AGRICULTURAL RESEARCH COUNCIL

WEED RESEARCH ORGANIZATION

TECHNICAL REPORT No. 34

THE ACTIVITY AND PRE-EMERGENCE SELECTIVITY OF SOME RECENTLY DEVELOPED HERBICIDES:

TRIFLURALIN
ISOPROPALIN
ORYZALIN
DINITRAMINE
BIFENOX
PERFLUIDONE

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November 1974

Price

UK and overseas surface mail - £2.50
Overseas airmail - £2.76

BEGBROKE HILL, YARNTON, OXFORD

CONTENTS

NOTE

RICHARDSON, W.G. and DEAN, M.L. The activity and pre-emergence selectivity of some recently developed herbicides: trifluralin, isopropalin, oryzalin, dinitramine, bifenox and perfluidone. Tech. Rep. agric. Res. Coun. Weed Res. Orgn., 1974, 34, pp 58.

NOTE

MBR 8251 HAS BEEN USED THROUGHOUT THE TEXT OF THIS REPORT BUT SHOULD NOW BE READ AS PERFLUIDONE, THE COMMON NAME RECENTLY APPROVED BY BSI FOR THIS HERBICIDE

ISBN 0 902290 91 6

THE ACTIVITY AND PRE-EMERGENCE SELECTIVITY OF SOME RECENTLY DEVELOPED HERBICIDES: TRIFLURALIN, ISOPROPALIN, ORYZALIN, DINITRAMINE, BIFENOX AND MBR 8251

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SUMMARY

Six recently developed herbicides were tested on six species for their soil and foliar activity and subsequently on a range of 31 temperate and 17 tropical crops and weeds to determine pre-emergence selectivity following soil incorporation. The persistence of biological activity in the soil was also examined.

Trifluralin was included for comparison with three similar herbicides, isopropalin, oryzalin and dinitramine. All four compounds controlled annual grasses and certain broad-leaved weeds, notably Convolvulus arvensis, while a range of broad-leaved crops were tolerant. Isopropalin was not as active as trifluralin and the potential selectivities were not outstanding. Crop tolerance to oryzalin was generally lower than with trifluralin except for the large seeded temperate legumes. Few potential selectivities were found with oryzalin and annual grass weed control was not so good as with trifluralin. Dinitramine gave slightly more efficient weed control than trifluralin but crop tolerance was not so great. The shorter period of soil persistence of dinitramine compared to the relatively long period of the other three compounds, is a potential advantage.

Bifenox had an interesting weed control spectrum which included composites, Convolvulus arvensis and Cyperus esculentus, but the resistance of Stellaria media was a serious disadvantage. Potential selectivities were found in certain leguminous and cereal crops.

Brassica and large seeded leguminous crops were highly tolerant of MBR 8251 while excellent grass and perennial weed control was obtained, including the Cyperaceae and Allium vineale.

INTRODUCTION

The pre-emergence selectivities of new herbicides are investigated by the Herbicide and Tropical Weeds Groups of the Weed Research Organization, on a large number of pot-grown crop and weed species. The objectives are to investigate the susceptibility of weeds and crops and to discover selectivities between them, and to obtain experience of the type of effects produced by each compound. Soil persistence is also monitored and this information, in conjunction with crop susceptibilities, is of value in considering subsequent cropping of treated land. Attention is drawn to the limitations of these investigations such as the use of only one crop variety or source of weed species and growth in one particular soil type at only one depth of sowing without intraspecific competition. Consequently the results should only be used as a guide for further work, as plant responses in pot experiments can be very different to those in the field.

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The present report gives pre-emergence selectivity data on five new herbicides plus trifluralin which was included for comparison with isopropalin, oryzalin and dinitramine. Results of activity experiments are also included to provide information on levels of phytotoxicity, types of effect and route of action. The corresponding information for bifenox was published in a previous report (Richardson and Dean, 1973b).

MATERIALS AND METHODS

These were similar to previous trials. The activity experiments (AE) were carried out on six selected species, four being raised from seeds and two perennial species from rhizome fragments. Herbicides were applied by four different methods (Richardson and Dean, 1973a). Species data are summarised in Table 1 and soil and environmental conditions in Table 2.

Table 1. Plant data for activity experiments

	Cultivar /Source	No. per pot at spraying		Depth of planting (cm)	Stage of growth of post-emergence treatments	Stage of growth at assessment	
		pre-	post-			pre-	post-
Dwarf bean (*Phaseolus vulgaris*)	The Prince	3	2	1.8	2 unifoliate leaves	1-1½ trifoliate leaves	1½-2 trifoliate leaves
Kale (*Brassica oleracea acephala*)	Green Marrow-stem	10-15	3-5	0.6	½-2 leaves	3½ leaves	3½ leaves
Polygonum amphibium	WRO Clone 1	6	5	1.2	3½-4 leaves	5-6 leaves	6½-7 leaves
Perennial ryegrass (*Lolium perenne*)	S 23	10-20	10	0.6	1½-2 leaves	5-7 leaves tillering	6½ leaves tillering
Avena fatua	Boxworth 1967	9	5	1.2	2-2½ leaves	4½-5 leaves tillering	4-7 leaves tillering
Agropyron repens	WRO Clone 31	6	5	1.2	2½-3 leaves	3½-6 leaves some tillering	5-8 leaves tillering

Techniques for the selectivity experiment were the same as reported by Richardson and Dean (1973a). Soil and environmental conditions are summarised in Table 2 and plant data in Table 3. Radish (*Raphanus* *raphanistrum*) was included for ease of propagation and may be regarded as a crop or weed. To improve germination *Chenopodium album* seeds were rubbed with sand paper; seeds of *Chrysanthemum segetum* were pricked; tubers of *Cyperus esculentus* were stored moist at 4°C for 23 days to break dormancy; *Rottboellia exaltata* seeds were soaked for 48-72 hours in water and those which sank were lightly crushed. Freshly harvested bulbils of *Oxalis latifolia* were stored at 20°C for 4 weeks followed by heating at 45°C for 4 hours. During the experiment normal daylight was supplemented with a 14 hour photoperiod using warm white fluorescent tubes or mercury vapour lamps.

Table 2. Soil and environmental conditions

Herbicides included	AE 1 trifluralin isopropalin oryzalin dinitramine	AE 2 MBR 8251	Pre-emergence selectivity experiment trifluralin isopropalin oryzalin	 dinitramine bifenox MBR 8251
Date of spraying	14/5/71	14/4/72	23/2/72	
Main assessment completed	8/6/71	18/5/72	7/4/72	
Soil moisture at spraying (%)	-	13.0	14.0	
Organic matter (%)	2.8	2.8	2.8	
Clay content (%)	16.0	16.0	16.0	
pH	7.7	7.7	7.7	
John Innes Base fertiliser (g/kg)	4.0	4.0	1.0	
5% DDT dust (g/kg)	0.5	0.5	0.5	
Fritted trace elements (g/kg)	-	0.25	-	
			Temperate	Tropical
Temperature (°C)				
Mean	18	18	18	25
Maximum	28	27	30	31
Minimum	13	8	10	12
Relative humidity (%)				
Mean	65	60	60	65
Maximum	95	90	88	95
Minimum	34	25	26	32

In all experiments surviving plants were counted and their vigour was scored on a 0-7 scale as defined by Richardson and Dean (1973a). Histograms were prepared from these results and a computer was used to process the selectivity experiment data as before (Richardson and Dean, 1973a). For each treatment a histogram is presented which includes a pair of figures; the upper figure represents mean plant survival and the lower, mean vigour score, both calculated as percentage of untreated controls.

The same information is displayed as a histogram where each 'x' represents a 5% increment except in the activity experiment results where each 'X' represents a 7% increment. A '+' indicates a value in excess of 100%; 'R' indicates a result based on one replicate only and 'M' represents a missing treatment.

It was not possible to computerise the results for Senecio vulgaris because of erratic germination. Veronica persica germinated successfully but many plants died back from the cotyledon leaf stage because of a damping-off type of syndrome. Maize and Rottboellia exaltata suffered from mouse damage at emergence but sufficient plants survived for assessment to be possible.

A table of potential selectivities, using the criteria specified, are presented for each compound with comments to highlight salient points.

Soil persistence was monitored, in conjunction with the pre-emergence selectivity experiment by storing moist treated soil at 23°C and assaying at intervals with a suitable sensitive test species (Richardson and Dean, 1973a).

Table 3. Species, abbreviations, cultivars and stage of growth at assessment for pre-emergence selectivity experiment

	Designation and computer serial number	Cultivar or source	No. per pot	Depth of planting (cm)	Stage of growth at assessment (untreated controls, leaf numbers exclusive of cotyledons)
Temperate species					
Wheat (Triticum aestivum)	WHEAT (1)	Kolibri	8	1.2	4 leaves
Barley (Hordeum vulgare)	BARLEY (2)	Sultan	8	1.2	4 leaves
Oat (Avena sativa)	OAT (3)	Condor	8	1.2	4 leaves
Perennial ryegrass (Lolium perenne)	PER RYGR (4)	S23	15	0.6	4½ leaves, tillering
Onion (Allium cepa)	ONION (8)	Ailsa Craig	15	0.6	1½-2½ leaves
Dwarf bean (Phaseolus vulgaris)	DWF BEAN (9)	The Prince	3	1.8	1½ trifoliate leaves
Field bean (Vicia faba)	FLD BEAN (10)	Maris Bead	4	1.8	3-4½ leaves

Table 3 (continued)

	Designa-tion and computer serial number	Cultivar or source	No. per pot	Depth of plant-ing (cm)	Stage of growth at assessment (untreated controls, leaf numbers exclusive of cotyledons)
Pea (*Pisum sativum*)	PEA (11)	Dark Skinned Perfection	4	1.8	5½-6½ leaves
White clover (*Trifolium repens*)	W CLOVER (12)	S100	20	0.6	3 trifoliate leaves
Tomato (*Lycopersicon esculentum*)	TOMATO (14)	Ailsa Craig	10	0.6	2½ leaves
Kale (*Brassica oleracea acephala*)	KALE (15)	Green Marrowstem	10	0.6	2½-3½ leaves
Swede (*Brassica napus*)	SWEDE (17)	Lord Derby	10	0.6	2½-3½ leaves
Carrot (*Daucus carota*)	CARROT (18)	Chantenay Red Core	10	0.6	3½-4 leaves
Lettuce (*Lactuca sativa*)	LETTUCE (20)	Borough Wonder	15	0.6	4 leaves
Sugar beet (*Beta vulgaris*)	SUG BEET (21)	Klein Monogerm	15	1.2	3½ leaves
Avena fatua	AVE FATU (26)	Boxworth 1967	8	1.2	3½-4 leaves
Alopecurus myosuroides	ALO MYOS (27)	Rothamsted 1968	30	0.6	5 leaves, tillering
Poa annua	POA ANN (28)	WRO 1966	25	0.2	5 leaves, tillering
Sinapis arvensis	SIN ARV (30)	WRO 1966	15	0.6	4½-5 leaves
Raphanus raphanistrum	RAPH RAP (31)	Wood's Frame	10	0.6	2½-3 leaves
Chrysanthemum segetum	CHRY SEG (32)	WRO 1971	20	0.3	6½ leaves
Tripleurospermum maritimum	TRIP MAR (33)	WRO 1967	25	Surface	6½ leaves

Table 3 (continued)

	Designation and computer serial number	Cultivar or source	No. per pot	Depth of planting (cm)	Stage of growth at assessment (untreated controls, leaf numbers exclusive of cotyledons)
Senecio vulgaris	SEN VULG (34)	WRO 1967	25	0.6	Erratic germination
Polygonum lapathifolium	POL LAPA (35)	WRO 1970	15	0.6	3½-4 leaves
Galium aparine	GAL APAR (38)	WRO 1970	12	0.6	3-4 whorls
Chenopodium album	CHEN ALB (39)	WRO 1971	25	0.6	6 leaves
Stellaria media	STEL MED (40)	WRO 1970	20	0.6	8-10 leaves
Veronica persica	VER PERS (42)	WRO 1972	20	0.6	Diseased
Agropyron repens	AG REPEN (47)	WRO Clone 31	6†	1.2	4-5 leaves, tillering
Allium vineale	ALL VIN (49)	WRO 1971	6*	1.2	2-2½ leaves
Cirsium arvense	CIRS ARV (50)	WRO Clone 1	4††	1.2	5-6 leaves
Tussilago farfara	TUS FARF (51)	WRO Clone 1	4†	1.8	4½-5 leaves
Convolvulus arvensis	CONV ARV (52)	WRO Clone 1	4††	1.2	6-8 leaves
Tropical species (grown under higher of temperature regimes)					
Maize (Zea mays)	MAIZE (58)	Inra 200	6	1.8	5-5½ leaves
Sorghum (Sorghum bicolor)	SORGHUM (59)	Fetereita	8	1.2	5½ leaves
Rice (Oryza sativa)	RICE (60)	Kogbandi	10	1.2	3-4 leaves
Groundnut (Arachis hypogea)	GRNDNUT (64)	Natal Common	4	1.8	4½-5½ trifoliate leaves

Table 3 (continued)

	Designation and computer serial number	Cultivar or source	No. per pot	Depth of planting (cm)	Stage of growth at assessment (untreated controls, leaf numbers exclusive of cotyledons)
Soyabean (<u>Glycine max</u>)	SOYABEAN (65)	Wayne	6	1.2	1½-2½ trifoliate leaves
Cotton (<u>Gossypium hirsutum</u>)	COTTON (66)	26J	6	1.8	2-2½ leaves
Jute (<u>Corchorus olitorius</u>)	JUTE (67)	Egypt 1971	20	0.6	3½-5 leaves
Kenaf (<u>Hibiscus cannabinus</u>)	KENAF (68)	Thai Native	10	0.6	2-3 leaves
Sesamum (<u>Sesamum indicum</u>)	SESAMUM (70)	Addis Ababa 1970	10	0.6	2-4 leaves
<u>Eleusine indica</u>	ELEU IND (74)	WRO 1964	15	0.6	5-6½ leaves
<u>Echinochloa crus-galli</u>	ECH CRUS (75)	WRO 1969	15	0.6	4½-5 leaves
<u>Rottboellia exaltata</u>	ROT EXAL (76)	Rhodesia 1971	30	0.6	4-4½ leaves
<u>Digitaria sanguinalis</u>	DIG SANG (77)	WRO 1968	20	0.6	3½-5 leaves
<u>Amaranthus retroflexus</u>	AMAR RET (78)	WRO 1968	15	0.3	5-6 leaves
<u>Cyperus esculentus</u>	CYP ESCU (85)	WRO Clone 2 (ex South Africa)	5**	1.8	3½-7½ leaves/shoot
<u>Cyperus rotundus</u>	CYP ROTU (86)	WRO Clone 1 (ex Rhodesia)	5**	1.8	8½-9½ leaves/shoot
<u>Oxalis latifolia</u>	OXAL LAT (87)	WRO Clone 2 (ex Cornwall)	14 bulbs	1.2	1-6 leaves

≠ one node rhizome fragments
≠≠ 4 cm root fragments

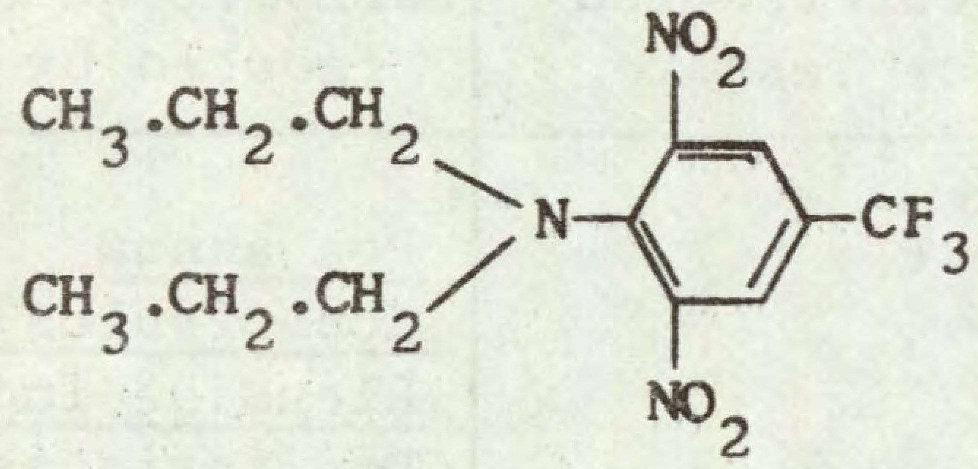
* serial bulbils
** tubers

TRIFLURALIN

Code number L 36352 Trade name Treflan

Chemical name 2,6-dinitro-N,N-dipropyl-4-trifluoromethylaniline

Structure



Source Lilly Research Centre Ltd
Erl Wood Manor
Windlesham
Surrey

Information available and suggested uses

Manufacturer's literature over many years reports control of annual grass and broad-leaved weeds, following pre-emergence incorporation. The herbicide must be incorporated immediately after application. Tolerant crops include cotton, soyabeans and safflower (both for seed only), commercial gladioli and established ornamentals. Weed control in transplanted brassica crops, dwarf beans, sugar beet and the control of Oxalis spp. has been summarised by Smith and Day (1967). Ford and Massey (1971) have compared the characteristics of trifluralin with some related dinitro-aniline herbicides.

Formulation used 48% w/v a.i. emulsifiable concentrate

Spray volume for activity experiment 388 l/ha (34.5 gal/ac)
for selectivity experiment 352 l/ha (31.3 gal/ac)

RESULTS

Full histogram results are given on pages 12-16 and potential selectivities are summarised in the following Table.

RATE (kg ai/ha)	CROPS: vigour reduced by 15% or less	WEEDS: number or vigour reduced by 70% or more
4.00	carrot	Polygonum lapathifolium Agropyron repens Cirsium arvense Rottboellia exaltata + species below
1.00	species above + kale radish groundnut soyabean cotton	Avena fatua Alopecurus myosuroides Chenopodium album Stellaria media Echinochloa crus-galli Amaranthus retroflexus Oxalis latifolia + species below

(Table continued overleaf)

RATE (kg ai/ha)	CROPS: vigour reduced by 15% or less	WEEDS: number or vigour reduced by 70% or more
0.25	species above + wheat barley onion dwarf bean field bean pea white clover tomato swede lettuce maize kenaf sesamum	Poa annua Convolvulus arvensis Eleusine indica Digitaria sanguinalis

Comments on results

General

Trifluralin was included as a standard for comparison with the chemically related isopropalin, oryzalin and dinitramine. In the activity experiment, phytotoxicity was caused mainly by the soil treatments, especially pre-emergence applications. Greater activity was found following incorporation, particularly with the perennial and large seeded species. In a separate experiment using soil thin-layer chromatography plates, the mobility of trifluralin was low and very similar to isopropalin, oryzalin and dinitramine.

In the selectivity experiment, annual grass weeds were well controlled. Some dicotyledonous species were also susceptible, particularly Convolvulus arvensis and Oxalis latifolia. Several crops were tolerant, most notably carrot.

Symptoms

The activity experiment foliar spray caused only minor contact scorch and necrosis on kale and dwarf bean at the higher doses. This may have been due to the formulation solvent. Post-emergence soil drenches inhibited growth of Avena fatua and perennial ryegrass and their foliage became darker green. Roots of kale were inhibited resulting in a tendency for plants to fall over at soil level. Grasses failed to emerge from the soil or to develop beyond the coleoptile stage at higher pre-emergence doses, while at low rates leaves emerged but were generally stunted and darker green. Susceptible broad-leaved species usually emerged but were severely inhibited with darker green deformed leaves and stunted roots.

Temperate weeds and crops

The small seeded Poa annua was controlled at 0.25 kg/ha and the larger seeded Alopecurus myosuroides and Avena fatua at 1.00 kg/ha. Agropyron repens was susceptible at 4.00 kg/ha and rhizome fragments replanted in untreated soil failed to develop. There was however eventual recovery from the initial severe effects at 1.00 kg/ha. Only three annual broad-leaved weeds were controlled and the cruciferous weeds were notably resistant. The eventual kill of all root fragments of Convolvulus arvensis, even at 0.25 kg/ha, was most impressive. Tussilago farfara and Allium vineale were resistant but root fragments of Cirsium arvense eventually rotted after treatment with 4.00 kg/ha.

Carrot was outstandingly tolerant at 4.00 kg/ha. Kale and radish were resistant at 1.00 kg/ha and all other broad-leaved crops, with the exception of sugar beet, were tolerant to 0.25 kg/ha. Perennial ryegrass was particularly susceptible and the cereals only showed resistance at the lowest dose.

The potential selective control of annual grass weeds in kale and radish was noted. The perennials A. repens and C. arvense were susceptible at rates where carrot was resistant. The sensitivity of C. arvensis at doses tolerated by these and other crops was most impressive.

Tropical weeds and crops

The annual tropical grasses were killed at 1.00 kg/ha with the exception of Rottboellia exaltata which, although severely reduced, was recovering from 4.00 kg/ha. Digitaria sanguinalis and Eleusine indica were controlled at 0.25 kg/ha and did not emerge at 1.00 kg/ha. Amaranthus retroflexus was controlled at 1.00 kg/ha although some plants still produced inflorescences. There was little effect on the perennial Cyperus spp. but Oxalis latifolia had not emerged at 1.00 kg/ha four weeks after planting. Nine weeks after treatment some plants were beginning to grow at this dose, albeit stunted, while at 4.00 kg/ha severely deformed leaves were just emerging. These results on O. latifolia are similar to those reported by Dean and Parker (1971).

Crops were only tolerant up to 1.00 kg/ha where soyabean, cotton and particularly groundnut were resistant. Maize only suffered minor damage at this dose and was recovering at assessment. All crops tested showed some tolerance at 0.25 kg/ha with the exception of sorghum and rice. The former was particularly susceptible.

Potential selective control of certain annual grasses was obtained in maize, kenaf, sesamum, groundnut, soyabean and cotton. The latter three crops were also resistant at rates where A. retroflexus and O. latifolia were controlled.

Soil persistence

The long persistence of trifluralin in the soil was confirmed using perennial ryegrass as a test species. Although 0.25 kg/ha could not be detected 33 weeks after treatment, doses of 1.00 and 4.00 kg/ha were still causing 84 and 98% fresh weight reductions respectively, 54 weeks after application.

Degradation by photodecomposition and volatilization has been reported by Wright and Warren (1965) and by Bardsley et al. (1968). More recently the work of Parr and Smith (1973) has shown that microbiological degradation can take place and that decomposition can occur by different pathways depending on whether soil conditions are aerobic or anaerobic.

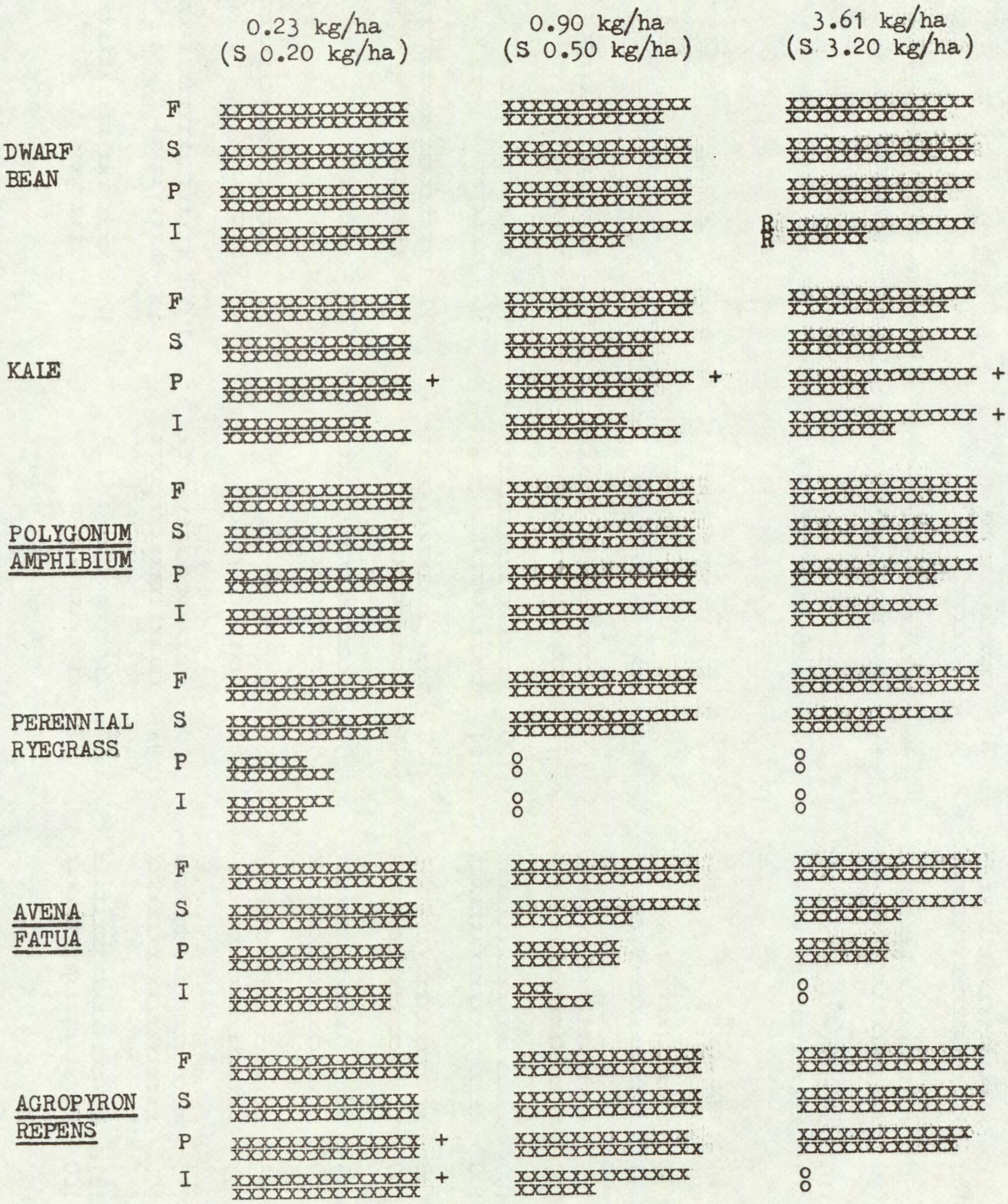
Possible uses and further testing

Trifluralin has been extensively field tested and is well established for the selective control of annual grass weeds in certain crops. This trial shows its activity against Convolvulus arvensis which deserves further investigation under European conditions. Other reports have shown a similar result particularly when applied as a sub-surface layer (Agamalian and Kempen, 1971, Agamalian et al., 1972, Lange et al., 1972 and Warner, 1973).

Activity against Oxalis latifolia was good, and this may be a potential use for trifluralin in certain crops. Increasing the selectivity in maize, sorghum and rice against annual grass weeds is worth further investigation, possibly using a seed protectant.

ACTIVITY EXPERIMENT

TRIFLURALIN



Key: F = post-emergence, foliar application
S = post-emergence, soil drench
P = pre-emergence, surface film
I = pre-planting, incorporated

SPECIES	TRIFLURALIN 0.25 KG/HA		TRIFLURALIN 1.00 KG/HA		TRIFLURALIN 4.00 KG/HA	
WHEAT	91	xxxxxxxxxxxxxxxxxx	72	xxxxxxxxxxxxxx	0	
(1)	100	xxxxxxxxxxxxxxxxxxxx	50	xxxxxxxxxx	0	
BARLEY	96	xxxxxxxxxxxxxxxxxxx	96	xxxxxxxxxxxxxxxxxxx	89	xxxxxxxxxxxxxxxxxx
(2)	100	xxxxxxxxxxxxxxxxxxxx	71	xxxxxxxxxxxxxx	43	xxxxxxxxx
OAT	110	xxxxxxxxxxxxxxxxxxxx +	22	xxxx	0	
(3)	79	xxxxxxxxxxxxxxxx	50	xxxxxxxxxx	0	
PER RYGR	4	x	0		0	
(4)	14	xxx	0		0	
ONION	94	xxxxxxxxxxxxxxxxxxx	9	xx	0	
(8)	93	xxxxxxxxxxxxxxxxxxx	14	xxx	0	
DWF BEAN	100	xxxxxxxxxxxxxxxxxxxx	100	xxxxxxxxxxxxxxxxxxxx	83	xxxxxxxxxxxxxxxxx
(9)	100	xxxxxxxxxxxxxxxxxxxx	79	xxxxxxxxxxxxxxxx	36	xxxxxxx
FLD BEAN	100	xxxxxxxxxxxxxxxxxxxx	100	xxxxxxxxxxxxxxxxxxxx	75	xxxxxxxxxxxxxxx
(10)	100	xxxxxxxxxxxxxxxxxxxx	64	xxxxxxxxxxxxx	36	xxxxxxx
PEA	90	xxxxxxxxxxxxxxxxxx	120	xxxxxxxxxxxxxxxxxxxx +	90	xxxxxxxxxxxxxxxxxx
(11)	100	xxxxxxxxxxxxxxxxxxxx	71	xxxxxxxxxxxxxx	36	xxxxxxx
W CLOVER	115	xxxxxxxxxxxxxxxxxxxx +	90	xxxxxxxxxxxxxxxxxx	29	xxxxxx
(12)	100	xxxxxxxxxxxxxxxxxxxx	57	xxxxxxxxxxx	14	xxx
TOMATO	98	xxxxxxxxxxxxxxxxxxxx	81	xxxxxxxxxxxxxxxx	98	xxxxxxxxxxxxxxxxxxxx
(14)	93	xxxxxxxxxxxxxxxxxxx	64	xxxxxxxxxxxxx	43	xxxxxxxxx
KALE	118	xxxxxxxxxxxxxxxxxxxx +	118	xxxxxxxxxxxxxxxxxxxx +	100	xxxxxxxxxxxxxxxxxxxx
(15)	100	xxxxxxxxxxxxxxxxxxxx	93	xxxxxxxxxxxxxxxxxxx	43	xxxxxxxxx
SWEDE	131	xxxxxxxxxxxxxxxxxxxx +	37	xxxxxxx	112	xxxxxxxxxxxxxxxxxxxx +
(17)	100	xxxxxxxxxxxxxxxxxxxx	57	xxxxxxxxxxx	43	xxxxxxxxx

SPECIES	TRIFLURALIN 0.25 KG/HA		TRIFLURALIN 1.00 KG/HA		TRIFLURALIN 4.00 KG/HA	
CARROT	100	xxxxxxxxxxxxxxxxxxxx	112	xxxxxxxxxxxxxxxxxxxx +	94	xxxxxxxxxxxxxxxxxxx
(18)	100	xxxxxxxxxxxxxxxxxxxx	100	xxxxxxxxxxxxxxxxxxxx	100	xxxxxxxxxxxxxxxxxxxx
LETTUCE	105	xxxxxxxxxxxxxxxxxxxx +	112	xxxxxxxxxxxxxxxxxxxx +	71	xxxxxxxxxxxxxx
(20)	100	xxxxxxxxxxxxxxxxxxxx	57	xxxxxxxxxxx	29	xxxxxx
SUG BEET	68	xxxxxxxxxxxxxx	60	xxxxxxxxxxxx	52	xxxxxxxxxx
(21)	71	xxxxxxxxxxxxxx	36	xxxxxxx	29	xxxxxx
AVE FATU	109	xxxxxxxxxxxxxxxxxxxx +	14	xxx	0	
(26)	57	xxxxxxxxxxx	14	xxx	0	
ALO MYOS	54	xxxxxxxxxxx	0		0	
(27)	36	xxxxxxx	0		0	
POA ANN	0		0		0	
(28)	0		0		0	
SIN ARV	120	xxxxxxxxxxxxxxxxxxxx +	114	xxxxxxxxxxxxxxxxxxxx +	90	xxxxxxxxxxxxxxxxxx
(30)	100	xxxxxxxxxxxxxxxxxxxx	100	xxxxxxxxxxxxxxxxxxxx	57	xxxxxxxxxxx
RAPH RAP	107	xxxxxxxxxxxxxxxxxxxx +	102	xxxxxxxxxxxxxxxxxxxx +	96	xxxxxxxxxxxxxxxxxxx
(31)	100	xxxxxxxxxxxxxxxxxxxx	93	xxxxxxxxxxxxxxxxxxx	57	xxxxxxxxxxx
CHRY SEG	53	xxxxxxxxxxx	102	xxxxxxxxxxxxxxxxxxxx +	48	xxxxxxxxxx
(32)	93	xxxxxxxxxxxxxxxxxxx	93	xxxxxxxxxxxxxxxxxxx	50	xxxxxxxxxx
TRIP MAR	84	xxxxxxxxxxxxxxxxx	89	xxxxxxxxxxxxxxxxxx	110	xxxxxxxxxxxxxxxxxxxx +
(33)	100	xxxxxxxxxxxxxxxxxxxx	79	xxxxxxxxxxxxxxxx	43	xxxxxxxxx
POL LAPA	129	xxxxxxxxxxxxxxxxxxxx +	106	xxxxxxxxxxxxxxxxxxxx +	106	xxxxxxxxxxxxxxxxxxxx +
(35)	100	xxxxxxxxxxxxxxxxxxxx	50	xxxxxxxxxx	29	xxxxxx
GAL APAR	100	xxxxxxxxxxxxxxxxxxxx	107	xxxxxxxxxxxxxxxxxxxx +	79	xxxxxxxxxxxxxxxx
(38)	71	xxxxxxxxxxxxxx	57	xxxxxxxxxxx	36	xxxxxxx

SPECIES	TRIFLURALIN 0.25 KG/HA		TRIFLURALIN 1.00 KG/HA		TRIFLURALIN 4.00 KG/HA	
CHEN ALB	89	xxxxxxxxxxxxxxxxxx	11	xx	11	xx
(39)	50	xxxxxxxxxx	29	xxxxxx	14	xxx
STEL MED	61	xxxxxxxxxxxx	8	xx	0	
(40)	50	xxxxxxxxxx	7	x	0	
AG REPEN	69	xxxxxxxxxxxxxx	94	xxxxxxxxxxxxxxxxxxx	0	
(47)	86	xxxxxxxxxxxxxxxxx	43	xxxxxxxxx	0	
ALL VIN	100	xxxxxxxxxxxxxxxxxxxx	100	xxxxxxxxxxxxxxxxxxxx	100	xxxxxxxxxxxxxxxxxxxx
(49)	100	xxxxxxxxxxxxxxxxxxxx	71	xxxxxxxxxxxxxx	57	xxxxxxxxxxx
CIRS ARV	218	xxxxxxxxxxxxxxxxxxxx +	82	xxxxxxxxxxxxxxxx	0	
(50)	100	xxxxxxxxxxxxxxxxxxxx	100	xxxxxxxxxxxxxxxxxxxx	0	
TUS FARF	100	xxxxxxxxxxxxxxxxxxxx	100	xxxxxxxxxxxxxxxxxxxx	100	xxxxxxxxxxxxxxxxxxxx
(51)	100	xxxxxxxxxxxxxxxxxxxx	100	xxxxxxxxxxxxxxxxxxxx	71	xxxxxxxxxxxxxx
CONV ARV	0		0		0	
(52)	0		0		0	
MAIZE	112	xxxxxxxxxxxxxxxxxxxx +	84	xxxxxxxxxxxxxxxxx	56	xxxxxxxxxxx
(58)	100	xxxxxxxxxxxxxxxxxxxx	79	xxxxxxxxxxxxxxxx	50	xxxxxxxxxx
SORGHUM	70	xxxxxxxxxxxxxx	0		0	
(59)	57	xxxxxxxxxxx	0		0	
RICE	82	xxxxxxxxxxxxxxxx	47	xxxxxxxxx	0	
(60)	64	xxxxxxxxxxxxx	29	xxxxxx	0	
GRNDNUT	131	xxxxxxxxxxxxxxxxxxxx +	131	xxxxxxxxxxxxxxxxxxxx +	75	xxxxxxxxxxxxxxx
(64)	100	xxxxxxxxxxxxxxxxxxxx	100	xxxxxxxxxxxxxxxxxxxx	50	xxxxxxxxxx
SOYABEAN	79	xxxxxxxxxxxxxxxx	97	xxxxxxxxxxxxxxxxxxx	97	xxxxxxxxxxxxxxxxxxx
(65)	93	xxxxxxxxxxxxxxxxxxx	86	xxxxxxxxxxxxxxxxx	57	xxxxxxxxxxx

PRE-EMERGENCE SELECTIVITY EXPERIMENT

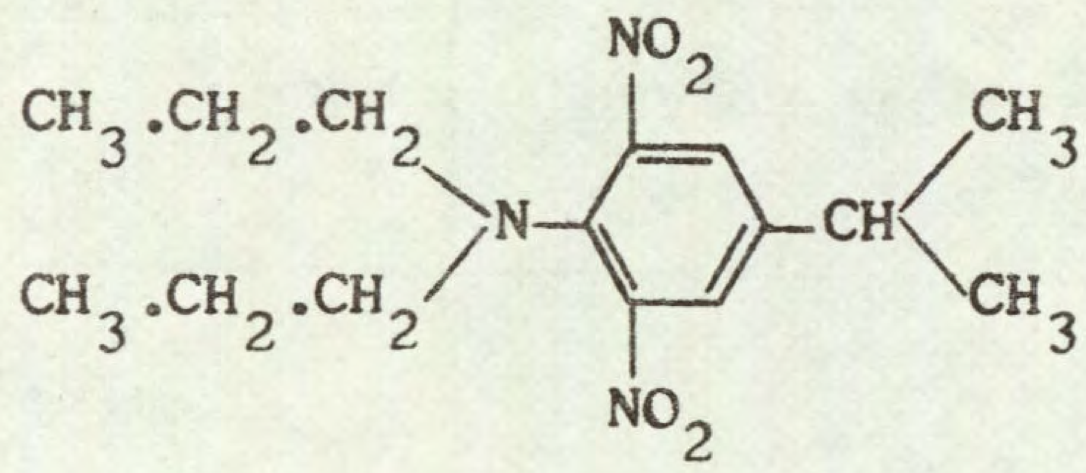
SPECIES	TRIFLURALIN 0.25 KG/HA		TRIFLURALIN 1.00 KG/HA		TRIFLURALIN 4.00 KG/HA	
COTTON	110	xxxxxxxxxxxxxxxxxxxx +	90	xxxxxxxxxxxxxxxxxx	90	xxxxxxxxxxxxxxxxxx
(66)	100	xxxxxxxxxxxxxxxxxxxx	86	xxxxxxxxxxxxxxxxx	57	xxxxxxxxxxx
JUTE	119	xxxxxxxxxxxxxxxxxxxx +	81	xxxxxxxxxxxxxxxx	0	
(67)	79	xxxxxxxxxxxxxxxx	29	xxxxxx	0	
KENAF	98	xxxxxxxxxxxxxxxxxxxx	104	xxxxxxxxxxxxxxxxxxxx +	82	xxxxxxxxxxxxxxxx
(68)	100	xxxxxxxxxxxxxxxxxxxx	71	xxxxxxxxxxxxxx	43	xxxxxxxxx
SESAMUM	137	xxxxxxxxxxxxxxxxxxxx +	150	xxxxxxxxxxxxxxxxxxxx +	0	
(70)	93	xxxxxxxxxxxxxxxxxxx	43	xxxxxxxxx	0	
ELEU IND	0		0		0	
(74)	0		0		0	
ECH CRUS	60	xxxxxxxxxxxx	0		0	
(75)	43	xxxxxxxxx	0		0	
ROT EXAL	87	xxxxxxxxxxxxxxxxx	57	xxxxxxxxxxx	15	xxx
(76)	64	xxxxxxxxxxxxx	50	xxxxxxxxxx	36	xxxxxxx
DIG SANG	11	xx	0		0	
(77)	14	xxx	0		0	
AMAR RET	85	xxxxxxxxxxxxxxxxx	65	xxxxxxxxxxxxx	0	
(78)	50	xxxxxxxxxx	29	xxxxxx	0	
CYP ESCU	90	xxxxxxxxxxxxxxxxxx	110	xxxxxxxxxxxxxxxxxxxx +	40	xxxxxxxx
(85)	100	xxxxxxxxxxxxxxxxxxxx	86	xxxxxxxxxxxxxxxxx	86	xxxxxxxxxxxxxxxxx
CYP ROTU	114	xxxxxxxxxxxxxxxxxxxx +	105	xxxxxxxxxxxxxxxxxxxx +	65	xxxxxxxxxxxxx
(86)	100	xxxxxxxxxxxxxxxxxxxx	100	xxxxxxxxxxxxxxxxxxxx	93	xxxxxxxxxxxxxxxxxxx
OXAL LAT	67	xxxxxxxxxxxxx	0		0	
(87)	57	xxxxxxxxxxx	0		0	

ISOPROPALIN

Code number EL-179 Trade name Paarlan

Chemical name 4-isopropyl-2,6-dinitro-N,N-dipropylaniline

Structure



Source Lilly Research Centre Ltd
Erl Wood Manor
Windlesham
Surrey

Information available and suggested uses

In 1970 the manufacturer reported pre-emergence control of certain annual grasses and a few broad-leaved weeds following incorporation. The weed control and crop tolerance spectrum is similar to that of trifluralin but a greater degree of selectivity is claimed for isopropalin in alfalfa, beans, peppers, tomatoes, peas, potatoes and transplanted tobacco.

Formulation used 72% w/v a.i. emulsifiable concentrate

Spray volume for activity experiment 388 l/ha (34.5 gal/ac)
for selectivity experiment 352 l/ha (31.3 gal/ac)

RESULTS

Full histogram results are given on pages 20-24 and potential selectivities are summarised in the following Table.

RATE (kg ai/ha)	CROPS: vigour reduced by 15% or less	WEEDS: number or vigour reduced by 70% or more
4.00	dwarf bean field bean pea kale carrot radish maize groundnut soyabean cotton	Avena fatua Alopecurus myosuroides Stellaria media Echinochloa crus-galli Amaranthus retroflexus Oxalis latifolia + species below
1.00	species above + wheat barley oat white clover lettuce kenaf	Poa annua Convolvulus arvensis Eleusine indica Digitaria sanguinalis

(Table continued overleaf)

RATE (kg ai/ha)	CROPS: vigour reduced by 15% or less	WEEDS: number or vigour reduced by 70% or more
0.25	None listed as no weeds controlled	None

Comments on results

General

The activity experiment results showed that the type of action was similar to that of trifluralin. The foliar spray caused only minor symptoms on kale and dwarf bean. Most activity occurred with the soil treatments, pre-emergence applications being more active than post-emergence soil drenches. Incorporation generally resulted in greater activity than surface application.

In the selectivity experiment annual grass weeds proved to be particularly susceptible although some annual and perennial broad-leaved species were also controlled, notably Convolvulus arvensis and Oxalis latifolia. Maize, certain temperate and tropical legumes and a number of other crops were resistant and several selectivities were found. Both the trials reported here showed that isopropalin was much less phytotoxic than trifluralin.

Symptoms

Symptoms on susceptible species were generally very similar to those caused by trifluralin. Severe inhibition of grasses occurred soon after germination. The foliage of grasses and broad-leaved species was darker green and root systems were inhibited.

Temperate weeds and crops

Poa annua was controlled at 1.00 kg/ha while Alopecurus myosuroides and Avena fatua were susceptible at 4.00 kg/ha. Stellaria media was the only annual broad-leaved weed to be controlled. Convolvulus arvensis was completely killed at 4.00 kg/ha and 80% of the plants died at 1.00 kg/ha. All other perennial weeds were resistant.

Radish, carrot and all the large seeded leguminous crops were tolerant at 4.00 kg/ha. White clover, lettuce and the cereals, were resistant at 1.00 kg/ha.

Potential selectivities were found in the large seeded legume crops, carrot and certain brassica crops at rates where S. media, C. arvensis and the annual grasses were controlled. At 1.00 kg/ha C. arvensis and P. annua were susceptible, while white clover, lettuce and the cereals were resistant.

Tropical weeds and crops

Digitaria sanguinalis and Eleusine indica were the most susceptible weeds being controlled at 1.00 kg/ha. At 4.00 kg/ha there was no emergence of these weeds and Echinochloa crus-galli was killed. Rottboellia exaltata was particularly resistant however. Amaranthus retroflexus was controlled at 4.00 kg/ha though some survivors were likely to recover. Oxalis latifolia was also controlled at this dose, but nine weeks after treatment leaves were beginning to develop from all bulbs. No effects were observed on the Cyperus spp. tested.

Groundnut, soyabean, maize and cotton were all tolerant at 4.00 kg/ha but were slightly retarded compared with the untreated controls. At 1.00 kg/ha kenaf was resistant while rice, sesamum and sorghum, showed some degree of recovery at assessment.

O. latifolia and A. retroflexus were controlled at 4.00 kg/ha where maize, cotton, groundnut and soyabean were tolerant. Potential selective control of some of the annual grasses was achieved in these crops and in kenaf at 1.00 kg/ha.

Soil persistence

Using perennial ryegrass as the sensitive test species, 4.00 kg/ha of isopropalin was causing an 82% fresh weight reduction 54 weeks after application. At this time 1.00 kg/ha was barely detectable. 0.25 kg/ha was not detected in the initial assay set up at the time of spraying.

Possible uses and further testing

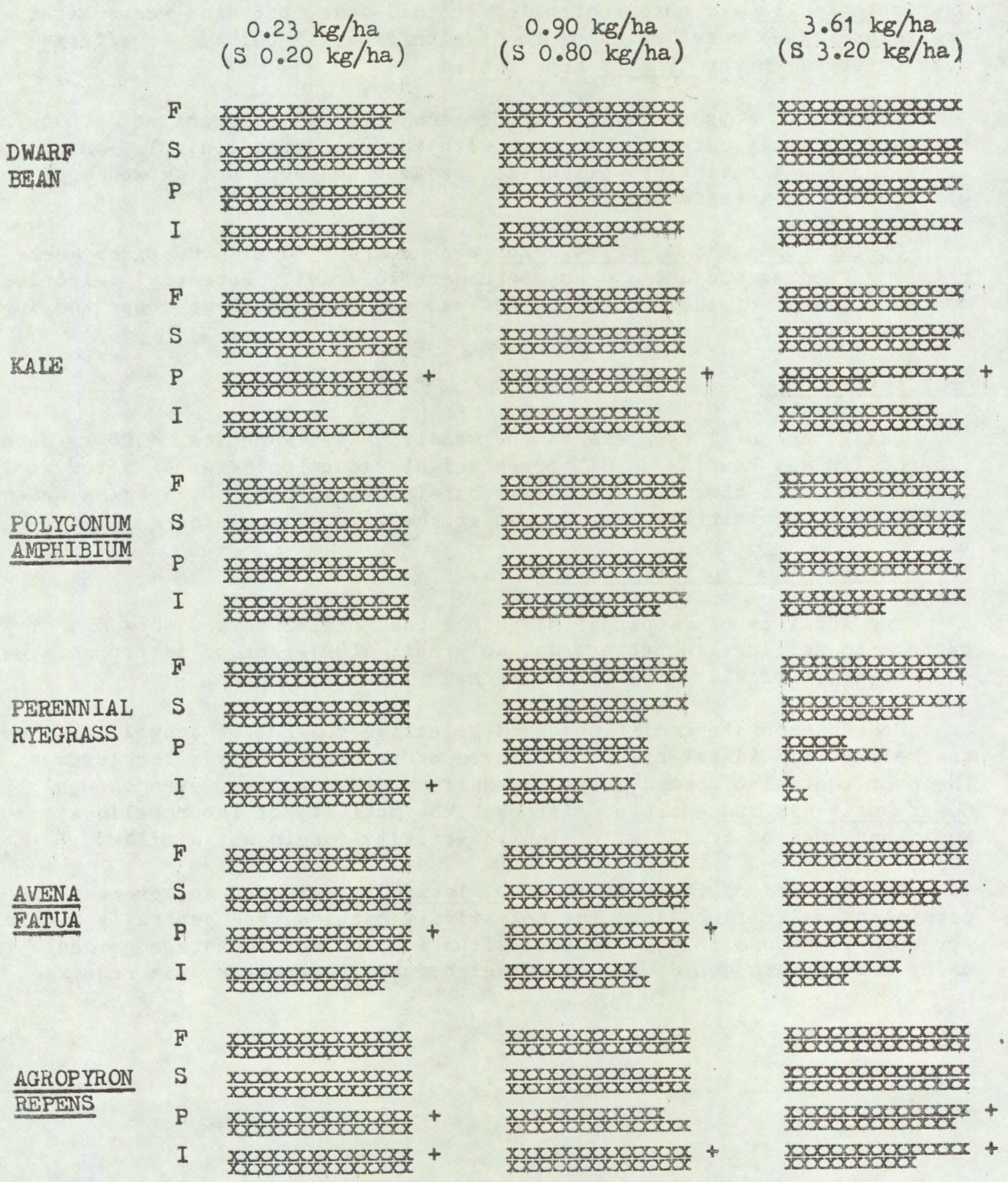
The activity of isopropalin against the species tested showed a similar pattern to trifluralin but was not so great; 4.00 kg/ha of isopropalin were equivalent to trifluralin at 1.00 kg/ha.

Under temperate conditions good selective control of annual grass weeds can be expected in several broad-leaved crops, particularly the legumes. The poor control of broad-leaved weeds is a disadvantage, even though C. arvensis was susceptible. Although the activity of isopropalin was much less than that of trifluralin, the selectivity margin was similar.

The effects of isopropalin on O. latifolia were not so severe or as persistent as trifluralin. The selectivity margins were generally similar for both compounds in the tropical situation and any advantage gained using isopropalin could well be outweighed by the greater dose required.

ACTIVITY EXPERIMENT.

ISOPROPALIN



Key: F = post-emergence, foliar application
S = post-emergence, soil drench
P = pre-emergence, surface film
I = pre-planting, incorporated

PRE-EMERGENCE SELECTIVITY EXPERIMENT

SPECIES	ISOPROPALIN 0.25 KG/HA		ISOPROPALIN 1.00 KG/HA		ISOPROPALIN 4.00 KG/HA	
WHEAT	85	xxxxxxxxxxxxxxxxx	98	xxxxxxxxxxxxxxxxxxxx	85	xxxxxxxxxxxxxxxxx
(1)	100	xxxxxxxxxxxxxxxxxxxx	100	xxxxxxxxxxxxxxxxxxxx	71	xxxxxxxxxxxxxx
BARLEY	96	xxxxxxxxxxxxxxxxxxx	96	xxxxxxxxxxxxxxxxxxx	89	xxxxxxxxxxxxxxxxxx
(2)	100	xxxxxxxxxxxxxxxxxxxx	100	xxxxxxxxxxxxxxxxxxxx	71	xxxxxxxxxxxxxx
OAT	110	xxxxxxxxxxxxxxxxxxxx +	110	xxxxxxxxxxxxxxxxxxxx +	51	xxxxxxxxxx
(3)	100	xxxxxxxxxxxxxxxxxxxx	86	xxxxxxxxxxxxxxxxx	57	xxxxxxxxxxx
PER RYGR	93	xxxxxxxxxxxxxxxxxxx	25	xxxxx	0	
(4)	93	xxxxxxxxxxxxxxxxxxx	43	xxxxxxxxx	0	
ONION	94	xxxxxxxxxxxxxxxxxxx	77	xxxxxxxxxxxxxxx	51	xxxxxxxxxx
(8)	93	xxxxxxxxxxxxxxxxxxx	79	xxxxxxxxxxxxxxxx	29	xxxxxx
DWF BEAN	100	xxxxxxxxxxxxxxxxxxxx	100	xxxxxxxxxxxxxxxxxxxx	100	xxxxxxxxxxxxxxxxxxxx
(9)	100	xxxxxxxxxxxxxxxxxxxx	100	xxxxxxxxxxxxxxxxxxxx	100	xxxxxxxxxxxxxxxxxxxx
FLD BEAN	100	xxxxxxxxxxxxxxxxxxxx	100	xxxxxxxxxxxxxxxxxxxx	87	xxxxxxxxxxxxxxxxx
(10)	100	xxxxxxxxxxxxxxxxxxxx	100	xxxxxxxxxxxxxxxxxxxx	86	xxxxxxxxxxxxxxxxx
PEA	45	xxxxxxxxx	105	xxxxxxxxxxxxxxxxxxxx +	105	xxxxxxxxxxxxxxxxxxxx +
(11)	100	xxxxxxxxxxxxxxxxxxxx	86	xxxxxxxxxxxxxxxxx	86	xxxxxxxxxxxxxxxxx
W CLOVER	99	xxxxxxxxxxxxxxxxxxxx	132	xxxxxxxxxxxxxxxxxxxx +	66	xxxxxxxxxxxxx
(12)	100	xxxxxxxxxxxxxxxxxxxx	100	xxxxxxxxxxxxxxxxxxxx	43	xxxxxxxxx
TOMATO	92	xxxxxxxxxxxxxxxxxx	75	xxxxxxxxxxxxxxx	81	xxxxxxxxxxxxxxxx
(14)	100	xxxxxxxxxxxxxxxxxxxx	79	xxxxxxxxxxxxxxxx	64	xxxxxxxxxxxxx
KALE	109	xxxxxxxxxxxxxxxxxxxx +	136	xxxxxxxxxxxxxxxxxxxx +	118	xxxxxxxxxxxxxxxxxxxx +
(15)	100	xxxxxxxxxxxxxxxxxxxx	100	xxxxxxxxxxxxxxxxxxxx	93	xxxxxxxxxxxxxxxxxxx
SWEDE	94	xxxxxxxxxxxxxxxxxxx	122	xxxxxxxxxxxxxxxxxxxx +	37	xxxxxxx
(17)	86	xxxxxxxxxxxxxxxxx	79	xxxxxxxxxxxxxxxx	57	xxxxxxxxxxx

PRE-EMERGENCE SELECTIVITY EXPERIMENT

SPECIES	ISOPROPALIN 0.25 KG/HA		ISOPROPALIN 1.00 KG/HA		ISOPROPALIN 4.00 KG/HA	
CARROT	94	xxxxxxxxxxxxxxxxxxx	94	xxxxxxxxxxxxxxxxxxx	81	xxxxxxxxxxxxxxxx
(18)	100	xxxxxxxxxxxxxxxxxxxx	100	xxxxxxxxxxxxxxxxxxxx	100	xxxxxxxxxxxxxxxxxxxx
LETTUCE	109	xxxxxxxxxxxxxxxxxxxx +	97	xxxxxxxxxxxxxxxxxxx	90	xxxxxxxxxxxxxxxxxx
(20)	100	xxxxxxxxxxxxxxxxxxxx	93	xxxxxxxxxxxxxxxxxxx	43	xxxxxxxxx
SUG BEET	100	xxxxxxxxxxxxxxxxxxxx	96	xxxxxxxxxxxxxxxxxxx	72	xxxxxxxxxxxxxx
(21)	100	xxxxxxxxxxxxxxxxxxxx	57	xxxxxxxxxxx	36	xxxxxxx
AVE FATU	95	xxxxxxxxxxxxxxxxxxx	95	xxxxxxxxxxxxxxxxxxx	20	xxxx
(26)	100	xxxxxxxxxxxxxxxxxxxx	79	xxxxxxxxxxxxxxxx	50	xxxxxxxxxx
ALO MYOS	84	xxxxxxxxxxxxxxxxx	66	xxxxxxxxxxxxx	0	
(27)	100	xxxxxxxxxxxxxxxxxxxx	57	xxxxxxxxxxx	0	
POA ANN	125	xxxxxxxxxxxxxxxxxxxx +	0		0	
(28)	86	xxxxxxxxxxxxxxxxx	0		0	
SIN ARV	108	xxxxxxxxxxxxxxxxxxxx +	42	xxxxxxxx	96	xxxxxxxxxxxxxxxxxxx
(30)	100	xxxxxxxxxxxxxxxxxxxx	100	xxxxxxxxxxxxxxxxxxxx	86	xxxxxxxxxxxxxxxxx
RAPH RAP	96	xxxxxxxxxxxxxxxxxxx	91	xxxxxxxxxxxxxxxxxx	102	xxxxxxxxxxxxxxxxxxxx +
(31)	100	xxxxxxxxxxxxxxxxxxxx	100	xxxxxxxxxxxxxxxxxxxx	93	xxxxxxxxxxxxxxxxxxx
CHRY SEG	102	xxxxxxxxxxxxxxxxxxxx +	77	xxxxxxxxxxxxxxx	44	xxxxxxxxx
(32)	100	xxxxxxxxxxxxxxxxxxxx	93	xxxxxxxxxxxxxxxxxxx	57	xxxxxxxxxxx
TRIP MAR	95	xxxxxxxxxxxxxxxxxxx	92	xxxxxxxxxxxxxxxxxx	92	xxxxxxxxxxxxxxxxxx
(33)	100	xxxxxxxxxxxxxxxxxxxx	100	xxxxxxxxxxxxxxxxxxxx	93	xxxxxxxxxxxxxxxxxxx
POL LAPA	94	xxxxxxxxxxxxxxxxxxx	106	xxxxxxxxxxxxxxxxxxxx +	82	xxxxxxxxxxxxxxxx
(35)	100	xxxxxxxxxxxxxxxxxxxx	100	xxxxxxxxxxxxxxxxxxxx	57	xxxxxxxxxxx
GAL APAR	107	xxxxxxxxxxxxxxxxxxxx +	93	xxxxxxxxxxxxxxxxxxx	114	xxxxxxxxxxxxxxxxxxxx +
(38)	100	xxxxxxxxxxxxxxxxxxxx	100	xxxxxxxxxxxxxxxxxxxx	64	xxxxxxxxxxxxx

PRE-EMERGENCE SELECTIVITY EXPERIMENT

SPECIES	ISOPROPALIN 0.25 KG/HA		ISOPROPALIN 1.00 KG/HA		ISOPROPALIN 4.00 KG/HA	
CHEN ALB	117	xxxxxxxxxxxxxxxxxxxx +	61	xxxxxxxxxxxx	72	xxxxxxxxxxxxxx
(39)	100	xxxxxxxxxxxxxxxxxxxx	50	xxxxxxxxxx	43	xxxxxxxxx
STEL MED	80	xxxxxxxxxxxxxxxx	68	xxxxxxxxxxxxxx	23	xxxxx
(40)	93	xxxxxxxxxxxxxxxxxxx	57	xxxxxxxxxxx	29	xxxxxx
AG REPEN	103	xxxxxxxxxxxxxxxxxxxx +	94	xxxxxxxxxxxxxxxxxxx	94	xxxxxxxxxxxxxxxxxxx
(47)	100	xxxxxxxxxxxxxxxxxxxx	79	xxxxxxxxxxxxxxxx	57	xxxxxxxxxxx
ALL VIN	100	xxxxxxxxxxxxxxxxxxxx	92	xxxxxxxxxxxxxxxxxx	100	xxxxxxxxxxxxxxxxxxxx
(49)	100	xxxxxxxxxxxxxxxxxxxx	100	xxxxxxxxxxxxxxxxxxxx	100	xxxxxxxxxxxxxxxxxxxx
CIRS ARV	109	xxxxxxxxxxxxxxxxxxxx +	109	xxxxxxxxxxxxxxxxxxxx +	82	xxxxxxxxxxxxxxxx
(50)	100	xxxxxxxxxxxxxxxxxxxx	100	xxxxxxxxxxxxxxxxxxxx	100	xxxxxxxxxxxxxxxxxxxx
TUS FARF	100	xxxxxxxxxxxxxxxxxxxx	100	xxxxxxxxxxxxxxxxxxxx	100	xxxxxxxxxxxxxxxxxxxx
(51)	100	xxxxxxxxxxxxxxxxxxxx	100	xxxxxxxxxxxxxxxxxxxx	100	xxxxxxxxxxxxxxxxxxxx
CONV ARV	91	xxxxxxxxxxxxxxxxxx	26	xxxxx	0	
(52)	100	xxxxxxxxxxxxxxxxxxxx	100	xxxxxxxxxxxxxxxxxxxx	0	
MAIZE	103	xxxxxxxxxxxxxxxxxxxx +	84	xxxxxxxxxxxxxxxxx	112	xxxxxxxxxxxxxxxxxxxx +
(58)	93	xxxxxxxxxxxxxxxxxxx	86	xxxxxxxxxxxxxxxxx	86	xxxxxxxxxxxxxxxxx
SORGHUM	98	xxxxxxxxxxxxxxxxxxxx	91	xxxxxxxxxxxxxxxxxx	35	xxxxxxx
(59)	93	xxxxxxxxxxxxxxxxxxx	79	xxxxxxxxxxxxxxxx	50	xxxxxxxxxx
RICE	94	xxxxxxxxxxxxxxxxxxx	94	xxxxxxxxxxxxxxxxxxx	76	xxxxxxxxxxxxxxx
(60)	100	xxxxxxxxxxxxxxxxxxxx	79	xxxxxxxxxxxxxxxx	50	xxxxxxxxxx
GRNDNUT	131	xxxxxxxxxxxxxxxxxxxx +	112	xxxxxxxxxxxxxxxxxxxx +	94	xxxxxxxxxxxxxxxxxxx
(64)	100	xxxxxxxxxxxxxxxxxxxx	100	xxxxxxxxxxxxxxxxxxxx	93	xxxxxxxxxxxxxxxxxxx
SOYABEAN	88	xxxxxxxxxxxxxxxxxx	106	xxxxxxxxxxxxxxxxxxxx +	88	xxxxxxxxxxxxxxxxxx
(65)	93	xxxxxxxxxxxxxxxxxxx	100	xxxxxxxxxxxxxxxxxxxx	86	xxxxxxxxxxxxxxxxx

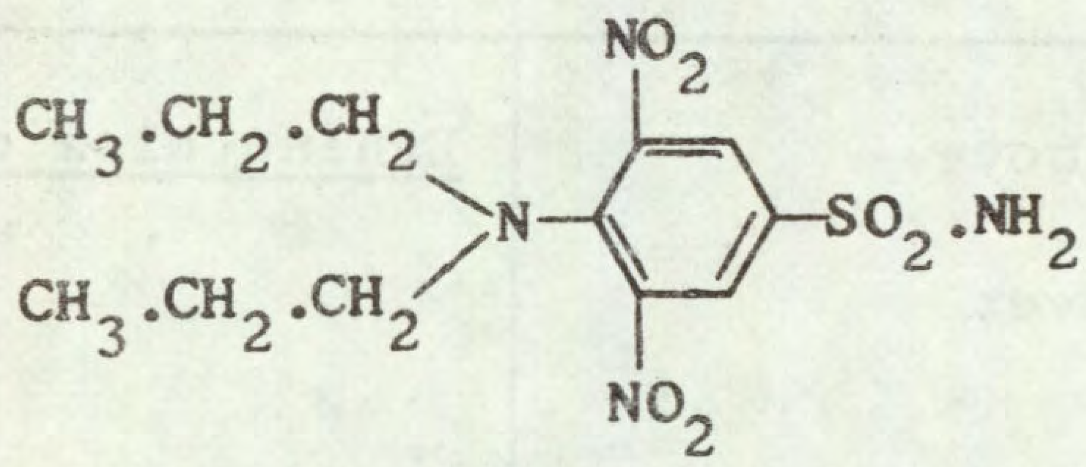
SPECIES	ISOPROPALIN 0.25 KG/HA		ISOPROPALIN 1.00 KG/HA		ISOPROPALIN 4.00 KG/HA	
COTTON	100	xxxxxxxxxxxxxxxxxxxx	110	xxxxxxxxxxxxxxxxxxxx +	110	xxxxxxxxxxxxxxxxxxxx +
(66)	100	xxxxxxxxxxxxxxxxxxxx	100	xxxxxxxxxxxxxxxxxxxx	86	xxxxxxxxxxxxxxxxx
JUTE	107	xxxxxxxxxxxxxxxxxxxx +	122	xxxxxxxxxxxxxxxxxxxx +	41	xxxxxxxx
(67)	93	xxxxxxxxxxxxxxxxxxx	71	xxxxxxxxxxxxxx	43	xxxxxxxxx
KENAF	109	xxxxxxxxxxxxxxxxxxxx +	82	xxxxxxxxxxxxxxxx	109	xxxxxxxxxxxxxxxxxxxx +
(68)	100	xxxxxxxxxxxxxxxxxxxx	100	xxxxxxxxxxxxxxxxxxxx	71	xxxxxxxxxxxxxx
SESAMUM	50	xxxxxxxxxx	137	xxxxxxxxxxxxxxxxxxxx +	125	xxxxxxxxxxxxxxxxxxxx +
(70)	100	xxxxxxxxxxxxxxxxxxxx	79	xxxxxxxxxxxxxxxx	57	xxxxxxxxxxx
ELEU IND	56	xxxxxxxxxxx	4	x	0	
(74)	79	xxxxxxxxxxxxxxxx	21	xxxx	0	
ECH CRUS	116	xxxxxxxxxxxxxxxxxxxx +	103	xxxxxxxxxxxxxxxxxxxx +	0	
(75)	93	xxxxxxxxxxxxxxxxxxx	57	xxxxxxxxxxx	0	
ROT EXAL	109	xxxxxxxxxxxxxxxxxxxx +	62	xxxxxxxxxxxx	92	xxxxxxxxxxxxxxxxxx
(76)	93	xxxxxxxxxxxxxxxxxxx	71	xxxxxxxxxxxxxx	50	xxxxxxxxxx
DIG SANG	71	xxxxxxxxxxxxxx	7	x	0	
(77)	86	xxxxxxxxxxxxxxxxx	29	xxxxxx	0	
AMAR RET	143	xxxxxxxxxxxxxxxxxxxx +	117	xxxxxxxxxxxxxxxxxxxx +	13	xxx
(78)	100	xxxxxxxxxxxxxxxxxxxx	50	xxxxxxxxxx	36	xxxxxxx
CYP ESCU	110	xxxxxxxxxxxxxxxxxxxx +	80	xxxxxxxxxxxxxxxx	80	xxxxxxxxxxxxxxxx
(85)	100	xxxxxxxxxxxxxxxxxxxx	93	xxxxxxxxxxxxxxxxxxx	100	xxxxxxxxxxxxxxxxxxxx
CYP ROTU	114	xxxxxxxxxxxxxxxxxxxx +	105	xxxxxxxxxxxxxxxxxxxx +	105	xxxxxxxxxxxxxxxxxxxx +
(86)	100	xxxxxxxxxxxxxxxxxxxx	93	xxxxxxxxxxxxxxxxxxx	93	xxxxxxxxxxxxxxxxxxx
OXAL LAT	73	xxxxxxxxxxxxxxx	47	xxxxxxxxx	0	
(87)	100	xxxxxxxxxxxxxxxxxxxx	50	xxxxxxxxxx	0	

ORYZALIN

Code number EL-119 **Trade name** Ryzelan

Chemical name 3,5-dinitro-N^4N^4-dipropylsulphanilamide

Structure



Source Lilly Research Centre Ltd
Erl Wood Manor
Windlesham
Surrey

Information available and suggested uses

Manufacturer's information published in 1968 reports selective control of annual grass weeds at the 1-2 leaf stage in transplanted rice. Control of aquatic broad-leaved species and some annual sedges (e.g. *Cyperus* spp., *Scirpus* spp., *Fimbristylis* spp.) has been obtained. Improved control of grasses, sedges and broad-leaved weeds was reported with the addition of 2,4-D, MCPA or with a follow-up treatment with these products. The tolerance of transplanted rice to oryzalin is altered by rate, water depth at spraying and time after planting. Further research on surface application to direct-seeded rice is suggested.

Formulation used 75% w/w a.i. wettable powder

Spray volume for activity experiment 388 l/ha (34.5 gal/ac)
for selectivity experiment 352 l/ha (31.3 gal/ac)

RESULTS

Full histogram results are given on pages 28-32 and potential selectivities are summarised in the following Table.

RATE (kg ai/ha)	CROPS: vigour reduced by 15% or less	WEEDS: number or vigour reduced by 70% or more
4.00	None	None listed as no crops tolerant
1.00	dwarf bean field bean pea radish	*Polygonum lapathifolium* *Chenopodium album* *Stellaria media* *Convolvulus arvensis* *Eleusine indica* *Digitaria sanguinalis* *Oxalis latifolia* + species below

(Table continued overleaf)

RATE (kg ai/ha)	CROPS: vigour reduced by 15% or less	WEEDS: number or vigour reduced by 70% or more
0.25	species above + onion white clover kale swede carrot maize groundnut soyabean cotton	Echinochloa crus-galli

Comments on results

General

The activity experiment results for oryzalin were similar to those of trifluralin and isopropalin. Most activity was found in the soil treatments, particularly with pre-emergence applications. Incorporation increased activity compared to the surface spray in this test, especially with Avena fatua, Agropyron repens and Polygonum amphibium.

Control of temperate annual grasses in the selectivity test was not so good as with trifluralin, but the susceptibility of other weed species was similar. Although the pattern of crop tolerance was similar to that with trifluralin, fewer crops showed useful resistance following treatment with oryzalin. A number of potential selectivities were noted however.

Symptoms

These were generally similar to those found with the other dinitro-aniline herbicides and although plant emergence was better, root systems were severely inhibited. Certain species were severely stunted with either dark green or chlorotic leaves. Necrosis developed slowly even in stunted plants. Many species suffered no greater damage following increased application rates, a characteristic of other herbicides causing root inhibition e.g. fenac and credazine.

Temperate weeds and crops

The same annual broad-leaved weeds were controlled as with trifluralin i.e. Stellaria media, Chenopodium album and Polygonum lapathifolium although the latter was much more sensitive to oryzalin. The composite weeds Chrysanthemum segetum and Tripleurospermum maritimum were controlled at 4.00 kg/ha and were severely reduced at 1.00 kg/ha thus showing an increased sensitivity to oryzalin compared with the other dinitro-aniline herbicides tested. Cruciferous weeds were particularly resistant. Convolvulus arvensis was the most susceptible perennial weed, being controlled at 1.00 kg/ha, while plant number was severely reduced at 0.25 kg/ha. Cirsium arvense and Agropyron repens were both susceptible at 4.00 kg/ha. A. repens was eventually killed at only 1.00 kg/ha. Annual grasses were only controlled at 4.00 kg/ha but reductions of 36% and 57-64% were caused at 0.25 and 1.00 kg/ha respectively.

No crops tolerated 4.00 kg/ha. Radish and the large seeded legumes were resistant at 1.00 kg/ha and several small seeded crops were tolerant at 0.25 kg/ha.

Potential selective control of four broad-leaved weeds, including C. arvensis was found in dwarf bean, pea, field bean and radish at 1.00 kg/ha. Eventually A. repens was also selectively killed at this dose.

Tropical weeds and crops

Echinochloa crus-galli was controlled at only 0.25 kg/ha. All other annual grasses, with the exception of Rottboellia exaltata, were controlled at 1.00 kg/ha. Amaranthus retroflexus, although seriously reduced at 1.00 kg/ha, was only controlled at 4.00 kg/ha. However Oxalis latifolia was somewhat more sensitive, and was well controlled at only 1.00 kg/ha. There was no emergence initially at 4.00 kg/ha but nine weeks after treatment plants had emerged and recovery was evident at both these doses. Cyperus esculentus was somewhat more sensitive than Cyperus rotundus but little effect was seen on either species.

The larger seeded species maize, cotton, soyabean and groundnut were only fully tolerant at 0.25 kg/ha and the latter almost tolerated 1.00 kg/ha. Kenaf showed marginal resistance at 0.25 kg/ha.

E. crus-galli was the only weed selectively controlled at 0.25 kg/ha, although a number of other small seeded annual weeds were severely reduced at this dose.

Soil persistence

Perennial ryegrass showed no symptoms at 0.25 and 1.00 kg/ha 17 and 43 weeks respectively after application. The fresh weight of plants was, however, still reduced by 70% at 4.00 kg/ha 43 weeks after treatment.

Possible uses and further testing

The pattern of activity of oryzalin was generally similar to trifluralin. Annual grass weed control was not so good as with trifluralin with the exception of E. crus-galli. The temperate composite weeds and P. lapathifolium were more sensitive to oryzalin.

Crop tolerance, with the exception of the large seeded temperate legumes, was notably lower than with trifluralin. Hence few potential selectivities were noted.

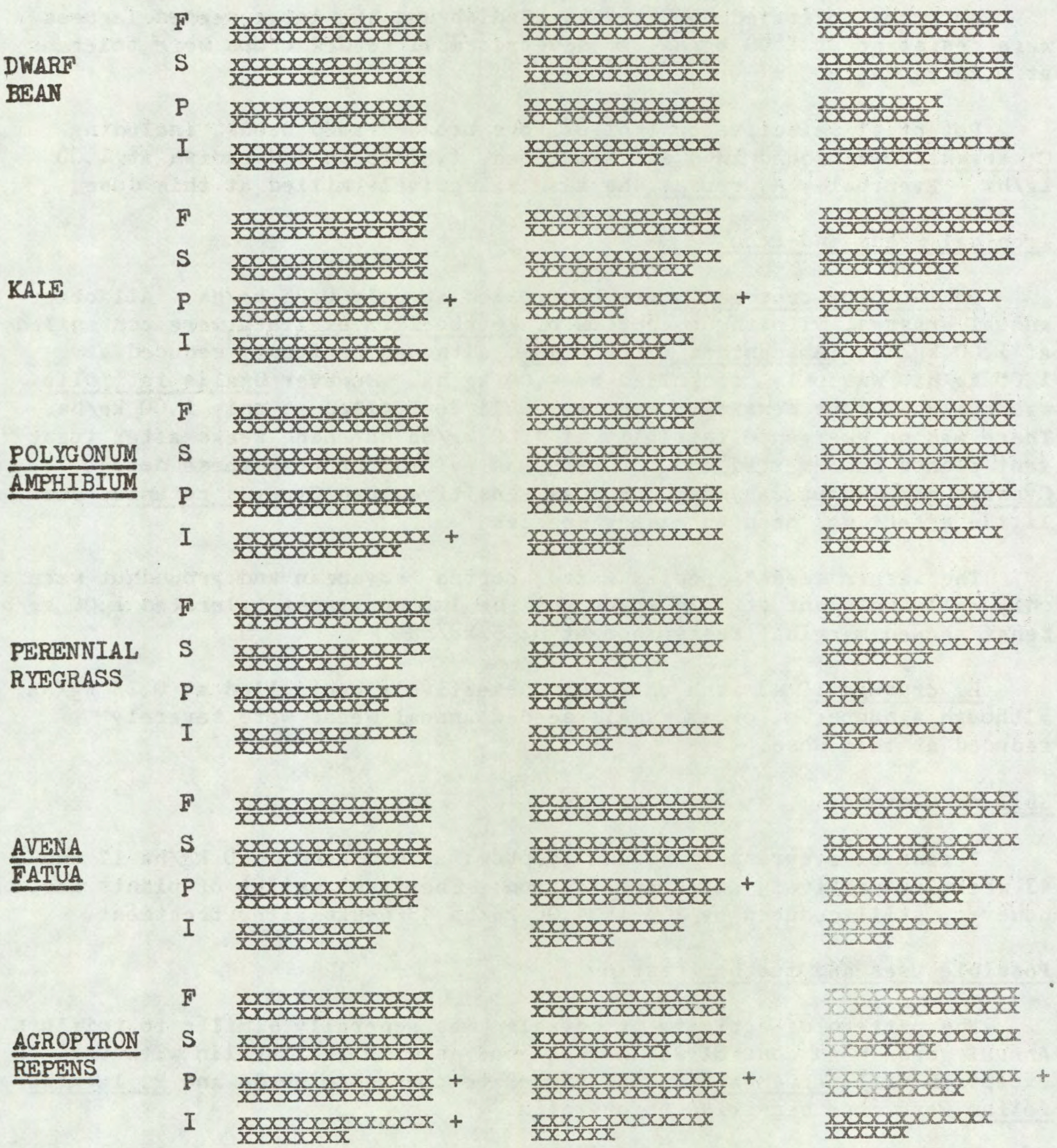
A shorter period of soil persistence was obtained with oryzalin compared with trifluralin.

From the results of this experiment no outstanding advantages were noted over existing herbicides in either the temperate or tropical situation.

ACTIVITY EXPERIMENT

ORYZALIN

0.23 kg/ha (S 0.20 kg/ha)	0.90 kg/ha (S 0.80 kg/ha)	3.61 kg/ha (S 3.20 kg/ha)



Key: F = post-emergence, foliar application
S = post-emergence, soil drench
P = pre-emergence, surface film
I = pre-planting, incorporated

PRE-EMERGENCE SELECTIVITY EXPERIMENT

SPECIES	ORYZALIN 0.25 KG/HA		ORYZALIN 1.00 KG/HA		ORYZALIN 4.00 KG/HA	
WHEAT	104	xxxxxxxxxxxxxxxxxxxx +	98	xxxxxxxxxxxxxxxxxxxx	104	xxxxxxxxxxxxxxxxxxxx +
(1)	57	xxxxxxxxxxx	43	xxxxxxxxx	43	xxxxxxxxx
BARLEY	96	xxxxxxxxxxxxxxxxxxx	102	xxxxxxxxxxxxxxxxxxxx +	89	xxxxxxxxxxxxxxxxxx
(2)	71	xxxxxxxxxxxxxx	57	xxxxxxxxxxx	43	xxxxxxxxx
OAT	117	xxxxxxxxxxxxxxxxxxxx +	110	xxxxxxxxxxxxxxxxxxxx +	102	xxxxxxxxxxxxxxxxxxxx +
(3)	57	xxxxxxxxxxx	43	xxxxxxxxx	36	xxxxxxx
PER RYGR	100	xxxxxxxxxxxxxxxxxxxx	86	xxxxxxxxxxxxxxxxx	57	xxxxxxxxxxx
(4)	57	xxxxxxxxxxx	36	xxxxxxx	29	xxxxxx
ONION	171	xxxxxxxxxxxxxxxxxxxx +	129	xxxxxxxxxxxxxxxxxxxx +	9	xx
(8)	86	xxxxxxxxxxxxxxxxx	50	xxxxxxxxxx	21	xxxx
DWF BEAN	100	xxxxxxxxxxxxxxxxxxxx	100	xxxxxxxxxxxxxxxxxxxx	100	xxxxxxxxxxxxxxxxxxxx
(9)	100	xxxxxxxxxxxxxxxxxxxx	86	xxxxxxxxxxxxxxxxx	64	xxxxxxxxxxxxx
FLD BEAN	87	xxxxxxxxxxxxxxxxx	100	xxxxxxxxxxxxxxxxxxxx	87	xxxxxxxxxxxxxxxxx
(10)	100	xxxxxxxxxxxxxxxxxxxx	86	xxxxxxxxxxxxxxxxx	57	xxxxxxxxxxx
PEA	105	xxxxxxxxxxxxxxxxxxxx +	105	xxxxxxxxxxxxxxxxxxxx +	105	xxxxxxxxxxxxxxxxxxxx +
(11)	100	xxxxxxxxxxxxxxxxxxxx	93	xxxxxxxxxxxxxxxxxxx	71	xxxxxxxxxxxxxx
W CLOVER	99	xxxxxxxxxxxxxxxxxxxx	95	xxxxxxxxxxxxxxxxxxx	33	xxxxxxx
(12)	100	xxxxxxxxxxxxxxxxxxxx	43	xxxxxxxxx	14	xxx
TOMATO	104	xxxxxxxxxxxxxxxxxxxx +	81	xxxxxxxxxxxxxxxx	58	xxxxxxxxxxxx
(14)	79	xxxxxxxxxxxxxxxx	43	xxxxxxxxx	43	xxxxxxxxx
KALE	109	xxxxxxxxxxxxxxxxxxxx +	100	xxxxxxxxxxxxxxxxxxxx	127	xxxxxxxxxxxxxxxxxxxx +
(15)	100	xxxxxxxxxxxxxxxxxxxx	71	xxxxxxxxxxxxxx	29	xxxxxx
SWEDE	112	xxxxxxxxxxxxxxxxxxxx +	66	xxxxxxxxxxxxx	122	xxxxxxxxxxxxxxxxxxxx +
(17)	86	xxxxxxxxxxxxxxxxx	64	xxxxxxxxxxxxx	43	xxxxxxxxx

Click here to continue