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THE ACTIVITY AND PRE-EMERGENCE SELECTIVITY OF SOME RECENTLY DEVELOPED HERBICIDES: DIMEFURON, HEXAZINONE, TRIFOP-METHYL, FLUOTHIURON, BUTHIDAZOLE AND BUTAM

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THE ACTIVITY AND PRE-EMERGENCE SELECTIVITY OF SOME RECENTLY DEVELOPED HERBICIDES: DIMEFURON, HEXAZINONE, TRIFOP-METHYL, FLUOTHIURON, BUTHIDAZOLE AND BUTAM

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SUMMARY

In a series of pot experiments in the glasshouse five herbicides were examined for their soil and foliar activity on six selected species and these and one other herbicide were examined for pre-emergence selectivities in 34 temperate and 24 tropical crop and weed species as incorporated pre-planting treatments. An antidote seed dressing was applied to maize to see if the crop could be protected from herbicidal injury, thereby increasing selectivity. Persistence of the herbicides in the soil was examined in conjunction with the pre-emergence selectivity test.

The high activity of dimefuron was largely due to its effect through the soil. It controlled several important annual and a few perennial weeds pre-emergence, while some crop tolerance was found with certain large seeded legumes and brassicas.

Hexazinone possesses considerable foliar and soil activity. There was excellent control of weeds pre-emergence, but crop tolerance was limited.

Trifop-methyl controlled nearly all annual and perennial grass weeds while many broad-leaved crops, both temperate and tropical, were tolerant but broad-leaved weeds were resistant.

Fluothiuron was more active as a foliar or as a surface pre-emergence spray on certain broad-leaved species. In the pre-emergence selectivity test where the herbicide was incorporated into the soil, weed control was very poor, even though many crops were tolerant.

Buthidazole is very active on foliage and via the soil and possesses a broad spectrum of weed control pre-emergence. Crop tolerance was limited to only a few tropical species.

Butam gave pre-emergence control of several temperate and tropical weeds, mainly annual grasses, but also Agropyron repens. Many broad-leaved crops, notably brassicas and certain legumes, were tolerant.

The antidote seed dressing gave some slight protection (20% vigour improvement) to maize from damage by dimefuron and butam but only at certain doses of the herbicides.

All herbicides have moderate to long periods of persistence in the soil.

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* Herbicide Group
** ODM Tropical Weeds Group

INTRODUCTION

The pre- and post-emergence selectivities of new herbicides are investigated on a large number of pot-grown crop and weed species at WRO. The objectives are to discover selectivities, crop and weed susceptibilities and to obtain experience of the type of effects produced by each compound. Soil persistence is also monitored and these data, in conjunction with crop susceptibilities, are useful in considering subsequent cropping of treated land. Attention is drawn to the limitations of these investigations; ie 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 from those in the field.

The present report gives pre-emergence selectivity data on six herbicides. Results of activity experiments are included for dimefuron, hexazinone, fluothiuron, buthidazole and butam to provide information on levels of phytotoxicity, type and route of action. These data for trifop-methyl (HOE 29152) have already been published (Richardson and Parker, 1977).

METHODS AND MATERIALS

Activity experiments (AE1, AE2, AE3) These were carried out in the glasshouse on six selected species as described previously (Richardson and Dean, 1973a). Four annual species were raised from seeds and two perennials from rhizome fragments. Herbicides were applied by four different methods: (i) a post-emergence spray to the foliage only, avoiding contact with the soil, (ii) post-emergence to the soil only, as a drench avoiding foliage contact, (iii) pre-emergence to the soil surface, (iv) pre-emergence with thorough incorporation before planting. Species data are summarised in Table 1 and soil and environmental conditions in Table 2.

Table 1. Plant data for activity experiments

Species	Cultivar /source	No. per pot at spraying		Depth of planting (cm)	Post-emergence stage of growth at spraying	Stage of growth at assessment	
		pre-	post-			pre-	post-
Dwarf bean (*Phaseolus vulgaris*)	The Prince	3	2	1.8	2 uni-foliate leaves	$1\frac{1}{2}$-2 tri-foliate leaves	$1\frac{1}{2}$-$2\frac{1}{2}$ tri-foliate leaves
Kale (*Brassica oleracea acephala*)	Marrow-stem/ Maris Kestrel	12-15	5-8	0.6	$1\frac{1}{2}$-$2\frac{1}{2}$ leaves	$2\frac{1}{2}$-4 leaves	$3\frac{1}{2}$-$4\frac{1}{2}$ leaves
Polygonum amphibium	WRO Clone 1	6	3-5	1.2	3-7 leaves	7-8 leaves	6-11 leaves
Perennial ryegrass (*Lolium perenne*)	S 23	15-20	10	0.6	$1\frac{1}{2}$-$2\frac{1}{2}$ leaves	3-10 leaves, tillering	5-9 leaves, tillering

Species	Cultivar /source	No. per pot at spraying		Depth of planting (cm)	Post-emergence stage of growth at spraying	Stage of growth at assessment	
		pre-	post-			pre-	post-
Avena fatua	Hensington 1969/ Farthinghoe 1972	8-12	5-6	1.2	2-3 leaves	3-9 leaves, tillering	4½-9 leaves, tillering
Agropyron repens	WRO Clone 31	6	3-5	1.2	2-2½ leaves	3-8 leaves, tillering	4½-10 leaves, tillering

Table 2. Soil and environment conditions

Experiment number, type and herbicide(s) included	AE 1 Dimefuron	AE 2 Hexazinone	AE 3 Fluothiuron Butam Buthidazole	Pre-emergence selectivity test	
				Dimefuron Hexazinone Trifop-methyl	Fluothiuron Buthidazole Butam
Date of spraying	6.12.73	26.9.74	21.4.77	2 and 3.11.76	
Main assessment completed	24.1.74	6.11.74	26.5.77	21.12.76	
Soil moisture at spraying (%)	12.0	-	14.0	12.0	
Organic matter (%)	2.8	2.8	4.1	2.8	
Clay content (%)	16.0	16.0	15.0	16.0	
pH	7.7	7.7	7.0	7.7	
John Innes Base fertiliser (g/kg)	5.0	5.0	5.0	2.5	
DDT (5% dust) (g/kg)	0.5	0.5	0.5	0.5	
Fritted trace elements	0.25	0.25	0.25	-	
Hydrated Mg SO_4 (g/kg)	1.0	1.0	1.0	1.0	
Temperature (°C)				Temperate	Tropical
Mean	19	17	17	17	21
Maximum	29	23	25	23	30
Minimum	9	10	10	11	10
Relative humidity (%)					
Mean	60	70	55	54	58
Maximum	88	100	84	74	74
Mimimum	30	45	20	36	40

Pre-emergence selectivity experiment

Techniques for the selectivity experiment were as previously described (Richardson and Dean 1973), all herbicides being thoroughly incorporated into the soil by mixing immediately after spraying. Species were sown as detailed in Appendix 1, each being replicated twice for every treatment. Herbicides were applied using a laboratory sprayer operating at a pressure of 2.11 kg/cm^2 (30 lb/in^2) and moving at constant speed, 30 cm above the soil. Subsequent watering was from overhead. Soil and environmental conditions are summarised in Table 2. During the experiment plants were raised in the glasshouse, normal daylight being supplemented by warm white fluorescent tubes or mercury vapour lamps to provide a 14 hour photoperiod for temperate species and a 12 hour photoperiod for tropical species.

Radish (Raphanus raphanistrum) was included for ease of propagation and may be regarded as a crop or weed. To improve establishment Chenopodium album seeds were kept in 0.1 M potassium nitrate for 24 hours in the light; tubers of Cyperus esculentus were stored moist at 4°C for 23 days to break dormancy and freshly harvested bulbils of Oxalis latifolia were stored at 20°C for 4 weeks followed by heating at 45°C for 4 hours. To protect from soil-borne pathogens, all seeds except Chenopodium album were pretreated with one of the following: thiram, benomyl (for onion), Harvesan organomercury (for Avena fatua) or ethylmercuric phosphate + dieldrin (for sugarbeet). Cereal seeds were purchased already treated with a mercurial seed dressing (temperates), captan-methoxychlor + malathion (sorghum) or captan A + teraquinone (maize). In addition a series of treatments were included for maize in which seeds had been treated with an antidote (naphthalic anhydride at 0.5% w/w of seeds) to investigate possible protection from herbicide injury (see computer No 57, abbreviation 'maize + A').

Assessment and processing of results

Results were processed as described before (Richardson and Dean, 1973). Survivors were counted and scored on a 0-7 scale as previously where 0 = dead, and 7 = control. It was not possible to analyse by computer the data for Convolvulus arvensis because of premature dieback, but observations were made and are referred to in the text. Emergence of pigeon pea were very variable and results were not analysed. Dwarf bean was raised under tropical conditions to improve growth.

Pairs of histograms are presented for each treatment, the upper representing mean plant survival and the lower, mean vigour score, both calculated as percentages of untreated controls. Each 'x' represents a 5% increment, but in the activity experiment histograms, 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.

A table of observed selectivities, using the criteria specified, is presented for each herbicide along with comments to highlight salient points.

Soil persistence

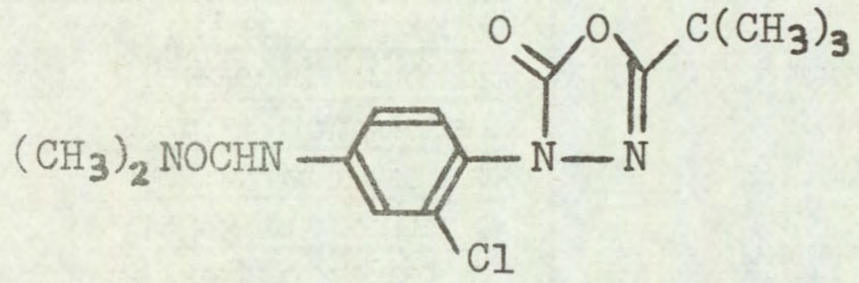
Soil persistence was monitored, in conjunction with the pre-emergence selectivity experiment. Moist treated soil (and untreated soil for controls) was stored in glass jars which were kept in the dark at 23°C. Every six to eight weeks, the jars were emptied into polythene bags, the soil thoroughly mixed, and sampled for pot bioassays in the glasshouse with a suitably sensitive test species. Plants were harvested three to four weeks after sowing, when they had reached a predetermined growth stage. Periodical bioassays were carried out for up to a year unless the herbicide disappeared before then. The soil moisture level was determined at the start of the experiment and at the time of assay and adjusted if necessary.

DIMEFURON

Code number RP 23465 Trade name Pradone Plus (+ carbetamide)

Chemical name N'-[4-(5-t-butyl-2-oxo-1,3,4-oxadiazol-3-yl)-3-chloro-phenyl] -N,N-dimethylurea

Structure



Source

Rhone Poulenc
Division Phytosanitaire
25 quai Paul Doumer
92408 Courbevoie
France

via May and Baker Ltd
Ongar Research Station
Fyfield Road
Ongar
Essex

Information available and suggested uses

Originally suggested for pre- and post-emergence weed control in brassicas, legumes, cotton and sunflower at 1 to 3 kg a.i./ha; pre-emergence in orchard and plantation crops at 2 to 6 kg a.i./ha; industrial weed control at 4 to 8 kg a.i./ha.

Now recommended in mixture with carbetamide as 'Pradone Plus' for control of grasses and a wide range of broad-leaved weeds in winter oil seed rape at 3.5 kg product/ha.

Formulation used 50% w/w a.i. wettable powder

Spray volumes for activity experiment 305 l/ha
for selectivity experiment 417 l/ha

RESULTS

Full results are given in the histograms on pages 8-14 and potential selectivities are summarised in the following table.

RATE (kg a.i./ha)	CROPS: vigour reduced by 15% or less	WEEDS: number or vigour reduced by 70% or more
3.0	None	None listed as no crops tolerant

(Table continued overleaf)

RATE (kg a.i./ha)	CROPS: vigour reduced by 15% or less	WEEDS: number or vigour reduced by 70% or more
1.0	pea	Avena fatua Alopecurus myosuroides Poa annua Poa trivialis Raphanus raphanistrum Tripleurospermum maritimum Galium aparine Holcus lanatus Agropyron repens Cirsium arvense Allium vineale* Tussilago farfara* Oryza punctata Echinochloa crus-galli Rottboellia exaltata Digitaria sanguinalis Snowdenia polystachya Oxalis latifolia + species below
0.33	species above + kale maize + antidote sorghum cowpea sesamum	Senecio vulgaris Polygonum lapathifolium Chenopodium album Stellaria media Veronica persica Rumex obtusifolius Amaranthus retroflexus Solanum nigrum

* killed at later assessment

Comments on results

Activity experiment (see page 8)

Phytotoxicity was found primarily with the soil treatments, the foliar spray being without any effect on broad-leaved species and perennial ryegrass and causing only minor, temporary effects on A. fatua and A. repens. Among the soil treatments, post-emergence drenches were often as effective as the pre-emergence treatments and sometimes more so. Annual species were more sensitive than the two perennials to pre-emergence treatments, the larger seeded species being just as susceptible as the smaller seeded species. Incorporation tended to increase activity marginally on all species, with the exception of kale.

Symptoms

These were typical for photosynthetic inhibitors such as ureas and triazines, chlorosis usually preceding necrosis and die-back. The foliar spray caused only a slight depression in vigour on two of the grasses. In the pre-emergence treatments, germination was unaffected, the plants dying back from an early growth stage after severe chlorosis.

Soil persistence

Perennial ryegrass was used as the test species. The dose of 0.33 kg/ha was undetectable seven weeks after spraying, but the higher doses were still killing plants after 38 weeks. Thus a moderate period of persistence is indicated for dimefuron.

Pre-emergence selectivity among temperate species

Dimefuron was found to have an impressive spectrum of weed control. At 1.0 kg/ha, all weeds except Sinapis arvensis were eventually controlled while even this species was reduced in vigour by more than 60%. All grass weeds were susceptible at 1.0 kg/ha, and all the perennials were eventually completely killed at this dose. Among the broad-leaved species, the control of Galium aparine is noteworthy. Cruciferous weeds, Raphanus raphanistrum and Sinapis arvensis showed some resistance.

Pea was the most tolerant crop, being unaffected at 1.0 kg/ha. This treatment was retained for a further three weeks after assessment to see if plants would succumb at a later stage, but apart from the oldest leaves showing slightly more senescence than in the controls, plants continued to grow normally. The fresh weight of the shoot system when harvested was 96% of control. Kale was the only other tolerant crop, but only at 0.33 kg/ha. Rape (a spring variety, Victor) showed a slight retardation of growth and some chlorosis at this dose. Unless winter rape varieties have intrinsically greater tolerance, the results of this test, in conjunction with those of the activity test (on kale), suggest that the safety of the recommended post-emergence use (+ carbetamide) may depend on very little herbicide reaching the root system of the crop.

Pre-emergence selectivity among tropical species

At 1 kg/ha, dimefuron controlled all annual weeds with the exception of Eleusine. At 3 kg/ha, Oxalis latifolia and Cyperus esculentus were also eventually killed, and C. rotundus severely weakened. At these doses no annual crops were tolerant but there is clearly some possibility of useful selectivity in perennial crops.

At 0.33 kg/ha only small-seeded broad-leaved species were controlled. Several crops were tolerant but the margin of safety was small, and there are other herbicides which would do better in most of them. For cowpea, however, there are not so many alternatives and the compound could be worth further testing in this crop, especially with surface pre-emergence applications which could be a little more selective.

There was a small protective effect of naphthalic anhydride antidote against this compound on maize but the differences were rather small, and of little practical significance.

ACTIVITY EXPERIMENT

DIMEFURON

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

PRE-EMERGENCE SELECTIVITY EXPERIMENT

DIMEFURON

SPECIES	0.33 kg/ha		1.0 kg/ha		3.0 kg/ha	
WHEAT	82	xxxxxxxxxxxxxxxx	52	xxxxxxxxxx	75	xxxxxxxxxxxxxxx
(1)	64	xxxxxxxxxxxxx	29	xxxxxx	29	xxxxxx
BARLEY	105	xxxxxxxxxxxxxxxxxxxx +	28	xxxxxx	0	
(2)	79	xxxxxxxxxxxxxxxx	7	x	0	
OAT	109	xxxxxxxxxxxxxxxxxxxx +	48	xxxxxxxxxx	41	xxxxxxxx
(3)	71	xxxxxxxxxxxxxx	14	xxx	7	x
PER RYGR	61	xxxxxxxxxxxx	0		0	
(4)	43	xxxxxxxxx	0		0	
ONION	81	xxxxxxxxxxxxxxxx	0		0	
(8)	43	xxxxxxxxx	0		0	
DWF BEAN	35	xxxxxxx	88	xxxxxxxxxxxxxxxxxx	88	xxxxxxxxxxxxxxxxxx
(9)	36	xxxxxxx	29	xxxxxx	29	xxxxxx
FLD BEAN	100	xxxxxxxxxxxxxxxxxxx	87	xxxxxxxxxxxxxxxx	87	xxxxxxxxxxxxxxxx
(10)	79	xxxxxxxxxxxxxxxx	21	xxxx	21	xxxx
PEA	87	xxxxxxxxxxxxxxxxx	100	xxxxxxxxxxxxxxxxxxx	100	xxxxxxxxxxxxxxxxxxx
(11)	100	xxxxxxxxxxxxxxxxxxx	100	xxxxxxxxxxxxxxxxxxx	36	xxxxxxx
W CLOVER	10	xx	0		0	
(12)	29	xxxxxx	0		0	
RAPE	114	xxxxxxxxxxxxxxxxxxx +	67	xxxxxxxxxxxx	16	xxx
(14)	79	xxxxxxxxxxxxxxxx	14	xxx	14	xxx
KALE	105	xxxxxxxxxxxxxxxxxxx +	38	xxxxxxxx	0	
(15)	86	xxxxxxxxxxxxxxxx	29	xxxxxx	0	

PRE-EMERGENCE SELECTIVITY EXPERIMENT

DIMEFURON

SPECIES		0.33 kg/ha		1.0 kg/ha		3.0 kg/ha	
CARROT	98	xxxxxxxxxxxxxxxxxxx	0		0		
(18)	57	xxxxxxxxxxx	0		0		
LETTUCE	105	xxxxxxxxxxxxxxxxxxx +	0		0		
(20)	36	xxxxxxx	0		0		
SUG BEET	13	xxx	0		0		
(21)	14	xxx	0		0		
AVE FATU	86	xxxxxxxxxxxxxxxx	0		5	x	
(26)	43	xxxxxxxxx	0		7	x	
ALO MYOS	65	xxxxxxxxxxxxx	4	x	0		
(27)	36	xxxxxxx	14	xxx	0		
POA ANN	103	xxxxxxxxxxxxxxxxxxx +	3	x	0		
(28)	50	xxxxxxxxxx	14	xxx	0		
POA TRIV	64	xxxxxxxxxxxxx	0		0		
(29)	36	xxxxxxx	0		0		
SIN ARV	181	xxxxxxxxxxxxxxxxxxx +	57	xxxxxxxxxxx	0		
(30)	93	xxxxxxxxxxxxxxxxxx	36	xxxxxxx	0		
RAPH RAP	88	xxxxxxxxxxxxxxxxx	0		0		
(31)	57	xxxxxxxxxxx	0		0		
TRIP MAR	69	xxxxxxxxxxxxxx	15	xxx	0		
(33)	36	xxxxxxx	7	x	0		
SEN VULG	14	xxx	0		0		
(34)	29	xxxxxx	0		0		

PRE-EMERGENCE SELECTIVITY EXPERIMENT

DIMEFURON

SPECIES	0.33 kg/ha		1.0 kg/ha		3.0 kg/ha	
POL LAPA	0		0		0	
(35)	0		0		0	
GAL APAR	105	xxxxxxxxxxxxxxxxxxx +	81	xxxxxxxxxxxxxxx	29	xxxxxx
(38)	79	xxxxxxxxxxxxxxx	14	xxx	21	xxxx
CHEN ALB	4	x	0		0	
(39)	14	xxx	0		0	
STEL MED	3	x	0		0	
(40)	7	x	0		0	
VER PERS	7	x	4	x	0	
(42)	7	x	7	x	0	
RUM OBTU	28	xxxxxx	0		0	
(44)	29	xxxxxx	0		0	
HOLC LAN	64	xxxxxxxxxxxxx	7	x	0	
(45)	36	xxxxxxx	14	xxx	0	
AG REPEN	86	xxxxxxxxxxxxxxxxx	94	xxxxxxxxxxxxxxxxxxx	94	xxxxxxxxxxxxxxxxxxx
(47)	86	xxxxxxxxxxxxxxxxx	29	xxxxxx	29	xxxxxx
ALL VIN	101	xxxxxxxxxxxxxxxxxxx +	94	xxxxxxxxxxxxxxxxxx	86	xxxxxxxxxxxxxxxx
(49)	86	xxxxxxxxxxxxxxxxx	36	xxxxxxx	29	xxxxxx
CIRS ARV	100	xxxxxxxxxxxxxxxxxx	0		14	xxx
(50)	86	xxxxxxxxxxxxxxxx	0		7	x
TUS FARF	86	xxxxxxxxxxxxxxxx	100	xxxxxxxxxxxxxxxxxxx	114	xxxxxxxxxxxxxxxxxxx +
(51)	100	xxxxxxxxxxxxxxxxxx	36	xxxxxxx	29	xxxxxx

PRE-EMERGENCE SELECTIVITY EXPERIMENT

DIMEFURON

SPECIES	0.33 kg/ha		1.0 kg/ha		3.0 kg/ha	
MAIZE +A	107	xxxxxxxxxxxxxxxxxxx +	107	xxxxxxxxxxxxxxxxxxx +	107	xxxxxxxxxxxxxxxxxxx +
(57)	93	xxxxxxxxxxxxxxxxxx	50	xxxxxxxxxx	29	xxxxxx
MAIZE	100	xxxxxxxxxxxxxxxxxxx	90	xxxxxxxxxxxxxxxxx	80	xxxxxxxxxxxxxxx
(58)	71	xxxxxxxxxxxxx	36	xxxxxxx	29	xxxxxx
SORGHUM	93	xxxxxxxxxxxxxxxxxx	0		0	
(59)	86	xxxxxxxxxxxxxxxx	0		0	
RICE	98	xxxxxxxxxxxxxxxxxxx	70	xxxxxxxxxxxxx	98	xxxxxxxxxxxxxxxxxx
(60)	43	xxxxxxxxx	29	xxxxxx	21	xxxx
COWPEA	106	xxxxxxxxxxxxxxxxxxx +	26	xxxxx	0	
(62)	93	xxxxxxxxxxxxxxxxxx	21	xxxx	0	
CHICKPEA	100	xxxxxxxxxxxxxxxxxxx	83	xxxxxxxxxxxxxxxx	0	
(63)	79	xxxxxxxxxxxxxxxx	21	xxxx	0	
GRNDNUT	55	xxxxxxxxxxx	41	xxxxxxxx	109	xxxxxxxxxxxxxxxxxxx +
(64)	64	xxxxxxxxxxxxx	71	xxxxxxxxxxxxxx	57	xxxxxxxxxx
SOYABEAN	96	xxxxxxxxxxxxxxxxxx	84	xxxxxxxxxxxxxxxx	48	xxxxxxxxx
(65)	79	xxxxxxxxxxxxxxx	21	xxxx	29	xxxxxx
COTTON	93	xxxxxxxxxxxxxxxxxx	0		0	
(66)	79	xxxxxxxxxxxxxxx	0		0	
JUTE	0		0		0	
(67)	0		0		0	
KENAF	58	xxxxxxxxxxx	0		0	
(68)	21	xxxx	0		0	

PRE- EMERGENCE SELECTIVITY EXPERIMENT

DIMEFURON

SPECIES	0.33 kg/ha		1.0 kg/ha		3.0 kg/ha	
SESAMUM	120	xxxxxxxxxxxxxxxxxxx +	0		0	
(70)	86	xxxxxxxxxxxxxxxxx	0		0	
TOMATO	0		0		0	
(71)	0		0		0	
OR PUNCT	162	xxxxxxxxxxxxxxxxxxx +	62	xxxxxxxxxxxx	85	xxxxxxxxxxxxxxxx
(73)	43	xxxxxxxxx	21	xxxx	14	xxx
ELEU IND	101	xxxxxxxxxxxxxxxxxxx +	91	xxxxxxxxxxxxxxxxx	0	
(74)	79	xxxxxxxxxxxxxxx	36	xxxxxxx	0	
ECH CRUS	95	xxxxxxxxxxxxxxxxxx	4	x	0	
(75)	36	xxxxxxx	7	x	0	
ROTT EXA	99	xxxxxxxxxxxxxxxxxxx	0		0	
(76)	71	xxxxxxxxxxxxxx	0		0	
DIG SANG	92	xxxxxxxxxxxxxxxxx	27	xxxxx	3	x
(77)	64	xxxxxxxxxxxxx	21	xxxx	14	xxx
AMAR RET	33	xxxxxxx	0		0	
(78)	7	x	0		0	
SOL NIG	95	xxxxxxxxxxxxxxxxxx	0		0	
(81)	21	xxxx	0		0	
SNOW POL	95	xxxxxxxxxxxxxxxxxx	0		0	
(83)	50	xxxxxxxxxx	0		0	
CYP ESCU	120	xxxxxxxxxxxxxxxxxxx +	60	xxxxxxxxxxxx	80	xxxxxxxxxxxxxxx
(85)	100	xxxxxxxxxxxxxxxxxxx	79	xxxxxxxxxxxxxxx	29	xxxxxx

PRE-EMERGENCE SELECTIVITY EXPERIMENT

		DIMEFURON					
SPECIES		0.33 kg/ha			1.0 kg/ha		3.0 kg/ha
CYP ROTU	102	xxxxxxxxxxxxxxxxxxxx +		96	xxxxxxxxxxxxxxxxxxx	70	xxxxxxxxxxxxx
(86)	100	xxxxxxxxxxxxxxxxxxx		86	xxxxxxxxxxxxxxxx	57	xxxxxxxxxx
OXAL LAT	107	xxxxxxxxxxxxxxxxxxx +		29	xxxxxx	29	xxxxxx
(87)	79	xxxxxxxxxxxxxxx		36	xxxxxxx	43	xxxxxxxxx

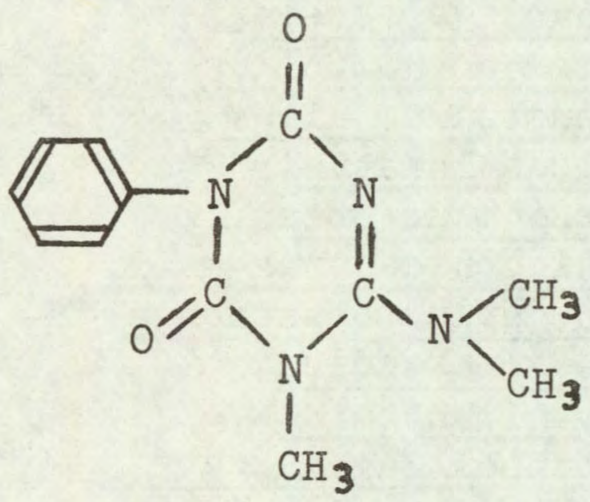
HEXAZINONE

Code number DPX 3674

Trade name Velpar

Chemical name 3-cyclohexyl-6-(dimethylamino)-1-methyl-1,3,5-triazine-2,4(1H,3H)-dione

Structure



Source

Du Pont (UK) Ltd
Maylands Avenue
Hemel Hempstead
Herts, HP2 7DP

Information available and suggested uses

Du Pont Product Development Bulletin on Velpar Weedkiller, (May 1977), suggests use as a non-selective herbicide for control of annual grass and broad-leaved weeds and top kill and suppression of perennial weeds at 1-3 kg/ha. Higher doses are recommended for short or long term control of established perennial weeds. Brush species eg ash (Fraxinus sp.), poplar (Populus sp.), oak (Quercus sp.), sycamore (Plantus occidentalis) and willow (Salix sp.) can be controlled at 4-12 kg/ha. A range of aquatic weeds (vascular, floating and algae) are susceptible. Suggested tolerant crops are: certain forestry species of Pinus, Picea, Abies; sugar cane, rubber, oil palm, coffee, tea, pineapple; dormant alfalfa; onions, post-emergence.

Formulation used 90% w/w a.i. water soluble powder

Spray volume
for activity experiment 305 l/ha
for selectivity experiment . 417 l/ha

RESULTS

Full results are given in the histograms on pages 18-24 and potential selectivities are summarised in the following table.

RATE (kg a.i./ha)	CROPS: vigour reduced by 15% or less	WEEDS: number or vigour reduced by 70% or more
3.0	None	None listed as no crops tolerant

(Table continued overleaf)

RATE (kg a.i./ha)	CROPS: vigour reduced by 15% or less	WEEDS: number or vigour reduced by 70% or more
0.15	ground nut	Avena fatua Alopecurus myosuroides Poa trivialis Sinapis arvensis Rumex obtusifolius Chenopodium album Holcus lanatus Cirsium arvense Echinochloa crus-galli Snowdenia polystachya Eleusine indica Oryza punctata Rottboellia exaltata + species below
0.05	Species above + wheat oat dwarf bean field bean pea carrot maize sorghum chick pea soya bean sesamum	Raphanus raphanistrum Amaranthus retroflexus Solanum nigrum Tripleurospermum maritimum Senecio vulgaris Polygonum lapathifolium Stellaria media Veronica persica

Comments on results

Activity experiment (see page 18)

Hexazinone was very active either as a foliar spray or when applied to the soil, pre- or post-emergence. Broad-leaved species were more sensitive to the foliar spray than the grasses. Post-emergence soil drenches were generally more effective than the foliar spray and in some instances (eg with the two perennials, Agropyron and Polygonum) more active than the pre-emergence treatments. In the latter, all annual species were killed, even at the lowest dose, while results on the two perennials showed an equivalent effect either as a surface spray or when incorporated into the soil.

Symptoms

These were typical of a photosynthetic inhibitor with chlorosis usually preceding necrosis and die-back. The foliar spray also caused severe contact scorch damage. In pre-emergence treatments germination was unaffected and plants usually died back from an early growth stage, preceded by chlorosis.

Soil persistence

Kale was used as the test species to monitor persistence. The 0.05 kg/ha dose was undetectable seven weeks after spraying but 0.15 and 0.45 kg/ha were still causing complete kill of plants 38 weeks after spraying. A moderate to long period of persistence is, therefore, indicated, similar to certain other triazines such as atrazine and simazine.

Pre-emergence selectivity among temperate species

At 0.15 kg/ha all annual weeds except Poa annua and Galium aparine were controlled, but even these were reduced by 50 - 60% at this dose. Several annual broad-leaved weeds, including the Compositae were controlled at the lowest dose. Perennial species generally required the highest dose of 0.45 kg/ha for satisfactory control.

None of the crops tolerated more than 0.05 kg/ha. At this dose, only two cereals (wheat and oat), the large seeded legumes (pea, dwarf and field bean) and carrot were tolerant.

Development in arable situations would seem unlikely for this herbicide, unless it could be used at very low doses as a component of a mixture. Its high phytotoxicity overall suggests use as a total herbicide or possibly in forestry species, such as pines, which have shown considerable tolerance (Dodel, J. B., 1975). Its high contact effect on established weeds and long residual activity would be advantageous in such situations.

Pre-emergence selectivity among tropical species

At 0.45 kg/ha hexazinone controlled all annual weeds and eventually killed Cyperus esculentus too. C. rotundus and Oxalis were also severely affected for at least 3 months. No annual crop tolerated this dose but there are clearly interesting possibilities in perennial crops.

The lower dose of 0.15 kg/ha controlled most annual weeds but several grasses were partially tolerant. Groundnut showed good tolerance and this was maintained when pots were kept for several further weeks (damage was not too serious even at 0.45 kg/ha). This crop has useful tolerance and hexazinone could conceivably be of value for control of broad-leaved weeds, in combination with an aniline or amide for grass control.

A few other crops tolerated the lowest dose but only small seeded annual broad-leaved species were then controlled. Sesamum is the most interesting of these crops, and some further work might be justified.

There was no protection of maize by naphthalic anhydride.

ACTIVITY EXPERIMENT

HEXAZINONE

		0.5 kg/ha	2.0 kg/ha	8.0 kg/ha
DWARF BEAN	F	xxxxxxxxxxxxxxx xxxx	xxxxxxx xx	xxxxxxx xx
	S	xxxxxxxxxxx xxxx	xxxxxxx xx	xxxxxxx xx
	P	o o	o o	o o
	I	o o	o o	o o
KALE	F	xxxxxxxxxx xxx	o o	o o
	S	o o	o o	o o
	P	o o	o o	o o
	I	o o	o o	o o
POLYGONUM AMPHIBIUM	F	xxxxxxxxxxx xxxxxxxx	xx x	xx xx
	S	xxxxx xx	xxxx xx	xxxxxx xx
	P	xxxxxxxxxx xxxxxx	xxxxxxxxx xxxxx	xxxxxxxxxxxxxx + xxxxxx
	I	xxxxxxxxxxxx xxxxxx	xxxxxxxxxxx xxxxxx	xxxxxxxxxxx xxxxx
PERENNIAL RYEGRASS	F	xxxxxxxxxxxxxx xxxxxxxxxx	xxxxxxx xxx	xxxxxxx xxx
	S	xxxxxxxxxxx xx	xxxxxxxxxxx xx	xxxxxxxxx xx
	P	o o	o o	o o
	I	o o	o o	o o
AVENA FATUA	F	xxxxxxxxxxxxxx xxxxxxxxxx	xxxxxxxxxxxxxx xxxxxx	o o
	S	o o	o o	o o
	P	o o	o o	o o
	I	o o	o o	o o
AGROPYRON REPENS	F	xxxxxxxxxxxxxx xxxxxxxxxx	xxxxxxxxxxxxx xxxxxxxxx	o o
	S	o o	o o	o o
	P	xxxxxxxxxxxxxx xxxxxx	xxxxxxxxx xxx	xxxxxxxxxx xxxx
	I	xxxxxxxx xxxx	xxxxxxxxxxx xxxx	xxxxxxxxxx xxxx

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

HEXAZINONE

SPECIES	0.05 kg/ha		0.15 kg/ha		0.45 kg/ha	
WHEAT	90	xxxxxxxxxxxxxxxxxx	75	xxxxxxxxxxxxxx	52	xxxxxxxxxx
(1)	100	xxxxxxxxxxxxxxxxxxx	29	xxxxxx	14	xxx
BARLEY	112	xxxxxxxxxxxxxxxxxxx +	98	xxxxxxxxxxxxxxxxxxx	28	xxxxxx
(2)	71	xxxxxxxxxxxxxx	36	xxxxxxx	21	xxxx
OAT	102	xxxxxxxxxxxxxxxxxxx +	109	xxxxxxxxxxxxxxxxxxx +	41	xxxxxxxx
(3)	100	xxxxxxxxxxxxxxxxxxx	50	xxxxxxxxxx	14	xxx
PER RYGR	96	xxxxxxxxxxxxxxxxxx	11	xx	0	
(4)	79	xxxxxxxxxxxxxxx	29	xxxxxx	0	
ONION	93	xxxxxxxxxxxxxxxxxx	0		0	
(8)	57	xxxxxxxxxxx	0		0	
DWF BEAN	106	xxxxxxxxxxxxxxxxxxx +	71	xxxxxxxxxxxxxx	71	xxxxxxxxxxxxxx
(9)	100	xxxxxxxxxxxxxxxxxxx	71	xxxxxxxxxxxxxx	21	xxxx
FLD BEAN	87	xxxxxxxxxxxxxxxx	50	xxxxxxxxxx	0	
(10)	86	xxxxxxxxxxxxxxxx	29	xxxxxx	0	
PEA	100	xxxxxxxxxxxxxxxxxxx	100	xxxxxxxxxxxxxxxxxxx	75	xxxxxxxxxxxxxx
(11)	100	xxxxxxxxxxxxxxxxxxx	71	xxxxxxxxxxxxx	29	xxxxxx
W CLOVER	26	xxxxx	0		0	
(12)	43	xxxxxxxxx	0		0	
RAPE	59	xxxxxxxxxxxx	8	xx	24	xxxxx
(14)	50	xxxxxxxxxx	7	x	7	x
KALE	38	xxxxxxxx	5	x	5	x
(15)	21	xxxx	14	xxx	7	x

PRE-EMERGENCE SELECTIVITY EXPERIMENT

HEXAZINONE

SPECIES		0.05 kg/ha		0.15 kg/ha	0.45 kg/ha
CARROT	93	xxxxxxxxxxxxxxxxxx	27	xxxxx	0
(18)	86	xxxxxxxxxxxxxxxx	43	xxxxxxxxx	0
LETTUCE	79	xxxxxxxxxxxxxxx	0		0
(20)	36	xxxxxxx	0		0
SUG BEET	56	xxxxxxxxxxx	0		0
(21)	57	xxxxxxxxxxx	0		0
AVE FATU	96	xxxxxxxxxxxxxxxxxx	27	xxxxx	0
(26)	100	xxxxxxxxxxxxxxxxxx	14	xxx	0
ALO MYOS	69	xxxxxxxxxxxxxx	8	xx	0
(27)	86	xxxxxxxxxxxxxxxx	21	xxxx	0
POA ANN	116	xxxxxxxxxxxxxxxxxxx +	37	xxxxxxx	0
(28)	64	xxxxxxxxxxxxx	36	xxxxxxx	0
POA TRIV	53	xxxxxxxxxxx	6	x	0
(29)	43	xxxxxxxxx	21	xxxx	0
SIN ARV	45	xxxxxxxxx	0		0
(30)	43	xxxxxxxxx	0		0
RAPH RAP	35	xxxxxxx	0		0
(31)	21	xxxx	0		0
TRIP MAR	30	xxxxxx	5	x	0
(33)	36	xxxxxxx	7	x	0
SEN VULG	29	xxxxxx	2	x	0
(34)	36	xxxxxxx	14	xxx	0

PRE-EMERGENCE SELECTIVITY EXPERIMENT

HEXAZINONE

SPECIES		0.05 kg/ha		0.15 kg/ha		0.45 kg/ha
POL LAPA	17	xxx	0		0	
(35)	43	xxxxxxxxx	0		0	
GAL APAR	90	xxxxxxxxxxxxxxxxxx	95	xxxxxxxxxxxxxxxxxx	14	xxx
(38)	100	xxxxxxxxxxxxxxxxxxxx	43	xxxxxxxxx	14	xxx
CHEN ALB	79	xxxxxxxxxxxxxxxx	30	xxxxxx	11	xx
(39)	86	xxxxxxxxxxxxxxxx	43	xxxxxxxxx	14	xxx
STEL MED	12	xx	0		0	
(40)	43	xxxxxxxxx	0		0	
VER PERS	29	xxxxxx	0		0	
(42)	36	xxxxxxx	0		0	
RUM OBTU	93	xxxxxxxxxxxxxxxxxx	14	xxx	0	
(44)	86	xxxxxxxxxxxxxxxx	36	xxxxxxx	0	
HOLC LAN	86	xxxxxxxxxxxxxxxx	4	x	0	
(45)	79	xxxxxxxxxxxxxxx	14	xxx	0	
AG REPEN	86	xxxxxxxxxxxxxxxxx	60	xxxxxxxxxxxx	60	xxxxxxxxxxxx
(47)	100	xxxxxxxxxxxxxxxxxxx	43	xxxxxxxxx	29	xxxxxx
ALL VIN	94	xxxxxxxxxxxxxxxxxx	101	xxxxxxxxxxxxxxxxxxx +	94	xxxxxxxxxxxxxxxxxx
(49)	100	xxxxxxxxxxxxxxxxxxx	71	xxxxxxxxxxxxx	29	xxxxxx
CIRS ARV	86	xxxxxxxxxxxxxxxx	29	xxxxxx	0	
(50)	79	xxxxxxxxxxxxxxx	29	xxxxxx	0	
TUS FARF	100	xxxxxxxxxxxxxxxxxx	100	xxxxxxxxxxxxxxxxxx	114	xxxxxxxxxxxxxxxxxx +
(51)	86	xxxxxxxxxxxxxxxx	64	xxxxxxxxxxxx	29	xxxxxx

PRE-EMERGENCE SELECTIVITY EXPERIMENT

HEXAZINONE

SPECIES		0.05 kg/ha		0.15 kg/ha		0.45 kg/ha
MAIZE +A	107	xxxxxxxxxxxxxxxxxxx +	107	xxxxxxxxxxxxxxxxxxx +	107	xxxxxxxxxxxxxxxxxxx +
(57)	79	xxxxxxxxxxxxxxx	50	xxxxxxxxxx	43	xxxxxxxxx
MAIZE	100	xxxxxxxxxxxxxxxxxxx	100	xxxxxxxxxxxxxxxxxxx	70	xxxxxxxxxxxxx
(58)	86	xxxxxxxxxxxxxxxx	50	xxxxxxxxxx	29	xxxxxx
SORGHUM	86	xxxxxxxxxxxxxxxx	29	xxxxxx	0	
(59)	86	xxxxxxxxxxxxxxxx	50	xxxxxxxxxx	0	
RICE	91	xxxxxxxxxxxxxxxxx	77	xxxxxxxxxxxxxx	70	xxxxxxxxxxxxx
(60)	57	xxxxxxxxxx	29	xxxxxx	14	xxx
COWPEA	62	xxxxxxxxxxx	25	xxxxxxx	0	
(62)	79	xxxxxxxxxxxxxx	29	xxxxxx	0	
CHICKPEA	100	xxxxxxxxxxxxxxxxxx	92	xxxxxxxxxxxxxxxxx	8	xx
(63)	93	xxxxxxxxxxxxxxxxx	79	xxxxxxxxxxxxxxx	7	x
GRNDNUT	55	xxxxxxxxxx	95	xxxxxxxxxxxxxxxxxx	82	xxxxxxxxxxxxxx
(64)	86	xxxxxxxxxxxxxxxx	86	xxxxxxxxxxxxxxx	71	xxxxxxxxxxxxx
SOYABEAN	84	xxxxxxxxxxxxxxx	72	xxxxxxxxxxxxx	120	xxxxxxxxxxxxxxxxxx +
(65)	86	xxxxxxxxxxxxxxxx	57	xxxxxxxxxx	21	xxxx
COTTON	72	xxxxxxxxxxxxx	0		0	
(66)	64	xxxxxxxxxxxx	0		0	
JUTE	0		0		0	
(67)	0		0		0	
KENAF	69	xxxxxxxxxxxxx	0		0	
(68)	43	xxxxxxxx	0		0	

PRE-EMERGENCE SELECTIVITY EXPERIMENT

HEXAZINONE

SPECIES	0.05 kg/ha		0.15 kg/ha		0.45 kg/ha	
SESAMUM	114	xxxxxxxxxxxxxxxxxxx +	60	xxxxxxxxxxxx	0	
(70)	100	xxxxxxxxxxxxxxxxxxx	64	xxxxxxxxxxxxx	0	
TOMATO	19	xxxx	0		0	
(71)	64	xxxxxxxxxxxxx	0		0	
OR PUNCT	108	xxxxxxxxxxxxxxxxxxx +	77	xxxxxxxxxxxxxxx	100	xxxxxxxxxxxxxxxxxxx
(73)	64	xxxxxxxxxxxxx	29	xxxxxx	14	xxx
ELEU IND	105	xxxxxxxxxxxxxxxxxxx +	21	xxxx	0	
(74)	64	xxxxxxxxxxxxx	29	xxxxxx	0	
ECH CRUS	109	xxxxxxxxxxxxxxxxxxx +	0		0	
(75)	64	xxxxxxxxxxxxx	0		0	
ROTT EXA	107	xxxxxxxxxxxxxxxxxxx +	28	xxxxxx	0	
(76)	86	xxxxxxxxxxxxxxxx	50	xxxxxxxxxx	0	
DIG SANG	104	xxxxxxxxxxxxxxxxxxx +	45	xxxxxxxxx	3	x
(77)	71	xxxxxxxxxxxxxx	50	xxxxxxxxxx	14	xxx
AMAR RET	11	xx	0		0	
(78)	14	xxx	0		0	
SOL NIG	16	xxx	0		0	
(81)	7	x	0		0	
SNOW POL	131	xxxxxxxxxxxxxxxxxxx +	30	xxxxxx	0	
(83)	79	xxxxxxxxxxxxxxxx	29	xxxxxx	0	
CYP ESCU	100	xxxxxxxxxxxxxxxxxxx	90	xxxxxxxxxxxxxxxxxx	50	xxxxxxxxxx
(85)	100	xxxxxxxxxxxxxxxxxxx	50	xxxxxxxxxx	29	xxxxxx

PRE-EMERGENCE SELECTIVITY EXPERIMENT

HEXAZINONE

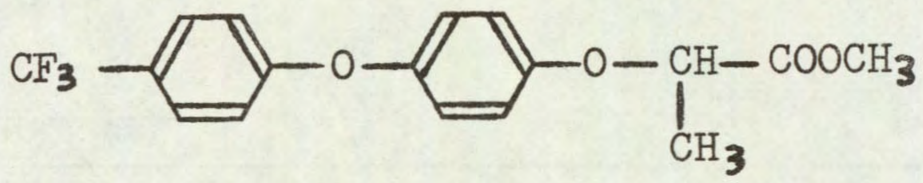
SPECIES		0.05 kg/ha		0.15 kg/ha		0.45 kg/ha
CYP ROTU	121	xxxxxxxxxxxxxxxxxxxx +	70	xxxxxxxxxxxxxx	77	xxxxxxxxxxxxxxx
(86)	100	xxxxxxxxxxxxxxxxxxxx	86	xxxxxxxxxxxxxxxxx	36	xxxxxxx
OXAL LAT	86	xxxxxxxxxxxxxxxxx	50	xxxxxxxxxx	36	xxxxxxx
(87)	93	xxxxxxxxxxxxxxxxxx	50	xxxxxxxxxx	36	xxxxxxx

TRIFOP-METHYL

Code number HOE 29152

Chemical name 2[4(4-trifluoromethyl-phenoxy)-phenoxy]-methylpropionate

Structure



Source

Hoechst UK Ltd
Agricultural Department
Hoechst House
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Information available and suggested uses

Control of perennial and annual grasses in broad-leaved crops. Dose for perennials, eg Agropyron repens, 2-3 kg a.i./ha; for annuals, eg Avena fatua, 0.75-1.5 kg a.i./ha.

Formulation used 36% w/v a.i. emulsifiable concentrate

Spray volume for selectivity experiment 417 l/ha

RESULTS

Full results are given in the histograms on pages 28- 33 and potential selectivities are summarised in the following table.

RATE (kg a.i./ha)	CROPS: vigour reduced by 15% or less	WEEDS: number or vigour reduced by 70% or more
3.0	pea white clover rape kale carrot sugar beet radish cowpea soya bean	Avena fatua Poa annua Agropyron repens + species below
1.0	Species above + field bean chick pea groundnut cotton jute kenaf sesamum tomato	Alopecurus myosuroides Poa trivialis Holcus lanatus Oryza punctata Echinochloa crus-galli Rottboellia exaltata Digitaria sanguinalis Snowdenia polystachya + species below

RATE (kg a.i./ha)	CROPS: vigour reduced by 15% or less	WEEDS: number or vigour reduced by 70% or more
0.33	species above+ barley oat onion dwarf bean lettuce	Eleusine indica

Comments on results

Activity test data, symptoms and post-emergence selectivities were the subject of a previous report (Richardson and Parker, 1977). Considerable foliar and soil activity was then found with grass species while onions and most broad-leaved crops exhibited some degree of tolerance. Incorporation led to a decrease in phytotoxicity on the grasses as compared with surface application and this should be borne in mind when considering the results of this test, where the herbicide was incorporated. A characteristic symptom of trifop-methyl is an inhibition of roots, at the lower doses in grasses but also at the higher doses with certain broad-leaved species.

Soil persistence

The sensitive test species, perennial ryegrass, indicated a considerable period of persistence of trifop-methyl in the soil. Doses of 0.33 and 1.0 kg/ha were barely detectable, 23 and 38 weeks respectively after treatment, but at the latter date the high dose (3.0 kg/ha) was still causing severe damage or kill of plants. This could possibly limit its use in certain situations, for instance where cereals or grass crops follow broad-leaved crops in which the herbicide has been used, especially if these are of short duration.

Pre-emergence selectivities among temperate species

All grass weeds were highly susceptible, being controlled at either 1.0 or 3.0 kg/ha, and considerably weakened at the dose below that at which control was achieved. Poa annua showed somewhat more resistance than the other small seeded species however, corresponding to the earlier post-emergence test (Richardson and Parker, 1977). All broad-leaved weeds including the perennials were resistant. (N.B. Veronica persica became diseased following spraying and this may account for the 75% mortality at 3.0 kg/ha).

Several broad-leaved crops showed good tolerance. Where damage was found it was generally at the higher doses and usually took the form of inhibition of the roots which was sometimes, though not always, accompanied by retardation of the shoots. However the brassicas, kale, rape and radish were completely tolerant at 3.0 kg/ha. The other crops listed as tolerant at this dose (pea, carrot, white clover, sugar beet) all showed a slight weakening of the root systems, but this was not serious or permanent, peas for instance eventually nodulating normally. Onions and lettuce, only listed as tolerant at the lowest dose, eventually recovered well from even the two higher doses, there having been no effect on the roots of onions, while those of lettuce seemed only slightly less sparse than in the controls at assessment, but were healthy when shoots were harvested seven weeks after spraying.

The results obtained in this test, to a large extent, correspond to those of the earlier post-emergence selectivity test (Richardson and Parker, 1977). Annual and perennial grass weeds and even volunteer cereals may be expected to be controlled in several broad-leaved crops and onion, by both methods of application. Some caution must be mentioned with regard to effect on root systems of certain crops and also its persistence in the soil however.

Pre-emergence selectivity among tropical species

In common with the related compounds diclofop methyl and clofop-isobutyl, this herbicide shows a very wide margin of selectivity against grass weeds in broad-leaved crops. Most of the latter tolerated 3 kg/ha or were only slightly affected, while all grasses were controlled at 1 kg/ha and most were seriously reduced at 0.33 kg/ha. Without direct comparison it is not possible to tell whether there are any significant differences in selectivity between trifop-methyl and its relatives previously tested, on this range of species. The main difference to have transpired from other work, yet to be reported, is the much higher activity of trifop-methyl on perennial grass weeds.

TRIFOP METHYL

SPECIES		0.33 kg/ha		1.00 kg/ha		3.00 kg/ha
WHEAT	90	xxxxxxxxxxxxxxxxxx	82	xxxxxxxxxxxxxxxx	52	xxxxxxxxxx
(1)	79	xxxxxxxxxxxxxxxx	43	xxxxxxxxx	29	xxxxxx
BARLEY	112	xxxxxxxxxxxxxxxxxxxx +	98	xxxxxxxxxxxxxxxxxxxx	112	xxxxxxxxxxxxxxxxxxxx +
(2)	100	xxxxxxxxxxxxxxxxxxxx	57	xxxxxxxxxx	36	xxxxxxx
OAT	102	xxxxxxxxxxxxxxxxxxxx +	102	xxxxxxxxxxxxxxxxxxxx +	95	xxxxxxxxxxxxxxxxxx
(3)	86	xxxxxxxxxxxxxxxx	57	xxxxxxxxxx	43	xxxxxxxxx
PER RYGR	89	xxxxxxxxxxxxxxxxxx	7	x	0	
(4)	57	xxxxxxxxxx	21	xxxx	0	
ONION	93	xxxxxxxxxxxxxxxxxx	93	xxxxxxxxxxxxxxxxxx	105	xxxxxxxxxxxxxxxxxxx +
(8)	100	xxxxxxxxxxxxxxxxxxx	79	xxxxxxxxxxxxxxx	79	xxxxxxxxxxxxxxx
DWF BEAN	71	xxxxxxxxxxxxxx	71	xxxxxxxxxxxxxx	53	xxxxxxxxxx
(9)	93	xxxxxxxxxxxxxxxxxx	71	xxxxxxxxxxxxx	64	xxxxxxxxxxxx
FLD BEAN	87	xxxxxxxxxxxxxxxx	100	xxxxxxxxxxxxxxxxxxx	87	xxxxxxxxxxxxxxxx
(10)	93	xxxxxxxxxxxxxxxxxx	86	xxxxxxxxxxxxxxxx	71	xxxxxxxxxxxxx
PEA	100	xxxxxxxxxxxxxxxxxxx	100	xxxxxxxxxxxxxxxxxxx	87	xxxxxxxxxxxxxxxx
(11)	100	xxxxxxxxxxxxxxxxxxx	100	xxxxxxxxxxxxxxxxxxx	86	xxxxxxxxxxxxxxxx
W CLOVER	106	xxxxxxxxxxxxxxxxxxx +	71	xxxxxxxxxxxxxx	81	xxxxxxxxxxxxxxx
(12)	100	xxxxxxxxxxxxxxxxxxx	93	xxxxxxxxxxxxxxxxxx	86	xxxxxxxxxxxxxxx
RAPE	95	xxxxxxxxxxxxxxxxxx	99	xxxxxxxxxxxxxxxxxxx	95	xxxxxxxxxxxxxxxxxx
(14)	100	xxxxxxxxxxxxxxxxxxx	93	xxxxxxxxxxxxxxxxxx	93	xxxxxxxxxxxxxxxxxx
KALE	119	xxxxxxxxxxxxxxxxxxx +	90	xxxxxxxxxxxxxxxxx	100	xxxxxxxxxxxxxxxxxxx
(15)	100	xxxxxxxxxxxxxxxxxxx	100	xxxxxxxxxxxxxxxxxxx	93	xxxxxxxxxxxxxxxxxx

TRIFOP METHYL

SPECIES	0.33 kg/ha		1.00 kg/ha		3.00 kg/ha	
CARROT	60	xxxxxxxxxxxx	82	xxxxxxxxxxxxxxx	65	xxxxxxxxxxxxx
(18)	100	xxxxxxxxxxxxxxxxxxx	100	xxxxxxxxxxxxxxxxxxx	93	xxxxxxxxxxxxxxxxxx
LETTUCE	74	xxxxxxxxxxxxxxx	68	xxxxxxxxxxxxxx	132	xxxxxxxxxxxxxxxxxxx +
(20)	86	xxxxxxxxxxxxxxxxx	79	xxxxxxxxxxxxxxxx	79	xxxxxxxxxxxxxxxx
SUG BEET	56	xxxxxxxxxxx	81	xxxxxxxxxxxxxxx	86	xxxxxxxxxxxxxxxx
(21)	93	xxxxxxxxxxxxxxxxxx	93	xxxxxxxxxxxxxxxxxx	86	xxxxxxxxxxxxxxxx
AVE FATU	86	xxxxxxxxxxxxxxxx	80	xxxxxxxxxxxxxxx	37	xxxxxxx
(26)	86	xxxxxxxxxxxxxxxx	50	xxxxxxxxxx	29	xxxxxx
ALO MYOS	62	xxxxxxxxxxxx	15	xxx	0	
(27)	57	xxxxxxxxxx	14	xxx	0	
POA ANN	116	xxxxxxxxxxxxxxxxxxx +	94	xxxxxxxxxxxxxxxxxx	44	xxxxxxxxx
(28)	86	xxxxxxxxxxxxxxxx	36	xxxxxxx	29	xxxxxx
POA TRIV	47	xxxxxxxxx	6	x	0	
(29)	50	xxxxxxxxxx	29	xxxxxx	0	
SIN ARV	142	xxxxxxxxxxxxxxxxxxx +	91	xxxxxxxxxxxxxxxxx	108	xxxxxxxxxxxxxxxxxxx +
(30)	100	xxxxxxxxxxxxxxxxxxx	93	xxxxxxxxxxxxxxxxxx	93	xxxxxxxxxxxxxxxxxx
RAPH RAP	101	xxxxxxxxxxxxxxxxxxx +	97	xxxxxxxxxxxxxxxxxx	97	xxxxxxxxxxxxxxxxxx
(31)	100	xxxxxxxxxxxxxxxxxxx	93	xxxxxxxxxxxxxxxxxx	100	xxxxxxxxxxxxxxxxxxx
TRIP MAR	79	xxxxxxxxxxxxxxx	133	xxxxxxxxxxxxxxxxxx +	89	xxxxxxxxxxxxxxxxx
(33)	100	xxxxxxxxxxxxxxxxxxx	100	xxxxxxxxxxxxxxxxxx	100	xxxxxxxxxxxxxxxxxxx
SEN VULG	79	xxxxxxxxxxxxxxx	90	xxxxxxxxxxxxxxxxx	77	xxxxxxxxxxxxxxx
(34)	86	xxxxxxxxxxxxxxxx	100	xxxxxxxxxxxxxxxxxx	79	xxxxxxxxxxxxxxx

PRE-EMERGENCE SELECTIVITY EXPERIMENT

TRIFOP METHYL

SPECIES		0.33 kg/ha		1.00 kg/ha		3.00 kg/ha
POL LAPA	98	xxxxxxxxxxxxxxxxxxx	87	xxxxxxxxxxxxxxxx	92	xxxxxxxxxxxxxxxxx
(35)	100	xxxxxxxxxxxxxxxxxxx	93	xxxxxxxxxxxxxxxxxx	100	xxxxxxxxxxxxxxxxxx
GAL APAR	67	xxxxxxxxxxxxx	76	xxxxxxxxxxxxxx	81	xxxxxxxxxxxxxxx
(38)	100	xxxxxxxxxxxxxxxxxxx	100	xxxxxxxxxxxxxxxxxx	100	xxxxxxxxxxxxxxxxxx
CHEN ALB	97	xxxxxxxxxxxxxxxxxx	101	xxxxxxxxxxxxxxxxxx +	97	xxxxxxxxxxxxxxxxxx
(39)	100	xxxxxxxxxxxxxxxxxxx	100	xxxxxxxxxxxxxxxxxx	100	xxxxxxxxxxxxxxxxxx
STEL MED	89	xxxxxxxxxxxxxxxxx	129	xxxxxxxxxxxxxxxxxx +	119	xxxxxxxxxxxxxxxxxx +
(40)	100	xxxxxxxxxxxxxxxxxxx	100	xxxxxxxxxxxxxxxxxx	100	xxxxxxxxxxxxxxxxxx
VER PERS	71	xxxxxxxxxxxxxx	107	xxxxxxxxxxxxxxxxxx +	25	xxxxx
(42)	100	xxxxxxxxxxxxxxxxxxx	100	xxxxxxxxxxxxxxxxxx	64	xxxxxxxxxxxxx
RUM OBTU	86	xxxxxxxxxxxxxxxxx	76	xxxxxxxxxxxxxx	79	xxxxxxxxxxxxxxx
(44)	86	xxxxxxxxxxxxxxxxx	71	xxxxxxxxxxxxx	71	xxxxxxxxxxxxx
HOLC LAN	75	xxxxxxxxxxxxxx	0		0	
(45)	64	xxxxxxxxxxxxx	0		0	
AG REPEN	103	xxxxxxxxxxxxxxxxxxx +	60	xxxxxxxxxxxx	0	
(47)	100	xxxxxxxxxxxxxxxxxxx	36	xxxxxxx	0	
ALL VIN	105	xxxxxxxxxxxxxxxxxxx +	84	xxxxxxxxxxxxxxxx	91	xxxxxxxxxxxxxxxxx
(49)	100	xxxxxxxxxxxxxxxxxxx	100	xxxxxxxxxxxxxxxxxx	93	xxxxxxxxxxxxxxxxx
CIRS ARV	71	xxxxxxxxxxxxxx	100	xxxxxxxxxxxxxxxxxx	86	xxxxxxxxxxxxxxxx
(50)	100	xxxxxxxxxxxxxxxxxxx	93	xxxxxxxxxxxxxxxxx	79	xxxxxxxxxxxxxxx
TUS FARF	100	xxxxxxxxxxxxxxxxxxx	114	xxxxxxxxxxxxxxxxxx +	86	xxxxxxxxxxxxxxxx
(51)	100	xxxxxxxxxxxxxxxxxxx	100	xxxxxxxxxxxxxxxxxx	93	xxxxxxxxxxxxxxxxx

TRIFOP METHYL

SPECIES		0.33 kg/ha		1.00 kg/ha		3.00 kg/ha
MAIZE +A	107	xxxxxxxxxxxxxxxxxxx +	96	xxxxxxxxxxxxxxxxxx	75	xxxxxxxxxxxxxx
(57)	64	xxxxxxxxxxxxx	29	xxxxxx	14	xxx
MAIZE	90	xxxxxxxxxxxxxxxxxx	100	xxxxxxxxxxxxxxxxxxx	60	xxxxxxxxxxxx
(58)	57	xxxxxxxxxxx	29	xxxxxx	14	xxx
SORGHUM	86	xxxxxxxxxxxxxxxxx	14	xxx	0	
(59)	50	xxxxxxxxxx	21	xxxx	0	
RICE	98	xxxxxxxxxxxxxxxxxxx	14	xxx	7	x
(60)	57	xxxxxxxxxxx	21	xxxx	14	xxx
COWPEA	79	xxxxxxxxxxxxxxxx	79	xxxxxxxxxxxxxxxx	88	xxxxxxxxxxxxxxxxxx
(62)	86	xxxxxxxxxxxxxxxxx	93	xxxxxxxxxxxxxxxxxx	86	xxxxxxxxxxxxxxxx
CHICKPEA	92	xxxxxxxxxxxxxxxxx	100	xxxxxxxxxxxxxxxxxxx	100	xxxxxxxxxxxxxxxxxxx
(63)	93	xxxxxxxxxxxxxxxxxx	93	xxxxxxxxxxxxxxxxxx	79	xxxxxxxxxxxxxxx
GRNDNUT	82	xxxxxxxxxxxxxxxx	109	xxxxxxxxxxxxxxxxxxx +	68	xxxxxxxxxxxxxx
(64)	93	xxxxxxxxxxxxxxxxxx	86	xxxxxxxxxxxxxxxxx	71	xxxxxxxxxxxxxx
SOYABEAN	84	xxxxxxxxxxxxxxxxx	72	xxxxxxxxxxxxxx	132	xxxxxxxxxxxxxxxxxxx +
(65)	100	xxxxxxxxxxxxxxxxxxx	86	xxxxxxxxxxxxxxxx	86	xxxxxxxxxxxxxxxxx
COTTON	124	xxxxxxxxxxxxxxxxxxx +	114	xxxxxxxxxxxxxxxxxxx +	114	xxxxxxxxxxxxxxxxxxx +
(66)	93	xxxxxxxxxxxxxxxxxx	100	xxxxxxxxxxxxxxxxxxx	79	xxxxxxxxxxxxxxx
JUTE	116	xxxxxxxxxxxxxxxxxxx +	69	xxxxxxxxxxxxxx	103	xxxxxxxxxxxxxxxxxxx +
(67)	100	xxxxxxxxxxxxxxxxxxx	93	xxxxxxxxxxxxxxxxxx	71	xxxxxxxxxxxxx
KENAF	98	xxxxxxxxxxxxxxxxxxx	81	xxxxxxxxxxxxxxx	87	xxxxxxxxxxxxxxxx
(68)	100	xxxxxxxxxxxxxxxxxxx	100	xxxxxxxxxxxxxxxxxxx	71	xxxxxxxxxxxxx

PRE-EMERGENCE SELECTIVITY EXPERIMENT

TRIFOP METHYL

SPECIES		0.33 kg/ha		1.00 kg/ha		3.00 kg/ha
SESAMUM	108	xxxxxxxxxxxxxxxxxxx +	90	xxxxxxxxxxxxxxxxxx	84	xxxxxxxxxxxxxxxx
(70)	100	xxxxxxxxxxxxxxxxxxx	93	xxxxxxxxxxxxxxxxxx	43	xxxxxxxxx
TOMATO	94	xxxxxxxxxxxxxxxxxx	75	xxxxxxxxxxxxxxx	37	xxxxxxx
(71)	100	xxxxxxxxxxxxxxxxxxx	100	xxxxxxxxxxxxxxxxxxx	71	xxxxxxxxxxxxxx
OR PUNCT	85	xxxxxxxxxxxxxxxxx	8	xx	0	
(73)	43	xxxxxxxxx	21	xxxx	0	
ELEU IND	14	xxx	0		0	
(74)	36	xxxxxxx	0		0	
ECH CRUS	88	xxxxxxxxxxxxxxxxx	4	x	0	
(75)	50	xxxxxxxxxx	14	xxx	0	
ROTT EXA	87	xxxxxxxxxxxxxxxx	71	xxxxxxxxxxxxx	32	xxxxxx
(76)	50	xxxxxxxxxx	29	xxxxxx	14	xxx
DIG SANG	83	xxxxxxxxxxxxxxxx	39	xxxxxxxx	0	
(77)	50	xxxxxxxxxx	21	xxxx	0	
AMAR RET	111	xxxxxxxxxxxxxxxxxxx +	144	xxxxxxxxxxxxxxxxxxx +	167	xxxxxxxxxxxxxxxxxxx +
(78)	100	xxxxxxxxxxxxxxxxxxx	100	xxxxxxxxxxxxxxxxxxx	79	xxxxxxxxxxxxxxx
SOL NIG	79	xxxxxxxxxxxxxxxx	158	xxxxxxxxxxxxxxxxxxx +	221	xxxxxxxxxxxxxxxxxxx +
(81)	100	xxxxxxxxxxxxxxxxxxx	100	xxxxxxxxxxxxxxxxxxx	100	xxxxxxxxxxxxxxxxxxx
SNOW POL	42	xxxxxxxx	45	xxxxxxxxx	71	xxxxxxxxxxxxx
(83)	50	xxxxxxxxxx	21	xxxx	14	xxx
CYP ESCU	100	xxxxxxxxxxxxxxxxxxx	110	xxxxxxxxxxxxxxxxxxx +	90	xxxxxxxxxxxxxxxxx
(85)	100	xxxxxxxxxxxxxxxxxxx	100	xxxxxxxxxxxxxxxxxxx	93	xxxxxxxxxxxxxxxxx

PRE-EMERGENCE SELECTIVITY EXPERIMENT

TRIFOP METHYL

SPECIES		0.33 kg/ha		1.00 kg/ha		3.00 kg/ha
CYP ROTU	96	xxxxxxxxxxxxxxxxxx	83	xxxxxxxxxxxxxxxxx	89	xxxxxxxxxxxxxxxxxx
(86)	100	xxxxxxxxxxxxxxxxxxx	93	xxxxxxxxxxxxxxxxxx	79	xxxxxxxxxxxxxxx
OXAL LAT	86	xxxxxxxxxxxxxxxxx	114	xxxxxxxxxxxxxxxxxxx +	100	xxxxxxxxxxxxxxxxxxx
(87)	86	xxxxxxxxxxxxxxxxx	100	xxxxxxxxxxxxxxxxxxx	93	xxxxxxxxxxxxxxxxxx

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