CONTROL OF ANNUAL AND PERENNIAL WEEDS IN MAIZE ESTABLISHED BY CONVENTIONAL AND CONSERVATION TILLAGE PRACTICES

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SUMMARY

The use of glyphosate 1.1 to 2.2 kg/ha gave good couch (*Agropyron repens*) control in maize (*Zea mays*) stubble prior to new crop establishment by either conventional cultivation or conservation tillage techniques. Sequential applications of alachlor plus atrazine 3.0+1.5 kg/ha or alachlor plus cyanazine 3.0+1.0 kg/ha gave high levels of annual grass and broad leaf weed control. Tank mixtures of glyphosate at the threshold level of 1.1 kg/ha plus either of the annual weed herbicide combinations indicated antagonism in the form of reduced control of perennial weeds. By increasing the rate of glyphosate to 2.2 kg/ha in the tank mixture antagonism was overcome.

INTRODUCTION

The presence of the perennial weeds, couch, paspalum (*Paspalum dilatatum*), Mercer grass (*Paspalum paspaloides*) Indian doab (*Cynodon dactylon*), Californian thistle (*Cirsium arvense*), docks (*Rumex* spp) and buttercup (*Ranunculus* spp) collectively or individually has caused problems when cultivating for the following crop, as well as reduced crop vigour from competition by plants regenerating from rhizome or root fragments (Scherp 1975; Meeklah and Mitchell 1979).

Patterson (1971) reported that high rates of atrazine (4 kg/ha) gave season long suppression of couch when applied post emergence to actively growing foliage. Suppression of couch is also possible with EPTC + antidote but rhizome regrowth may require retreatment in successive years of maize establishment (unpublished data).

Perennial broad leaf weed infestation in maize crops also cause yield reduction and crop loss. Traditional control practices have involved inter-row cultivation together with an overall application of the amine salt of 2,4-D (McPhail 1968; Mitchell 1970). More recent studies have evaluated the use of MCPA and amine and ester formulations of dicamba for broadcast selective treatment of Californian thistle, docks, buttercup and field bindweed (*Convolvulus arvensis*) (unpublished data). While season long suppression was adequate, repeat applications were necessary in subsequent crops. Crop tolerance was marginal with some of the herbicides evaluated. The timing of spray application was important in relation to the stage of crop development.

This paper presents results of trials conducted in the Waikato region where glyphosate was applied to couch and other stubble weeds in the spring, either in tank mixtures with alachlor plus atrazine or cyanazine, or separately before other herbicides.

A comparison was also made between the establishment of maize by conventional cultivation and direct drilling, following glyphosate application, on two sites over a two year period, 1978-1979.

METHOD

A small plot trial was laid down in November 1979 using a randomised block design with 10 treatments (Table 2) replicated three times in plots 10 x 3 m incorporating four rows of maize variety Pioneer 3709. Herbicides used were applied with a precision plot sprayer using 250 litres/ha at 210 kPa. Pre-plant treatments were applied 5.11.79 followed by drilling 11.11.79 and pre-emergence treatments 16.11.79. Visual assessments by at least two persons of annual and perennial grass, and broad leaf weed

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control were conducted at intervals after glyphosate application and the mean for each treatment recorded. Plant emergence counts were also made.

Two field scale trials were laid down with individual plots 60-100 x 20 m and each treatment replicated twice. Herbicides were applied by calibrated contractors boom in 200-225 litres/ha. In 1978 glyphosate 2.2 kg/ha pre-plant and alachlor 3 kg/ha plus atrazine 1 kg/ha was applied to all plots. Cultivated treatments involved the normal tillage operations for maize planting whereas conservation tillage treatments used direct seeding of maize into the sprayed crop and weed residue using unmodified planting equipment. In 1979 all plots were sprayed with alachlor plus atrazine but only the conservation tillage plots were sprayed with glyphosate 1.1 kg/ha.

Maize yields in the field scale trials were determined by hand harvesting cobs from 13.1 m row at 10 randomly selected sites per treatment. The cobs were shelled and all weights adjusted to 16% moisture content.

RESULTS AND DISCUSSION

Split applications of glyphosate 2.2 kg/ha and alachlor plus atrazine 3.0 + 1.5 kg/ha gave high levels of annual and perennial weed control in field scale plot trials (Table 1). Similar yields were obtained from the conventional and conservation tillage treatments on both sites (Table 1), despite increased insect pressure from stem weevil (*Hyperodes bonariensis*) and slugs in the conservation tillage plots, due to undisturbed over-wintering sites and the presence of decaying surface trash.

TABLE 1: Effect of cultivation versus conservation tillage following herbicide applications on weed control and yield of maize.

	% Control				Yield (t/ha)	
	Perennial Weeds ¹		Annual Weeds ²			
	Site 1	Site 2	Site 1	Site 2	Site 1	Site 2
1978						
Days after glyphosate application	137	128	137	128		
Treatment ³						
Cultivation	98	98	94	93	10.5	10.7
Conservation tillage	95	93	94	92	10.5	9.7
1979						
Days after glyphosate application	134	121	134	121		
Treatment ³						
Cultivation	85	89	97	97	8.7	10.8
Conservation tillage	97	99	96	96	8.5	9.8

¹ dock, buttercup

² summer grass, barnyard grass, redroot, willoweed

³ All plots treated with alachlor + atrazine 3.0 + 1.5 kg/ha and, in 1978, glyphosate 2.2 kg/ha. In 1979 glyphosate was applied to CT plots only at 1.1 kg/ha.

Effect on couch

At the 121 day assessment all split applications resulted in high levels of couch control, similar to glyphosate 1.1 kg/ha alone and significantly better than alachlor plus atrazine 3.0 + 1.5 kg/ha ($P < 0.05$) (Table 2). Tank mixtures of glyphosate plus alachlor and cyanazine 2.2 + 3.0 + 1.0 kg/ha also gave excellent couch control.

TABLE 2: Annual and perennial grass and broadleaf weed control in maize using pre-plant and emergence herbicides (% control).

Treatments	Rate kg/ha	Couch broadleaf weeds *	Perennial broadleaf weeds *	Annual grass weeds, warm zone grasses	Annual broadleaf weeds **	Plant numbers 1000/ha 45 days after glyphosate treatment
Split Application						
glyphosate (pre-pl)	1.1					
+ alachlor + atrazine (pre-em)	3.0 + 1.5	95 ab	99 a	93 a	99 a	68 ab
glyphosate (pre-pl)	1.1					
+ alachlor + cyanazine (pre-em)	3.0 + 1.0	83 bc	91 c	87 a	87 a	57 b
glyphosate (pre-pl)	2.2					
+ alachlor + atrazine (pre-em)	3.0 + 1.5	99 a	100 a	97 a	100 a	71 a
glyphosate (pre-pl)	2.2					
+ alachlor + cyanazine (pre-em)	3.0 + 1.0	98 ab	95 b	90 a	97 a	65 ab
Tank Mixture						
glyphosate + alachlor + atrazine (pre-plant)	1.1 3.0 + 1.5	68 c	63 d	80 ab	93 a	76 a
glyphosate + alachlor + cyanazine (pre-plant)	1.1 3.0 + 1.0	48 d	48 f	58 b	87 a	73 a
glyphosate + alachlor + atrazine (pre-plant)	2.2 3.0 + 1.5	94 ab	63 d	60 b	92 a	67 ab
glyphosate + alachlor + cyanazine (pre-plant)	2.2 3.0 + 1.0	93 ab	53 e	81 ab	75 a	66 ab
Straight Application						
glyphosate (pre-pl)	1.1	93 ab	53 e	17 c	55 a	66 ab
alachlor + atrazine (pre-em)	3.0 + 1.5	oe	38 g	96 a	96 a	76 a
CV%		7.7	15.1	11.9	18.5	8.1

* Buttercup, broadleaf dock, Californian thistle. ** redroot, willow weed.
Treatments 5-8 were tank mixtures.

Reducing the rate of glyphosate to 1.1 kg/ha in tank mixture with alachlor plus atrazine or cyanazine significantly reduced the level of control compared to the split application of the same herbicides or to glyphosate 1.1 kg/ha alone when applied pre-plant. This is likely to have been caused by antagonism to glyphosate at the low or threshold rate a factor previously reported by Appleby and Somabhi 1977.

Effect on perennial broad leaf weeds

Both rates of glyphosate pre-plant followed by alachlor plus atrazine pre-emergence resulted in significantly better control than all other treatments 121 days after treatment (Table 2). Substitution of cyanazine for atrazine reduced control levels and these declined even further when the rate of glyphosate was reduced. All herbicide tank mixtures and glyphosate alone were less effective than the equivalent split applications. The poor result from using glyphosate alone when assessed 121 days after

treatment was due to post treatment establishment of perennial broad leaf weeds. Alachlor and atrazine did not give knockdown of the stubble weeds present.

Effect of annual broad leaf weeds

There were no significant differences between treatments ($P > 0.05$). Glyphosate alone appeared least effective because of germination of redroot (*Amaranthus hybridus*) and willow weed (*Polygonum persicaria*) after treatment (Table 2).

Effect on annual 'warm zone' grasses

Pre-emergence application of alachlor resulted in higher levels of annual grass weed control than equivalent tank mixed treatments (Table 2).

CONCLUSIONS

These trials confirm the earlier finding of Scherp (1975) that glyphosate can provide high levels of control of perennial weeds. The use of conservation tillage to establish maize following vegetation control using glyphosate produced similar crops and yields to those established by conventional cultivation methods.

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