Maize

CONTROL OF GRASS WEEDS IN MAIZE FIELDS SHOWING DECREASED ACTIVITY OF EPTC + R25788*

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SUMMARY

Field trials were conducted for control of grass weeds in maize (*Zea mays*) fields where the herbicide EPTC⁺ was applied for at least three previous seasons and poor control of grasses was developing in its final year of use. Results confirmed the inadequate biological activity of EPTC⁺ in these situations but several other chemicals provided satisfactory control of common annual grass weeds and paspalum (*Paspalum dilatatum*). Resting the plot from EPTC⁺ for one season (using another herbicide) improved its performance in the next season but not to consistently adequate levels.

INTRODUCTION

The herbicide EPTC⁺ has been widely and successfully used for the control of grass weeds in maize for several years. It is especially useful where perennial grass weeds such as couch (*Agropyron repens*), Indian doab (*Cynodon dactylon*) and paspalum are the problem weeds (Rahman *et al* 1980). However, recent work by Rahman *et al* (1979) has shown that, in some soils, weed control efficiency of this herbicide decreases appreciably with its repeated use. Subsequently researchers in several parts of the United States have reported similar observations (Harvey 1980). A major reason for this reduced activity appears to be a faster rate of breakdown by microbial action in soils which have received the herbicide in previous years.

When the existence of the above-mentioned problem was established from glasshouse and laboratory experiments, field trials were started in two major maize growing areas of New Zealand to (a) confirm this phenomenon in the field, (b) establish what herbicides other than EPTC⁺ could be recommended for control of grass weeds in these situations, and (c) determine if EPTC⁺ could be used again for effective weed control in such fields if some other herbicide was employed for one season.

MATERIALS AND METHODS

Three field trials, one in Gisborne and two in the Waikato region were conducted in the 1979-80 season on maize fields where the herbicide EPTC⁺ had been used for at least three previous years and poor control of grass weeds was noted in its final year of use. Details of trial sites, their soil properties and rainfall data are presented in Table 1. A randomised block design with four replications was used for all these trials. Individual plots were 8.0 x 3.6 m in which maize cv 'Pioneer 3709' ('PX 74' in the Gisborne trial) was planted, in rows 75 cm apart, by a precision seeder.

All chemicals were applied in a spray volume of 350 litres/ha at a pressure of 200 kPa. The thiocarbamate herbicides, viz. EPTC⁺, vernolate⁺ and butylate⁺, were applied one or two days before planting and rotary hoed to a depth of about 7.5 cm followed by light rolling. All other herbicides were applied as pre-emergence treatments within a week after seeding.

*Hereinafter referred to as EPTC⁺. Similarly vernolate⁺ refers to vernolate + R25788 and butylate⁺ refers to butylate + R25788.

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TABLE 1: Details of trial sites.

Trial No.	Trial location	Soil type	Sand %	Clay %	Organic C(%)	Rainfall (mm)*		
						2 wks	1 mth	5 mths
1	Parawera	Otorohanga fine sandy loam	61	16	9.1	38	164	630
2	Kiokio	Punui heavy silt	32	35	5.1	38	164	630
3	Gisborne	Matawhero heavy silt loam	17	33	3.8	59	76	395

*From the date of planting

In the 1980-81 season all plots of the three 1979-80 trials were treated with 6 kg/ha of EPTC⁺ before planting the maize crop. Atrazine at 1.6 kg/ha was applied as a pre-emergence treatment within a week after planting.

Visual assessments of grass weed control and maize vigour were made at regular intervals. Data on dry matter of weeds were collected by harvesting duplicate 0.1 m² samples from each plot. Maize yield was assessed by hand harvesting cobs from three middle rows in each plot. The cobs were dried and shelled and all weights adjusted to 14% moisture content.

Soil samples were collected from some treatments (Table 4) for glasshouse work in October 1980 after the last cultivation but before EPTC⁺ was applied. These samples were air-dried and treated with 0, 4 or 8 kg/ha of EPTC⁺. They were then stored at 20°C and bioassayed with German millet (*Setaria italica*) at weekly intervals to determine if the extent and duration of the activity of EPTC⁺ in the soil was affected by the herbicide treatment in the previous year.

RESULTS AND DISCUSSION

The grass weed infestation in all three trials consisted mainly of summergrass (*Digitaria sanguinalis*), smooth witchgrass (*Panicum dichotomiflorum*) and barnyard grass (*Echinochloa crus-galli*). In addition Trials 1 and 2 also had some paspalum and the Gisborne site was heavily infested with rough bristlegrass (*Setaria verticillata*).

TABLE 2: Effect of various treatments in 1979-80 on grass weeds (DM yield as % of atrazine treatment).

Herbicides and rates (kg/ha)				Trial number		
				1	2	3
EPTC ⁺	6.0	+ atrazine	1.6	41b	29b	36b
EPTC ⁺	8.0	+ atrazine	1.6	29b	25b	26b
vernolate ⁺	6.0	+ atrazine	1.6	24bc	14c	18bc
vernolate ⁺	8.0	+ atrazine	1.6	15c	10c	8c
butylate ⁺	6.0	+ atrazine	1.6	17c	3c	47b
butylate ⁺	8.0	+ atrazine	1.6	6c	0c	28b
pendimethalin	1.5	+ atrazine	1.6	17c	19bc	34b
pendimethalin	2.2	+ atrazine	1.6	9c	5c	12c
metolachlor	3.2	+ atrazine	1.8	6c	1c	19bc
metolachlor	4.1	+ atrazine	1.8	1c	1c	8c
alachlor	4.0	+ metribuzin	0.6	0c	4c	11c
alachlor	4.0	+ atrazine	1.6	0c	6c	3c
alachlor	6.0	+ atrazine	1.6	0c	0c	0c
atrazine	1.6			100a	100a	100a
atrazine	1.6	(g/m ²)		221	160	121
CV%				14.2	9.8	21.7

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Dry matter weights of grass weeds taken in early January (Table 2) confirmed the reduction in the activity of EPTC⁺ as it did not provide adequate grass weed control in any of the three trial sites which had received this herbicide for at least three previous years. Vernolate⁺ (high rate) and butylate⁺ resulted in much better weed control except in Trial 3 where butylate failed due to its ineffectiveness on rough brome grass. The low rate of pendimethalin also did not give very good control in this trial mainly for the same reason. All other treatments provided good control of grass weeds in the trials reported here. These observations were supported by visual assessments of grass weed control at various stages of the crop growth and also by data on dry matter of grasses collected in mid February. All herbicide combinations increased the grain yield of maize over the atrazine alone plots but no significant differences were recorded between various treatments.

The above results suggest that provided rainfall occurs within the first two weeks after spraying (as was the case in all three trials), most of the recommended grass herbicides other than EPTC⁺ should prove satisfactory in maize fields known to have problems with rapid breakdown of this herbicide. However, the degree of control from some chemicals could be much lower where the weed infestation comprises mainly perennial grasses or grass weed(s) partially resistant to the particular herbicide as was the case with butylate⁺ in Trial 3.

TABLE 3: Dry matter (g/m²) of grass weeds after the 1980-81 application of EPTC⁺ 6 kg/ha over 1979-80 treatments.

Herbicides and rates (kg/ha)				Trial number		
				1	2	3
EPTC ⁺	6.0	+ atrazine	1.6	92.6ab	64.1a	48.9a
EPTC ⁺	8.0	+ atrazine	1.6	110.2a	65.8a	40.2ab
vernolate ⁺	6.0	+ atrazine	1.6	98.4ab	46.2a	36.8ab
vernolate ⁺	8.0	+ atrazine	1.6	81.1b	32.5b	39.7ab
butylate ⁺	6.0	+ atrazine	1.6	61.8bc	39.3ab	53.6a
butylate ⁺	8.0	+ atrazine	1.6	69.5bc	53.0a	38.7ab
pendimethalin	1.5	+ atrazine	1.6	63.7bc	46.5a	22.7bc
pendimethalin	2.2	+ atrazine	1.6	73.3bc	38.9ab	21.5bc
metolachlor	3.2	+ atrazine	1.8	52.1c	20.5b	15.0c
metolachlor	4.1	+ atrazine	1.8	34.7c	39.5ab	20.3bc
alachlor	4.0	+ metribuzin	0.6	32.8c	30.8b	17.9bc
alachlor	4.0	+ atrazine	1.6	52.1c	34.7b	29.1bc
alachlor	6.0	+ atrazine	1.6	42.5c	44.5ab	21.9bc
atrazine	1.6			50.2c	35.9b	30.2bc
CV%				14	21	27

When all the plots were retreated with EPTC⁺ in the second season, visual observations and dry matter of grass weeds indicated that the overall control was less than satisfactory (Table 3). Where EPTC⁺ was followed by the same chemical, the weed control was very poor as expected. The control from EPTC⁺ preceded by all the other treatments varied between 48 and 86% but no treatment was consistently better than the others. Thus spraying with EPTC⁺ after one year's use of another herbicide, although an improvement over continuous use of EPTC⁺, still did not provide good control of grass weeds which was given by a number of other herbicides in the previous year (Table 2).

These results from the field were confirmed by glasshouse data in Table 4. In the soil from site 1 the biological activity of EPTC⁺ lasted just over 4 weeks from the 4 kg/ha rate and about 9 weeks from the 8 kg/ha rate in the soil which had received this herbicide in the 1979-80 season. This activity extended to about 9 and 15 weeks from 4 and 8 kg/ha rates respectively where the previous year's treatment was other than

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TABLE 4: DM of German millet in glasshouse pots after application of EPTC⁺ to site 1 soil in October 1980; expressed as % of untreated (no EPTC⁺).

1979-80 treatment	0	4	Bioassayed after week		
			8	12	16
EPTC ⁺ 4 kg/ha					
EPTC ⁺	0	72	97	102	
vernolate ⁺	0	48	72	109	
pendimethalin	0	37	73	98	
alachlor	0	40	77	96	
control*	0	22	57	89	
± S.E. (P < 0.05)		5.6	5.1	6.2	
EPTC ⁺ 8 kg/ha					
EPTC ⁺	0	28	69	109	96
vernolate ⁺	0	6	29	56	94
pendimethalin	0	6	27	50	89
alachlor	0	11	32	68	111
control*	0	0	14	33	72
± S.E. (P < 0.05)		5.4	4.3	5.2	5.7

*Soil from a neighbouring field which had never received EPTC⁺.

EPTC⁺. In contrast the biological activity persisted for about 11 weeks and over 16 weeks in a soil from the nearby field which had never received this herbicide. Experiments with soils from sites 2 and 3 also showed trends similar to that of site 1.

Data from these trials show that a problem does exist with EPTC⁺ in that its biological activity is reduced considerably in some soils where it has been used for several previous years. If such 'problem maize fields' are treated with other herbicides, EPTC⁺ may be used in the next season with some success but the level of activity could still be well short of that obtained in a soil which is treated with this compound for the first time. Field trials conducted during this season and several glasshouse experiments with a new commercial formulation of EPTC⁺ indicate that it is not affected to the same extent with enhanced microbiological breakdown and that it could be possible to overcome the problems with EPTC⁺ by switching over to this new formulation. Results from these field trials will be reported after one further year's field testing.

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