crop was already severely affected by the weed competition, suggesting that use of herbicides for control of couch at this late stage could be of little value. Data on rhizome regrowth showed that all nicosulfuron treatments killed 98 - 100% of the rhizome material (data not presented). In all plots except the untreated control, dead, rotting rhizomes were also found but only those that had not decayed were collected for the regrowth evaluations. Based on these results, use of an adjuvant does not appear necessary for couch control, but might have benefits for control of other weeds present. Primisulfuron was less effective on the top growth of couch in two trials and there was also greater regrowth from the rhizomes in the glasshouse (20 - 60%).

TABLE 3: Percentage foliage brownoff of couch from various treatments.

Herbicide	Rate g ai/ha	Trial 4 26.1.94	Trial 5 14.3.95	Trial 6 22.12.95	Trial 7 15.1.96	Trial 8 15.1.96
untreated	-	0	0	0	0	0
nicosulfuron	60	1	90	-	-	-
nicosulfuron	80	70	97	94	94	85
nicosulfuron	120	-	99	-	-	-
nicosulfuron ^a	80	-	99	98	98	94
nicosulfuron ^b	80	80	95	96	95	90
nicosulfuron ^c	80	-	-	96	99	96
primisulfuron ^d	30	0	72	94	95	80
LSD 5%		-	16	3	4	11

¹ - = Treatment not included

^a + Ethokem 3 L/ha; ^b + Pulse 0.2%; ^c + Weedmaster CT Surfactant 0.5%; ^d + Citowett 0.1%

Crop tolerance

Grain yields were collected from three trials with low incidence of weeds to obtain some indication of crop tolerance. In general, nicosulfuron did not cause any visually apparent injury to the maize crop. However the addition of Ethokem resulted in some slight, silvery blotches on the leaves that were most exposed to the spray mix. The maize plants soon grew out of this effect as new, healthy green leaves were added. In Trial 5 this damage was first noticed the day after treatment but did not appear to check plant growth, however this treatment yielded significantly less than all others (Table 4). It is possible the damage in this trial was aggravated by the extremely dry weather because yields from this treatment were not significantly different in Trials 3 or 7. With the exception of the nicosulfuron plus Ethokem treatment discussed, grain yields from the other treatments in all three trials were equal to or greater than their respective untreated controls, although in most cases the difference was not significant. As a result of the damage noted from Ethokem, an alternative adjuvant was sought and the results show that Weedmaster CT Surfactant, investigated during the 1995/96 season, was less damaging to maize with only faint yellow blotches noticed on the leaves of some plants. These results confirm our earlier finding where maize showed good tolerance to nicosulfuron, except when the crop was planted with certain organo-phosphate insecticides (Green and Ulrich 1993; Rahman and James 1993; Kapusta *et al.* 1994).

TABLE 4: Maize grain yields (t/ha) from three field trials.

Herbicide	Rate g ai/ha	Trial 3	Trial 5	Trial 7
-----------	-----------------	---------	---------	---------

untreated	-	5.5	10.2	10.8
nicosulfuron	60	-	10.4	-
nicosulfuron	80	6.6	10.3	11.5
nicosulfuron	120	7.5	10.2	-
nicosulfuron ^a	80	7.3	9.1	10.9
nicosulfuron ^b	80	6.5	10.4	10.8
nicosulfuron ^c	80	6.3	-	11.2
primisulfuron ^d	30	6.5	10.2	11.4
LSD 5%		1.4	0.8	0.8

^a + Ethokem 3 L/ha; ^b + Pulse 0.2%; ^c + Weedmaster CT Surfactant 0.5%; ^d + Citowett 0.1%

ACKNOWLEDGEMENTS

The authors wish to thank Judy Mellsop and Clyve Maley for technical assistance.

REFERENCES

- Green, J.M. and Ulrich, J.F., 1993. Response of corn (*Zea mays* L.) inbreds and hybrids to sulfonylurea herbicides. *Weed Sci.* 41: 508-516.
- James, T.K. and Rahman, A., 1997. Use of adjuvants with nicosulfuron for control of *Paspalum distichum* in maize. *Proc. 16th Asian Pacific Weed Sci. Soc. Conf.*: (in press).
- Kapusta, G., Krausz, R.F., Khan, M. and Matthews, J.L., 1994. Effect of nicosulfuron rate, adjuvant, and weed size on annual weed control in corn (*Zea mays*). *Weed Technol.* 8: 696-702.
- Kimura, F., Haga, T., Sakashita, N., Murai, S. and Fujikawa, K., 1989. SL-950, a novel sulfonylurea herbicide for corn. *Proc. Brighton Crop Prot. Conf. - Weeds*: 29 - 34.
- Obrigawitch, T., Kenyon, T.W.H. and Kuratle, H., 1990. Effect of application timing on rhizome Johnson grass (*Sorghum halepense*) control with DPX - V9360. *Weed Sci.* 38: 45-49.
- O'Connor, B.P., 1996. Novachem Manual: A New Zealand Guide to Agrichemicals for Plant Protection. SwiftPrint Centre, Ltd, Palmerston North.
- Rahman, A., 1985. Weed control in maize in New Zealand. Pp 37-45. *In*: Maize ~ Management to Market. H.A. Eagles and G.S. Wratt, (Eds). Agronomy Society of New Zealand - Special Publication 4.
- Rahman, A., 1988. Recent major problems of weed control in maize in New Zealand. *Med. Fac. Landbouww Rijksuniv. Gent* 53: 1335-1342.
- Rahman, A. and James, T.K., 1993. Enhanced activity of nicosulfuron in combination with soil-applied insecticides in corn (*Zea mays*). *Weed Technol.* 7: 824 - 829.