PERSISTENCE AND MOVEMENT OF QUIZALOFOP IN TWO SOIL TYPES

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SUMMARY

The persistence and movement of quizalofop, at various rates, was investigated in two soil types. Soil samples from 0-10 cm depth were collected 1, 4 and 7 days after spraying and at weekly intervals thereafter and bioassayed using maize *(Zea mays* cv. 'Pioneer 3709') and annual ryegrass *(Lolium multiflorum* cv. 'Tama'). Quizalofop was found to be more persistent in the Hamilton clay loam soil than in the Horotiu sandy loam soil, with detectable residues from the 200 g/ha rate disappearing within 21 and 14 days respectively. No residues of quizalofop could be detected below 10 cm depth in the soil.

INTRODUCTION

Quizalofop (NCI-96683) is a recently developed herbicide for post-emergence control of grass weeds in broadleaf crops (Sakata *et al* 1983). Its mode of action is similar to the many other post-emergence grass herbicides, i.e. disruption and decay of meristematic tissues, resulting in a rapid suppression of growth as well as a reduction in the viability of underground parts in perennial grasses (Doll 1985; Ikai *et al* 1985).

Herbicides applied post-emergence are not completely intercepted by plant foliage and a certain amount of herbicide reaches the soil surface. The persistence of quizalofop in the soil has been reported to be relatively short (Richardson and West 1986) but good activity has still been noted (Sakata *et al* 1983). Soil activity was considerably greater following pre-plant incorporated applications than after pre-emergence surface applications, probably due to the relatively low mobility of quizalofop in the soil (Nilsson 1987; Sakata *et al* 1983).

The objective of this research was to determine the persistence, pattern of dissipation and movement of quizalofop in two different soil types.

MATERIALS AND METHODS

Two field trials were conducted in the same locality on different soils to study the persistence and movement of quizalofop (Targa) in the soil. One trial was on a Horotiu sandy loam soil with 9.1% organic C, 16% clay, 61% sand, a pH of 5.7, and a field capacity of 43%. The other trial was on a Hamilton clay loam soil with 3.1% organic C, 27% clay, 38% sand, a pH of 5.2 and a field capacity of 37%.

Five rates of quizalofop, viz 100, 200, 400, 600 and 800 g/ha, and 750 g/ha fluazifop-butyl (Fusilade) were applied to freshly cultivated ground using a CO_2 powered precision sprayer applying 300 litres/ha of water at 210 kPa. Both trials were treated on 22 October 1987 and had plot sizes of 2 × 6 m. The treatments were arranged in a randomised block design with four replications.

Soil samples for bioassay of herbicide activity were obtained from the 0-10 cm depth of each plot, 1, 4, 7, 14, 21, 28, 35, 42, 49, 56 and 63 days after spraying. Samples were also taken from the 10-20 cm depth 14 and 21 days after spraying, to investigate movement in the soil. Each soil sample consisted of five 7-cm diameter cores taken at random from the plot. Each sample was thoroughly mixed and bioassayed in the glasshouse using maize and annual ryegrass as the test species. Plants were grown in 12 cm diameter pots for 4-5 weeks before being visually assessed for damage and harvested for dry matter determinations.

For comparison a series of 'standards' was run concurrently with the sequential sampling, using a range of rates of quizalofop (mixed throughout the soil in the pot), to determine the effects of known amounts of the herbicide.

RESULTS

Dry shoot weights for the 'standard' series are presented in Table 1. Results show that maize was more susceptible than ryegrass to quizalofop on both soil types. Consequently the persistence data presented in Tables 2 and 3 are based on the maize bioassay only. The 'standard' series also showed that the level of activity of quizalofop was lower in the Horotiu sandy loam soil than in the Hamilton clay loam soil. Similar differences were found in the bioassays from the field trials (Tables 2 and 3). At rates of 100 and 200 g/ha (i.e. in the range of use rates for annual grasses) the residual activity of quizalofop lasted for up to 1 and 14 days respectively in the Horotiu sandy loam soil. The corresponding figures for the Hamilton clay loam soil were up to 7 and 21 days respectively.

TABLE 1: Effect of known rates of quizalofop on bioassay species grown in the glasshouse.

Quizalofop (g ai/ha **)	Dry shoot weight* (% of untreated)			
	Horotiu Sandy Loam		Hamilton Clay Loam	
	Maize	Ryegrass	Maize	Ryegrass
0	100	100	100	100
50	85	102	83	82
100	84	93	50	67
150	69	94	40	56
200	56	80	33	58
250	47	58	25	52
300	42	48	18	48
400	33	34	18	42
600	25	36	10	29
800	20	25	6	9
1600	11	4	0	2
3200	0	1	0	0

* Average of three 'standards' conducted on 8.10.87, 21.11.87 and 18.12.87.
** Incorporated in 10 cm of soil (the same depth as the field sample cores) before planting the bioassay species.

TABLE 2: Bioassay of herbicide residues in 0-10 cm soil depth in the Horotiu sandy loam soil.

Treatment	Rate (g ai/ha)	Dry Shoot Weight of maize (% of untreated)*								
		Days after spraying								
		1	4	7	14	21	28	35	42	56
quizalofop	100	*102*								
quizalofop	200	78	74	88	*113*					
quizalofop	400	51	52	49	81	89	72	*92*		
quizalofop	600	38	41	44	65	72	75	*95*		
quizalofop	800	32	41	34	59	52	76	88	84	*103*
fluazifop-butyl	750	49	49	54	*90*					

* Figures in italics are not significantly different from untreated controls (=100), $P>0.05$. The subsequent blank spaces also represent data not significantly different from the controls.

When used at the same rates, detectable amounts of quizalofop persisted for 7-14 days longer in the Hamilton clay loam soil than in the Horotiu sandy loam soil. Similarly fluazifop-butyl persisted for 28 days longer in the Hamilton clay loam soil. The ryegrass bioassay and the visual assessments showed the same differences in persistence between the two soils but were not as sensitive as the maize dry shoot weights.

No detectable residues of either quizalofop or fluazifop-butyl were found in soil samples collected from the 10-20 cm depth 14 and 21 days after treatment.

TABLE 3: Bioassay of herbicide residues in 0-10 cm soil depth in the Hamilton clay loam soil.

Treatment	Rate (g ai/ha)	Dry shoot weight of maize (% of untreated)* Days after spraying										
		1	4	7	14	21	28	35	42	49	56	63
quizalofop	100	87	83	*95*								
quizalofop	200	60	56	69	72	*92*						
quizalofop	400	60	40	51	81	75	*96*					
quizalofop	600	36	40	31	48	56	78	64	*80*	62	82	*87*
quizalofop	800	31	34	30	36	51	54	53	76	76	74	87
fluazifop-butyl	750	26	23	38	41	52	83	79	*120*			

* Figures in italics are not significantly different from untreated controls (=100), P>0.05. The subsequent blank spaces also represent data not significantly different from the controls.

DISCUSSION

The persistence of quizalofop as reported here (Tables 2 and 3) is considerably shorter than that reported by Richardson and West (1986) who found that 25 g/ha persisted for 10 weeks, 125 g/ha for 30 weeks and 625 g/ha for more than 40 weeks when using perennial ryegrass *(Lolium perenne)* for the bioassay. Although in their experiments perennial ryegrass was more sensitive than maize to quizalofop it would seem that quizalofop is less persistent in the high organic matter, volcanic soils of New Zealand.

At similar rates quizalofop was found to be more persistent than fluazifop-butyl in both soil types. The residual life of fluazifop-butyl in these trials was similar to that reported by Rahman *et al* (1985) and Rahman *et al* (1988) for the Horotiu sandy loam soil, but slightly longer for the Hamilton clay loam soil. When comparing these with other recently developed grass weed herbicides reported on by Rahman *et al* (1985) the following points can be made. Quizalofop and fluazifop-butyl are more active on maize than on ryegrass whereas alloxydim-sodium, sethoxydim, fenoxaprop-ethyl, haloxyfop, RE36290 and clethodim show greater activity on ryegrass. Quizalofop, fluzifop-butyl and haloxyfop are more active in the Hamilton clay loam soil while all the others are more active in the Horotiu sandy loam soil. Lower activity in the clay soil is probably due to adsorption of the herbicides onto the clay particles (Smith and Hsiao 1983, Rahman *et al* 1985). When used at recommended rates quizalofop and haloxyfop are the most persistent of these herbicides but with shallow cultivation the biological activity should usually disappear within 6 weeks.

No rain fell in the first 7 days after treatment, but between 7 and 21 days 55 mm were recorded. Despite this significant rainfall no residues were found in the 10-20 cm depth samples. Sanders *et al* (1988) reports that quizalofop was still inhibiting germination of grasses 5 weeks after treatment on plots that were left undisturbed. This together with our results supports the findings of Nilsson (1987) and Sakata *et al* (1983) that quizalofop has a relatively low mobility in the soil and remains concentrated near the soil surface.

The results presented here show that quizalofop has a short residual life in the soil, with residues from most rates decreasing to below detectable levels within 6 weeks. Quizalofop should, therefore, pose no problem in a crop rotation.

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