FLUAZIFOP-BUTYL FOR THE SELECTIVE CONTROL OF MANY GRASS WEEDS IN BROADLEAF CROPS

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SUMMARY

Fluazifop-butyl is a systemic post-emergence herbicide for the selective control of grasses in broad-leaved crops. In replicated trials over 3 years it has shown very high activity against wild oats (*Avena fatua*), prairie grass (*Bromus unioloides*) and crowfoot grass (*Eleusine indica*) at 0.25 kg/ha, ryegrasses (*Lolium* spp), paspalum (*Paspalum dilatatum*), Mercer grass (*Paspalum paspaloides*), Indian doab (*Cynodon dactylon*), barnyard grass (*Echinochloa crus-galli*), summer grass (*Digitaria sanguinalis*), green bristle grass (*Setaria viridis*), couch (*Agropyron repens*) and canary grass (*Phalaris canariensis*) at 0.5 — 0.75 kg/ha. A wide range of broad-leaved species displayed complete tolerance to post emergence treatments of fluazifop-butyl at rates of 0.5 — 1.0 kg/ha.

INTRODUCTION

Fluazifop-butyl is a selective herbicide for post-emergence control of many annual and perennial grass weeds in broad-leaved and non-graminaceous crops. It will be marketed in New Zealand under the trade name Fusilade.

Fluazifop-butyl is quickly absorbed through leaf surfaces and transported in both the xylem and phloem. It accumulates at growing points in the plant and effects meristematic tissues of nodes and buds. Laboratory studies suggest fluazifop-butyl interferes with adenosinetriphosphate (ATP) production. First symptoms of effect are often not evident until a week after application although growth usually ceases within 48 h. Nodes and growing points become necrotic; young leaves show chlorosis followed by necrosis; there is a general loss of vigour and often pigment changes that are normally associated with senescence. Death is usually complete after 3-5 weeks (Stonebridge 1981).

It has an acute oral LD₅₀ of 3328 mg/kg and dermal LD₅₀ of > 6050 mg/kg to male and female rats. The chemical showed no effect on birds, bees, earthworms and other soil and water organisms but exhibited a moderate toxicity to fish. The chemical degrades rapidly in the environment with a half life in soils of 3-12 weeks. It is rapidly metabolised in plants and residues in crops are virtually undetectable at harvest.

METHOD

All treatments were applied by a precision plot sprayer delivering 250-420 litres/ha. Plot size was 4-15 x 1.5-2.5 m with each treatment replicated 3-5 times in a randomized block design. Crops and weeds tested were:—

Crop	Target weeds	Location	Harvest area
white clover	ryegrass and couch	Canterbury	3 x 1 m ² /plot
peas	wild oats	Canterbury	3 x 1 m ² /plot
sugar beet	wild oats	Canterbury	—
onions	prairie/Mercer grass	Auckland	3 x 1 m ² /plot
asparagus)	crowfoot grass)		
)	paspalum)	Waikato	—
)	paspalum	Whakatane	—
buttercup squash	green bristle grass	Waikato	5 x 1.5 m
apples	barnyard grass)		—
nectarines	paspalum)	Hastings	—
vineyards	summer grass,)		5 m x 1 row
	Indian doab)		

Weed control measurements were obtained by visual assessments on target weeds.

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Crop tolerance trials

A wide range of broadleaf crops were sprayed with fluazifop-butyl 0.5-1.0 kg/ha in October 1981 — January 1982 and crop tolerance assessed. Crop yields were measured on capsicums (*Capsicum frutescens*), kumara (*Ipomoea batatas*), tomatoes (*Lycopersicon esculentum*), potatoes (*Solanum tuberosum*), butternuts (*Cucurbita pepo*) and strawberries (*Fragaria* spp) while growth increments were measured on 1 year apples (*Malus sylvestris*), peaches (*Prunus persica*), black currants (*Ribes nigrum*), raspberries (*Rubus illecebrosus*), willows (*Salix* sp) and poplars (*Populus* sp).

Surfactant

In all trials 0.35% v/v of a non-ionic wetter containing 27% nonylphenyl-ethoxylate was added to all fluazifop-butyl treatments.

RESULTS AND DISCUSSION**White clover**

The results in Table 1 show fluazifop-butyl at rates of 0.375 kg/ha and above to have provided virtually complete control of 'Grasslands Tama and Nui' ryegrasses for the duration of the white clover seed crop. Activity on couch by fluazifop-butyl was initially high but some recovery occurred on all rates nearing harvest. Canary grass was completely controlled by fluazifop-butyl 0.5 kg/ha and above. In contrast to paraquat the effect of fluazifop-butyl on grasses was slow and took 25-30 days for total effect to be evident.

Visual assessments revealed no ill effects on white clover from fluazifop-butyl at any stage following treatment. On all trials yields were significantly higher than untreated. On two sites fluazifop-butyl recorded higher yields and on one an inferior yield to paraquat. Superior activity from fluazifop-butyl on couch was reflected in significant yield advantages over paraquat.

Fluazifop-butyl would offer growers a late season treatment with greater clover selectivity than the current standard paraquat. It also offers very useful suppressant activity against couch for the period the crop is in seed production.

TABLE 1: Control of various grasses in white clover seed crops

Date of treatment		4.11.81		19.10.81		28.10.81	
Main grasses present and stage of growth		'Tama' ryegrass 25cm — early seedhead		'Nui' ryegrass vegetative		couch, canary grass vegetative	
		Clover yield % of UT		Clover yield % of UT		Clover yield % of UT	
Treatment	Rate kg/ha	% Tama control DAT* 31	% of UT	% Nui control 93	% of UT	% couch control 31	% of UT
untreated	-	0	100 c	0	100 cd	0	0
fluazifop-butyl	0.25	93	168 b	-	-	-	-
fluazifop-butyl	0.375	-	-	100	123 ab	-	-
fluazifop-butyl	0.5	100	183 b	100	144 a	98	74
fluazifop-butyl	0.625	-	-	100	119 bc	-	-
fluazifop-butyl	1.0	100	187 ab	-	-	98	80
fluazifop-butyl	1.5	-	-	-	-	98	88
paraquat	0.6	100	210 a	95	84 d	20	0
CV %			9.1		12.4		23.9
Yield of untreated			160 kg/ha		237 kg/ha		12 kg/ha

* Days after treatment

Peas and sugar beet

Table 2 shows fluazifop-butyl to have provided near complete control of wild oats at rates from 0.12 kg/ha when applied at growth stages Feekes 1-10. Whilst this latitude would allow greater flexibility in time of spraying it would be preferable to control the weed before it exerted any competition to the crop.

No phytotoxicity from fluazifop-butyl was seen on either peas or sugar beet at any time throughout the trials, and for peas was reflected in yields similar to untreated.

TABLE 2: Wild oat control in peas and sugar beet.

Date of treatment Crop Wild oats	Peas						Sugar Beet
	Trial 1 - 1979			Trial 2 - 1980			Trial 1 - 1981
	21 Dec 5-7 node Feekes 1-2	11 Nov 5-6 node Feekes 1-2		18 Dec 14 node Feekes 6-7			17 Dec 8-10 node Feekes 3-10
Treatment	Rate kg/ha	% control wild oats 9 weeks	wild oat panicles 1m ² /plot 11 weeks	pea seed yield t/ha	wild oat panicles 1m ² /plot 6 weeks	pea seed yield t/ha	% control wild oats 7 weeks
untreated	-	0	31.0	3.16 b	31.0	3.43	0
fluazifop-butyl	0.12	95	0.2	3.58 ab	0	3.42	90
fluazifop-butyl	0.19	-	-	-	-	-	100
fluazifop-butyl	0.25	98	0	3.51 ab	0	3.44	100
fluazifop-butyl	0.37	100	0	3.66 a	-	-	100
CV %				7.46			

Onions

The results in Table 3 show complete control of prairie grass at rates of fluazifop-butyl 0.25 kg/ha and above. Control was equivalent whether sprayed on to young seedlings or plants approaching seedhead emergence. Yield results indicate the best time of application was when the weeds were at the seedling stage and before competition was exerted on the crop. Yields show a significant increase on all fluazifop-butyl rates and reflect the competitive capability of prairie grass. Trial 2, although terminated before total effect could be accurately measured, shows fluazifop-butyl to have a high degree of activity on Mercer grass at rates of 0.5 kg/ha and above. Yields on all rates of fluazifop-butyl were comparable to untreated and thus demonstrate onion tolerance to this chemical.

TABLE 3: Grass weed control in onions

Date of treatment Crop Grasses	Trial 1 - 1981				Trial 2 - 1981		
	27 Aug (1st TOA) "flag" stage	12 Oct (2nd TOA) early-mid bulb formation			30 Dec mid-bulb formation		
	4-12 leaf	"boot" stage			vegetative		
Treatment	Rate kg/ha	% control prairie grass 13 weeks	onion yield t/ha 20 weeks	% control prairie grass 9 weeks	onion yield t/ha 13 weeks	% chemical effect on Mercer grass 4 weeks	onion yield t/ha 7 weeks
untreated	-	0	0.8 b	0	0	0	33.8 a
fluazifop-butyl	0.25	100	21.2 a	100	16.3 a	60	39.3 a
fluazifop-butyl	0.50	100	21.2 a	100	16.5 a	73	39.4 a
fluazifop-butyl	0.75	100	24.2 a	100	14.5 a	78	37.1 a
fluazifop-butyl	1.00	100	27.8 a	100	15.0 a	80	43.3 a
CV %			24.9		52.4		11.5

Asparagus

Data from Trial 1 and 3 in Table 4 shows complete control of crowfoot grass from fluazifop-butyl 0.25 kg/ha in both seedling and established asparagus. Paspalum was also controlled with 0.25 kg/ha in Trials 1 and 2, although a trace amount of regrowth was noted at all rates. No chemical effect on the crop was observed at any time.

Buttercup squash

A moderate level of green bristle grass control was achieved by fluazifop-butyl 0.5 and 0.75 kg/ha as shown in Table 4. It was observed that the young seedlings growing in the cultivated area between the rows were killed by rates of 0.5 kg/ha and above whereas many larger plants within the row regrew. Several factors could account for the regrowth and include 'sheltering' by the squash plants or a more advanced stage of green bristle grass development at the time of treatment.

Yield data shows a significant response to fluazifop-butyl 0.5-0.75 kg/ha compared to untreated.

TABLE 4: Grass weed control in asparagus and buttercup squash.

Date of treatment Crop Grasses	Rate kg/ha	Asparagus — 1981-82				Squash 1981	
		Trial 1 6 Feb 1982 seedlings	Trial 2 23 Dec 1981 early fern	Trial 3 8 Jan 1982 full fern		Trial 1 30 Dec 1981 early runner	
		early tillering	crown regrowth	vegeta- tive	seedhead stage	4-8 leaf to early tillering	
Treatment		% control				Yield in	
		crowfoot 10 weeks	paspalum 17 weeks	paspalum 17 weeks	crowfoot 15 weeks	green bristle grass 6 weeks	t/ha 6 weeks
untreated	-	0	0	0	0	0	21.7 b
fluazifop-butyl	0.25	100	96	92	100	28	23.1 b
fluazifop-butyl	0.50	100	98	94	100	70	26.5 a
fluazifop-butyl	0.75	100	99	99	100	80	24.9 a
fluazifop-butyl	1.00	100	100	99	100	-	-
CV %							11.9

Weed control in fruit crops

The data in Table 5, Trial 1 shows an almost complete kill of barnyard grass 3 weeks after application with all rates in the 1st time of application (TOA). Subsequent germination and emergence of new plants occurred after this assessment and resulted in a loss of control. A soil residual life which suppressed germination for approximately 3 weeks was noted on the 0.75 and 1.0 kg/ha rates. The second TOA gave adequate knockdown of plants in early seedhead development but the level of control was inferior to the 1st TOA. Some regrowth occurred at nodes and tillers on the 2nd TOA from 4 weeks after treatment particularly at lower rates.

Paspalum control was initially very high at both times of application but slowly declined over several months due to regrowth from crowns. The amount of regrowth was relative to rate with the highest recovery occurring at 0.25 kg/ha and only slight recovery at 1.0 kg/ha. Application to early paspalum growth, provided a higher degree of control than when applied to full vegetative growth. This is at variance with paspalum results in asparagus, which showed a high level of control when treated at an advanced vegetative stage. Fluazifop-butyl is known to perform better in conditions of high soil and air humidity. Such conditions existed in Hastings in mid October when the 1st TOA was applied but conditions were dry by the 2nd TOA and thus effectiveness was reduced. In the Waikato trials, high atmospheric and soil humidity persisted most of the summer and hence a better result was obtained. Fluazifop-butyl 0.5-1.0 kg/ha has demonstrated a high level of activity on paspalum with best results when applied under good growth conditions.

TABLE 5: Grass weed control in fruit crops and vineyards

Date of treatment	Apples		Nectarines		Vineyards			
	Trial 1—1981		Trial 2—1981		Trial 3—1981			
	3 Nov	22 Dec	13 Oct	24 Nov	23 Dec		24 Nov	
		seedhead	early	full	vegeta-	tiller-		
Grasses	2-4 leaf	formation	regrowth	regrowth	tive	ing		
Treatment	Rate kg/ha	barnyard grass		paspalum		Indian	summer	Grape
		% control 3 weeks	% control 4 weeks	% control 16 weeks	% control 16 weeks	doab % control 12 weeks	grass % control 14 weeks	Yield in kg/plot 14 weeks
untreated		0	0	0	0	0	0	18.3 a
fluazifop-butyl	0.25	93	73	86	62	25	60	-
fluazifop-butyl	0.50	95	85	88	74	50	85	-
fluazifop-butyl	0.75	100	88	96	70	90	90	-
fluazifop-butyl	1.00	100	90	94	92	95	95	23.0 a
LSD 5%								9.29

A high level of summer grass control was obtained by fluazifop-butyl 0.5-1.0 kg/ha on the vineyard trial but some older plants present at the time of the treatment regrew from nodes and tillers, particularly on the 0.25 kg/ha rate. A soil residual effect from the chemical was noted on all rates and persisted for about three weeks, thus preventing most seedling germination within that period. Indian doab was well controlled at rates of 0.75-1.0 kg/ha, the foliage slowly turning brown and collapsing. No phytotoxicity was observed on grape suckers that were sprayed and the yield was unaffected.

Crop tolerance trials

Constraints on the length of this paper do not allow the results to be presented in Tabular form. Capsicums, tomatoes, kumara, potatoes, butternuts, strawberries, apples, black currants, raspberries, willows and poplars showed no sign of phytotoxicity at 0.5-1.0 kg/ha, and this was reflected in statistically comparable yields or growth increments to untreated. Peaches, however, exhibited a slight leaf burn following treatment. The burn was evident mainly on the edges and tips of the lower leaves and probably resulted from the effect of hot weather ($>26^{\circ}\text{C}$) and high light intensity interacting with the emulsifiers and solvents in the formulation. Whilst this had no significant check on growth it would be prudent not to apply the chemical to sensitive species during such conditions.

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