WEED CONTROL IN MAIZE ON HIGH ORGANIC MATTER SOILS

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Summary

Several herbicide combinations adequately controlled the common annual grass weeds and paspalum (*Paspalum dilatatum*) in maize (*Zea mays*) in soils containing organic matter levels up to 39%. Highest recommended rates of alachlor, metolachlor and EPTC + antidote were all effective, as were post-emergent directed treatments of linuron applied with a shielded sprayer. Paraquat did not provide good weed control and glyphosate was damaging to the crop. Control of grass weeds by pre-plant or pre-emergence treatments resulted in higher yield increases than were achieved by post-emergence herbicides or cultivation. Pre-emergence treatments of atrazine did not give sufficient control of broadleaf weeds in these soils but post-emergence applications were very effective.

INTRODUCTION

Annual and perennial grass weeds such as summer grass (*Digitaria sanguinalis*), barnyard grass (*Echinochloa crus-galli*), witchgrass (*Panicum* spp), bristle grass (*Setaria* spp), couch (*Agropyron repens*) and Indian doab (*Cynodon dactylon*) have become the main problem of maize fields, especially where the crop has been grown on the same ground for several consecutive seasons (Matthews 1975; Rowe *et al* 1976). The problem is of particular concern on peaty soils because of their high organic matter levels. The control of grass weeds in maize on the high organic matter soils has been raised as a problem by many farmers and farm advisory officers in the past few years.

The trials reported in this paper were designed to compare a number of pre-plant and pre-emergence herbicides available for grass weed control in combination with atrazine or cyanazine. In addition, post-emergence directed applications of some other herbicides were also tested, as these could be cheaper and equally effective if suitable application techniques could be developed to avoid getting the herbicide on to maize plants and thus avoid crop damage.

MATERIALS AND METHODS

Three field trials were conducted over two growing seasons between 1977 and 1979. The location 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 three trials. Individual plots were 8.0 x 3.6 m in which maize cv PX 442 or XL 327 was planted in rows 75 cm apart by a Nodet Gougis precision seeder.

The herbicides were applied in a spray volume of 350 litres/ha at a pressure of 250 kPa. EPTC + antidote treatment was applied one or two days before seeding and rotary hoed to about 10 cm depth followed by light rolling. Alachlor and metolachlor were used as pre-emergence treatments. Atrazine was sprayed as an early post-emergence treatment 16-21 days after seeding, except in combinations with metolachlor which were applied pre-emergence as a tank-mix. Linuron, paraquat and glyphosate were applied as post-emergence directed treatments with a single nozzle shielded sprayer when the crop attained a height of 30 to 40 cm. The cultivation treatment was also carried out at the same stage of crop growth with a potato moulder in Trial 1 and with a hand hoe in the other two trials.

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Cereals and Maize

TABLE 1: Details of trial sites.

Trial No.	Trial location	Soil type	Sand %	Clay %	OM %	Rainfall (mm)*		
						2 weeks	1 month	5 months
1.	Hamilton	Rukuhia loamy peat	38	16	39	106	139	216
2.	Waitakaruru	Ngatea peaty loam	43	18	35	36	85	155
3.	Parawera	Otorohanga silt loam	45	22	17	51	147	269

* From the date of seeding.

Visual assessments of grass and broadleaf 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 four middle rows in each plot. The cobs were dried and shelled and all weights adjusted to 14% moisture content.

RESULTS AND DISCUSSION

The grass weed infestation in all three trials consisted mainly of summer grass, barnyard grass, smooth witchgrass (*Panicum dichotomiflorum*) and paspalum. Visual assessments of grass weed control at various stages of the crop growth and dry matter weights of grasses (Table 2) indicated that the pre-plant and pre-emergence herbicides provided good control in all trials. The level of control was slightly inferior from EPTC + antidote in Trials 2 and 3 to that obtained with alachlor or metolachlor combinations, although the differences were not significant. This may, in part, have been due to the fact that EPTC + antidote had been used on these sites for the previous 2 years (Rahman *et al* 1979). Directed post-emergence treatments often improved the control of grasses slightly over EPTC + antidote. However, when used in combination with atrazine alone, these directed treatments, particularly paraquat, were not always as effective as the pre-plant and pre-emergence treatments.

TABLE 2: Effect of treatments on grass weeds (DM yield as % of Treatment 1*).

Herbicides and rates (kg/ha)		Trial number		
		1	2	3
1.	atrazine 1.6	100 a	100 a	100 a
2.	cyanazine 1.6 + EPTC** 6.0	3 c	11 bc	9 b
3.	atrazine 1.6 + EPTC 6.0	2 c	14 bc	16 b
4.	atrazine 1.6 + alachlor 4.5	8 c	9 bc	6 b
5.	atrazine 1.6 + metolachlor 3.3	5 c	2 c	2b
6.	atrazine 1.6 + EPTC 6.0 + linuron 2.5	1 c	3 c	1 b
7.	atrazine 1.6 + EPTC 6.0 + paraquat 0.5	3 c	9 bc	5 b
8.	atrazine 1.6 + EPTC 6.0 + glyphosate 0.36	3 c	2 c	1 b
9.	atrazine 1.6 + linuron 2.5	17 bc	15 bc	9 b
10.	atrazine 1.6 + paraquat 0.5	41 b	23 b	19 b
11.	atrazine 1.6 + glyphosate 0.36	15 bc	11 bc	6 b
12.	atrazine 1.6 + cultivation	22 bc	16 bc	10 b

* Actual DM yields for Treat. 1 were 43, 67 and 89 g/m² for Trials 1, 2 and 3 respectively. Grass weeds harvested 3-4 weeks after the directed post-emergence treatments were applied.

** EPTC + antidote used throughout.

Cereals and Maize

None of the three trial sites had any significant infestations of the troublesome perennial grass weeds such as couch, Indian doab, onion twitch (*Arrhenatherum elatius* var. *bulbosum*) etc, which are sometimes the problem weeds of maize fields where the crop has been grown for several years.

Increases in maize grain yields obtained by various herbicide combinations over atrazine alone are given in Table 3. Over all the three trials, all herbicide additions gave significant yield increases, except paraquat and glyphosate (Treatments 10 and 11). In the case of paraquat this appeared to be due to insufficient weed control whereas in the case of glyphosate it resulted from herbicide damage to the crop which consisted of slight thinning of the stand, a reduction in height of plants, deformities of the foliage and delayed maturity. Directed applications of linuron were more successful as these provided better weed control than paraquat and did not damage the maize crop like glyphosate. However, linuron still did not provide as large yield increases as were achieved by most of the pre-plant and pre-emergence treatments, possibly because the crop had already suffered from some weed competition. The critical period of weed competition in maize is usually the first 30-40 days after emergence (Matthews 1975; Remison 1979).

TABLE 3: Maize grain yields (t/ha) - Actual yields from Treatment 1 and yield increases obtained from various combinations.

Treatment No. †	1	Trial number 2	3	Mean % increase
1	5.4	6.3	6.6	0
2	1.9*	0.8	1.0	21*
3	3.9***	1.2*	1.2*	36**
4	2.3**	1.7**	2.2***	34**
5	1.0	1.1*	2.0**	22*
6	3.5***	1.8**	2.2***	42**
7	2.3**	1.3*	2.0**	31**
8	1.9*	0.8	1.2*	22*
9	1.6*	1.3*	1.9**	27*
10	1.1	0.7	1.1*	16
11	0.8	0.1	0.2	7
12	2.7***	1.6**	1.9**	35**

† See Table 2 for treatments.

*, **, *** Significant increases at 5%, 1% and 0.1% respectively according to Dunnett's test for multiple comparisons - one tailed.

On an average the cyanazine and metolachlor combinations did not result in yield increases as large as those achieved by EPTC + antidote or alachlor treatments. This was mainly due to poor control of broadleaf weeds in Treatments 2 and 5. In Trials 1 and 2 metolachlor treatment reduced the dry matter of broadleaf weeds by 69% and 76% compared to an untreated area while the corresponding figures for cyanazine treatment were 78% and 82% respectively. Trial 3 had very few broadleaf weeds. The post-emergence applications of atrazine in all other cases provided satisfactory control of broadleaf weed infestations which consisted mainly of willow weed (*Polygonum persicaria*), redroot (*Amaranthus powellii*) and black nightshade (*Solanum nigrum*). This clearly suggests that 1.6 kg/ha atrazine applied pre-emergence (with metolachlor) was not sufficient to control broadleaf weeds effectively in these trials, probably due to its adsorption by the high organic matter content of the soils (Rahman and Matthews 1979). However, the present formulation of the metolachlor mixture provides 1.8 kg/ha of atrazine at recommended rates and it could overcome this problem in many areas.

Cereals and Maize

Combinations of cyanazine with alachlor and metolachlor and comparisons of pre- and post-emergence applications of atrazine with alachlor were also included in Trial 1. However, both the cyanazine combinations and tank mix application of atrazine and alachlor were dropped from the second year trials due to poor control of broadleaf weeds from all these treatments.

In addition to supporting the findings of some previous workers (Fellowes and Scherp 1971; Kitchener 1971; Patterson 1971; Upritchard and Naish 1974), the results of these trials indicate that an acceptable control of most common grass and broadleaf weeds can be obtained in maize crops growing on high organic matter soils by using the highest recommended rates of pre-plant and pre-emergence 'grass' herbicides followed by early post-emergence applications of atrazine. Pre-emergence applications of atrazine were not as effective. If suitable application equipment can be developed, linuron could provide satisfactory grass weed control as a post-emergent directed treatment. Cultivation may also be combined with atrazine for successful results where it is possible and economical e.g., in conjunction with side dressing of fertilisers. Paraquat did not provide very effective weed control and glyphosate was damaging to the crop even though special equipment and extreme care was used in its application.

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