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THE ACTIVITY AND PRE-EMERGENCE SELECTIVITY OF SOME RECENTLY DEVELOPED HERBICIDES: IMAZAQUIN, ISOXABEN, METSULFURON-METHYL, ACLONIFEN AND ORBENCARB

W G Richardson and T M West

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Agricultural and Food Research Council Weed Research Organization,
Begbroke Hill, Yarnton, Oxford, OX5 1PF

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THE ACTIVITY AND PRE-EMERGENCE SELECTIVITY OF SOME RECENTLY DEVELOPED HERBICIDES: IMAZAQUIN, ISOXABEN, METSULFURON-METHYL, ACLONIFEN, AND ORBENCARB.

W. G. Richardson*, and T. M. West*
Agricultural and Food Research Council Weed Research Organization,
Begbroke Hill, Yarnton, Oxford OX5 1PF, UK.

SUMMARY

In a series of pot experiments in the glasshouse, five herbicides were examined for pre-emergence selectivity as soil surface sprays on 47 temperate crop and weed species. Wheat, barley and maize were each treated with seed dressings of the safener 1,8 naphthalic anhydride (NA) to investigate possible protection from herbicide injury. The route of entry was examined in a separate test on six selected species. Persistence of the herbicides in the soil was examined over a period of 44 weeks.

Imazaquin controlled a wide range of annual and perennial broad-leaved and grass weeds while dwarf and field beans were tolerant. Herbicidal effects on wheat, barley and maize were reduced by NA at lower doses.

All four cereals were tolerant to isoxaben at doses which controlled many annual broad-leaved weeds, including all composites and crucifers but more interestingly Veronica persica, Viola arvensis and even Galium aparine.

Metsulfuron-methyl was extremely active, controlling mostly broad-leaved weeds while all four cereals were tolerant.

Aclonifen controlled a wide range of annual broad-leaved and grass weeds including Alopecurus myosuroides, Veronica persica and Viola arvensis. Crop tolerance was high and included all four cereals, carrot and many leguminous species.

Orbencarb controlled A. myosuroides, Veronica persica and Galium aparine in an otherwise narrow annual weed spectrum. Tolerance was found in cereals, legume and brassica crops.

Persistence in the soil was short to moderate for metsulfuron-methyl, aclonifen and orbencarb, moderately long for imazaquin and long for isoxaben, relative to the standard cyanazine (short persistence) and simazine (long persistence).

INTRODUCTION

The pre- and post-emergence activities and selectivities of new herbicides are investigated at WRO on a large number of pot-grown crop and weed species and at the same time experience of the type of effects produced by each compound is obtained. Persistence in the soil is also monitored and these data in conjunction with crop susceptibilities, are useful in considering subsequent cropping of treated land. The limitations of these investigations are that only one crop variety or source of weed species is used; they are grown in one particular soil type, at only one depth of sowing and without interspecific 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.

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* Herbicide Group

This report gives pre-emergence selectivity data on five new herbicides. Results of activity experiments are also included for isoxaben and orbencarb to provide information on levels of phytotoxicity, type and route of action. Those for imazaquin, metsulfuron-methyl and aclonifen were reported previously (Richardson et al., 1984; Richardson & West, 1984).

METHODS AND MATERIALS

Activity experiment (AE) This was carried out in the glasshouse on six selected species as described previously (Richardson and Dean, 1973). 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 foliar contact,
iii) pre-emergence to the soil surface,
iv) pre-emergence with thorough incorporation to 5 cm depth before planting.

Table 1. Plant data for activity experiments

Species	Cultivar /source	No.per pot at spraying		Depth of planting (cm)	Stage of growth		
		pre-	post		Spraying	Assessment	
					pre-em	pre-em	post-em
Dwarf bean (Phaseolus vulgaris)	Master-piece	3 to 4	2	2.0	2 uni-foliate leaves	1.5 to 2.5 tri-foliate leaves	2 to 3 tri-foliate leaves
Kale (Brassica oleracea acephala)	Marrowstem	10	5	0.5	2 to 2.5 leaves	4 to 5 leaves	4 to 5 leaves
Polygonum amphibium	WRO Clone 1	6	4 to 5	1.0	4.5 to 5.5	6 to 8 leaves	9 to 10 leaves
Perennial ryegrass (Lolium perenne)	S23	15	8 to 10	0.5	2 to 3 leaves	4 to 5 leaves, tiller-ing	2 to 6 tillers
Avena fatua	WRO 1978 WRO 1980	10 to 12	5	1.0	2.5 to 3 leaves	3.5 to 4.5 leaves, 0 to 2 tillers	2 tillers
Elymus repens	WRO Clone 1	6	4 to 5	1.0	2.5 to 3 leaves	3.5 to 5 leaves, 0 to 3 tillers	1 to 2 tillers

Table 2. Soil and environment conditions

Experiment type	Activity expt. 1 isoxaben	Activity expt. 2 orbencarb	Pre-emergence selectivity
Date of spraying	13.10.82	20.5.83	13.12.83
Main assessment completed	16.11.82	21.6.83	3.2.84
Organic matter (%)	2.2	2.2	2.2
Clay content (%)	15.0	15.0	15.0
pH (water; 1:2 soil/water)	7.5	7.5	7.5
Ammonium sulphate (g/kg)	-	-	0.4
Superphosphate (g/kg)	2.0	2.0	0.8
Potassium sulphate (g/kg)	-	-	0.4
Vitax QS fertilizer (g/kg)	2.5	2.5	-
Fritted trace elements (g/kg)	-	-	0.08
Hydrated Mg_2SO_4 (g/kg)	0.8	0.8	0.3
Temperature (^{o}C)			
Mean	19	19	15
Maximum	26	33	22
Minimum	12	11	6
Relative humidity (%)			
Mean	60	60	64
Maximum	85	90	88
Minimum	32	20	33

Pre-emergence selectivity experiment

Techniques for the selectivity experiment were as described by Richardson and Dean (1973), all herbicides being applied as surface pre-emergence treatments. Species were sown as detailed in Appendix 1, each being replicated twice for every treatment.

Radish (Raphanus raphanistrum) was included for ease of propagation and may be regarded as a crop or weed. To improve establishment, seeds of Chenopodium album were kept in 0.1 M potassium nitrate for 48 hours in the light.

To protect from soil-borne pathogens, all seeds (except wheat, barley, oat, perennial ryegrass, C. segetum, G. aparine, Viola arvensis and most perennials) were pre-treated with one of the following:- thiram, captan, thiram + benlate (for onion only), bromophos + captan + thiabendazole (pea only). A. fatua seeds were dressed with 'Harvesan' organo-mercury. Maize seeds were purchased already treated with captan A + teraquinone. The seeds of kale, radish, swede and dwarf bean, were treated with thiram, a 6% gum arabic solution being used prior to dressing, to give better adhesion. In addition, 'Cheshunt Compound' (3 g $litre^{-1}$) fungicide solutions were applied to certain species as soil drenches or sprays to protect against fungal diseases. Root fragments of Cirsium arvense were washed in a 2 ml $litre^{-1}$ colloidal copper solution.

A series of treatments were included for wheat, barley and maize in which seeds were treated with the safener (1,8-naphthalic anhydride) at 0.5% w/w a.i. of seeds.

Herbicides were applied using a laboratory sprayer embodying an 8002E Spraying Systems Tee Jet operated at a pressure of 207 kPa (30 lb/in^2) and moving at 0.54 m/s, 30 cm above the soil. Subsequent watering was from overhead. During the experiment, plants were raised in the glasshouse, normal daylight being supplemented by mercury vapour lighting to provide 14 hour photoperiods.

Assessment and processing of results

Results were processed as described by Richardson and Dean (1973). Survivors were counted and scored for vigour on a 0-7 scale where 0 = dead and 7 = as in untreated control. Certain species showed variable germination and these results were ignored. However, vigour scores were taken for Polygonum lapathifolium and Phalaris paradoxa and these are included in the selectivity tables and referred to in the text where appropriate. Polygonum aviculare, Solanum nigrum and Holcus lanatus failed to germinate.

Pairs of histograms are presented for each treatment, the upper representing plant survival and the lower vigour score, both calculated as percentages of untreated controls. Each 'x' represents a 5% increment in the pre-emergence selectivity experiment but 7% in the activity experiments. 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.

Several species, notably the perennials, were kept for an extra period to observe later effects or the degree of recovery from injury and these final observations are referred to in the text.

Persistence in the soil

This was monitored, by bioassay, in conjunction with the pre-emergence selectivity experiment. Pots (7.5 cm diameter) containing soil were sprayed directly with the herbicides. All pots were then transferred to the temperate glasshouse together with untreated controls and watered as necessary from overhead.

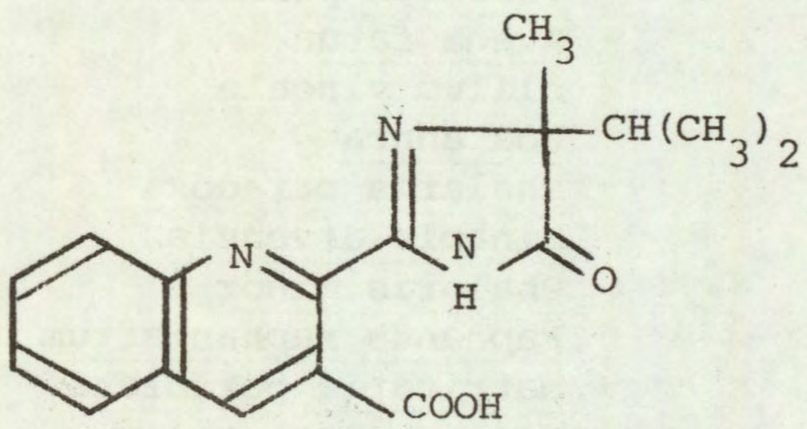
For each bioassay three replicate pots per treatment were selected and sensitive species (perennial ryegrass and turnip) were sown 0.5 cm deep, disturbing the soil as little as possible. Plants were harvested three or four weeks after sowing at a pre-determined growth stage, the number and fresh weight of shoots being recorded. Bioassays were repeated at six to eight week intervals for 44 weeks, unless the herbicides had disappeared before then. Herbicides are considered to have disappeared when shoot fresh weights of the test plants are 80% or more as compared with the controls. Results are presented graphically for each herbicide and comments are made in the text. Standard treatments of cyanazine (short persistence) and simazine (moderate to long persistence) were included for comparison (see page 52). Average temperature during this period was 15 ^{o}C (minimum 2 ^{o}C, maximum 34 ^{o}C) and relative humidity 60% (minimum 25%, maximum 90%).

Imazaquin

Code number Imazaquin

Chemical name 2-(4-isopropyl-4-methyl-5-oxo-2-imidazolin-2-yl) quinoline-3-carboxylic acid

Structure



Source

Cyanamid International Limited
Fareham Road
Gosport
Hants PO13 0AS
UK

Information available and suggested uses

Broad-spectrum weed control in soyabean pre-plant incorporated, pre- and post-emergence; beans and cowpeas pre-emergence; lucerne, clover, tobacco post-emergence. Addition of a non-ionic surfactant is recommended at 0.1 to 0.5% v/v final concentration for post-emergence applications.

Formulation used Water dispersible granules 70% w/w a.i.

Spray volume 373 l/ha

RESULTS

Full results are given in the histograms on pages 8-13 and potential selectivities are summarised in the following table.

RATE (kg a.i./ha)	CROPS: vigour reduced by less than 15%	WEEDS: number or vigour reduced by 70% or more
0.4	None	None listed as no crops tolerant
0.1	dwarf bean field bean	Bromus sterilis Veronica persica Avena fatua Allium vineale Poa annua Phalaris paradoxa + Sinapis arvensis Phalaris minor Raphanus raphanistrum Matricaria perforata Galium aparine + species below
0.025	as above + barley + safener (NA) pea lucerne fenugreek maize + safener (NA)	Beta vulgaris Festuca rubra Alopecurus myosuroides Poa trivialis Chrysanthemum segetum Senecio vulgaris Chenopodium album Stellaria media Rumex obtusifolius Elymus repens Cirsium arvense Tussilago farfara Convolvulus arvensis

+ not in histograms

Comments on results

The activity, post-emergence selectivity and symptoms produced on susceptible species were described previously (Richardson, et al. 1984). Activity was greater with soil applications, particularly pre-emergence, but with little difference between surface and incorporated treatments. A pronounced chlorosis and inhibition of growth usually preceded necrosis and death of tissues. At higher doses, plants often failed to emerge from the soil or died back soon after. Cessation of growth after reaching the cotyledon stage was a striking feature with broad-leaved species.

Persistence in the soil

A moderate to long period of persistence in the soil was apparent, using turnip as the test species. Although 0.025 kg/ha was undetected 44 weeks after treatment, 0.1 and 0.4 kg/ha were still reducing shoot fresh weights by 92 and 96% respectively at this same date.

Pre-emergence selectivity

Thirteen weeds were controlled at the lowest dose of 0.025 kg/ha. These included perennial species (Elymus repens, Cirsium arvense, Tussilago farfara) as well as annual broad-leaved and grass species. A further eleven species were controlled at 0.1 kg/ha, notably the annuals, but also Allium vineale.

Dwarf bean and field bean were the two most tolerant crops, withstanding 0.1 kg/ha and being reduced in vigour by only 29 and 36% respectively at 0.4 kg/ha. Three other leguminous species, pea, lucerne and fenugreek, tolerated 0.025 kg/ha. Onion, white clover, brassicas, (rape, kale, swede), carrot, sugar beet and perennial ryegrass were sensitive. The safener, NA improved the tolerance of the three cereals, wheat, barley and maize such that the two latter species were tolerant to 0.025 kg/ha. Even at 0.1 kg/ha, vigour of all three was improved considerably by NA, but no safening resulted at 0.4 kg/ha.

The potential control of such a wide range of weeds, including many of considerable importance in dwarf and field beans is impressive and deserves following up. The weed spectrum appears wider pre-emergence than in the earlier post-emergence trial with these crops (Richardson et al., 1984). However the possibility of spraying over such a long time interval from pre-emergence to post-emergence would be a distinct advantage. Further work with the safener, NA and possibly other safeners, and other crops would seem worthwhile, the results here suggesting the potential control of Alopecurus myosuroides, Avena fatua and Bromus sterilis as well as volunteer cereals and many other important weeds in cereals.

PRE-EMERGENCE SELECTIVITY TEST

IMAZAQUIN

SPECIES		0.025 KG/HA		0.1 KG/HA		0.4 KG/HA
WHEAT	102	XXXXXXXXXXXXXXXXXXX	102	XXXXXXXXXXXXXXXXXXX	83	XXXXXXXXXXXXXXXX
(1)	64	XXXXXXXXXXXXX	29	XXXXXX	21	XXXX
WHEAT+S	100	XXXXXXXXXXXXXXXXXXX	94	XXXXXXXXXXXXXXXXXX	81	XXXXXXXXXXXXXXXX
(2)	79	XXXXXXXXXXXXXXX	71	XXXXXXXXXXXXX	21	XXXX
BARLEY	102	XXXXXXXXXXXXXXXXXXX	102	XXXXXXXXXXXXXXXXXXX	102	XXXXXXXXXXXXXXXXXXX
(3)	79	XXXXXXXXXXXXXXX	36	XXXXXX	29	XXXXX
BARLEY+S	94	XXXXXXXXXXXXXXXXXX	100	XXXXXXXXXXXXXXXXXXX	100	XXXXXXXXXXXXXXXXXXX
(4)	86	XXXXXXXXXXXXXXXX	71	XXXXXXXXXXXXX	29	XXXXX
OAT	104	XXXXXXXXXXXXXXXXXXX+	104	XXXXXXXXXXXXXXXXXXX+	98	XXXXXXXXXXXXXXXXXXX
(5)	64	XXXXXXXXXXXXX	43	XXXXXXXXX	29	XXXXX
PER RYGR	69	XXXXXXXXXXXXXX	81	XXXXXXXXXXXXXXX	36	XXXXXX
(6)	36	XXXXXX	21	XXX	14	XXX
ONION	62	XXXXXXXXXXXX	66	XXXXXXXXXXXX	18	XXX
(8)	36	XXXXXX	29	XXXXX	21	XXX
DWF BEAN	100	XXXXXXXXXXXXXXXXXXX	100	XXXXXXXXXXXXXXXXXXX	100	XXXXXXXXXXXXXXXXXXX
(9)	100	XXXXXXXXXXXXXXXXXXX	93	XXXXXXXXXXXXXXXXXX	71	XXXXXXXXXXXXX
FLD BEAN	63	XXXXXXXXXXXXX	111	XXXXXXXXXXXXXXXXXXX+	111	XXXXXXXXXXXXXXXXXXX+
(10)	100	XXXXXXXXXXXXXXXXXXX	100	XXXXXXXXXXXXXXXXXXX	64	XXXXXXXXXXXX
PEA	88	XXXXXXXXXXXXXXXXX	71	XXXXXXXXXXXXX	71	XXXXXXXXXXXXX
(11)	100	XXXXXXXXXXXXXXXXXXX	79	XXXXXXXXXXXXXXX	43	XXXXXXXX

IMAZAQUIN

SPECIES	0.025 KG/HA		0.1 KG/HA		0.4 KG/HA	
W CLOVER	123	XXXXXXXXXXXXXXXXXXX+	123	XXXXXXXXXXXXXXXXXXX+	68	XXXXXXXXXXXXX
(12)	43	XXXXXXXXX	14	XXX	14	XXX
LUCERNE	121	XXXXXXXXXXXXXXXXXXX+	116	XXXXXXXXXXXXXXXXXXX+	74	XXXXXXXXXXXXXX
(13)	93	XXXXXXXXXXXXXXXXX	57	XXXXXXXXXX	29	XXXXXX
RAPE	97	XXXXXXXXXXXXXXXXX	78	XXXXXXXXXXXXXXX	86	XXXXXXXXXXXXXXXX
(14)	43	XXXXXXXXX	21	XXXX	14	XXX
KALE	92	XXXXXXXXXXXXXXXXX	92	XXXXXXXXXXXXXXXXX	99	XXXXXXXXXXXXXXXXXX
(15)	36	XXXXXXX	29	XXXXXX	29	XXXXXX
SWEDE	86	XXXXXXXXXXXXXXXX	90	XXXXXXXXXXXXXXXXX	64	XXXXXXXXXXXX
(17)	43	XXXXXXXXX	29	XXXXXX	14	XXX
CARROT	92	XXXXXXXXXXXXXXXXX	83	XXXXXXXXXXXXXXXX	58	XXXXXXXXXXX
(18)	36	XXXXXXX	21	XXXX	14	XXX
LETTUCE	93	XXXXXXXXXXXXXXXXXX	101	XXXXXXXXXXXXXXXXXX	34	XXXXXXX
(20)	71	XXXXXXXXXXXXXX	50	XXXXXXXXXX	21	XXXX
FENUGREK	115	XXXXXXXXXXXXXXXXXXX+	104	XXXXXXXXXXXXXXXXXXX+	104	XXXXXXXXXXXXXXXXXXX+
(21)	93	XXXXXXXXXXXXXXXXX	64	XXXXXXXXXXXX	29	XXXXXX
SUG BEET	60	XXXXXXXXXXXX	60	XXXXXXXXXXXX	86	XXXXXXXXXXXXXXXX
(22)	29	XXXXXX	14	XXX	14	XXX
BETA VUL	56	XXXXXXXXXX	32	XXXXXX	40	XXXXXXXX
(23)	29	XXXXXX	21	XXXX	14	XXX

PRE-EMERGENCE SELECTIVITY TEST

IMAZAQUIN

SPECIES	0.025 KG/HA		0.1 KG/HA		0.4 KG/HA	
BROM STE	82	XXXXXXXXXXXXXXXX	55	XXXXXXXXXXX	5	X
(24)	36	XXXXXXX	14	XXX	7	X
FEST RUB	57	XXXXXXXXXXX	16	XXX	49	XXXXXXXXXX
(25)	21	XXXX	14	XXX	14	XXX
AVE FATU	121	XXXXXXXXXXXXXXXXXXXX+	93	XXXXXXXXXXXXXXXXXXX	107	XXXXXXXXXXXXXXXXXXX+
(26)	50	XXXXXXXXXX	29	XXXXXX	21	XXXX
ALO MYOS	52	XXXXXXXXXX	46	XXXXXXXXX	17	XXX
(27)	21	XXXX	14	XXX	14	XXX
POA ANN	78	XXXXXXXXXXXXXXXX	62	XXXXXXXXXXXX	59	XXXXXXXXXXX
(28)	36	XXXXXXX	29	XXXXXX	14	XXX
POA TRIV	73	XXXXXXXXXXXXXXX	49	XXXXXXXXXX	16	XXX
(29)	14	XXX	14	XXX	14	XXX
SIN ARV	80	XXXXXXXXXXXXXXXX	83	XXXXXXXXXXXXXXXXX	17	XXX
(30)	36	XXXXXXX	14	XXX	14	XXX
RAPH RAP	92	XXXXXXXXXXXXXXXXXX	66	XXXXXXXXXXXXX	56	XXXXXXXXXX
(31)	36	XXXXXXX	29	XXXXXX	21	XXXX
CHRY SEG	97	XXXXXXXXXXXXXXXXXX	106	XXXXXXXXXXXXXXXXXXX+	72	XXXXXXXXXXXXX
(32)	29	XXXXXX	29	XXXXXX	14	XXX
MAT PERF	83	XXXXXXXXXXXXXXXX	91	XXXXXXXXXXXXXXXXX	29	XXXXXX
(33)	36	XXXXXXX	14	XXX	14	XXX

IMAZAQUIN

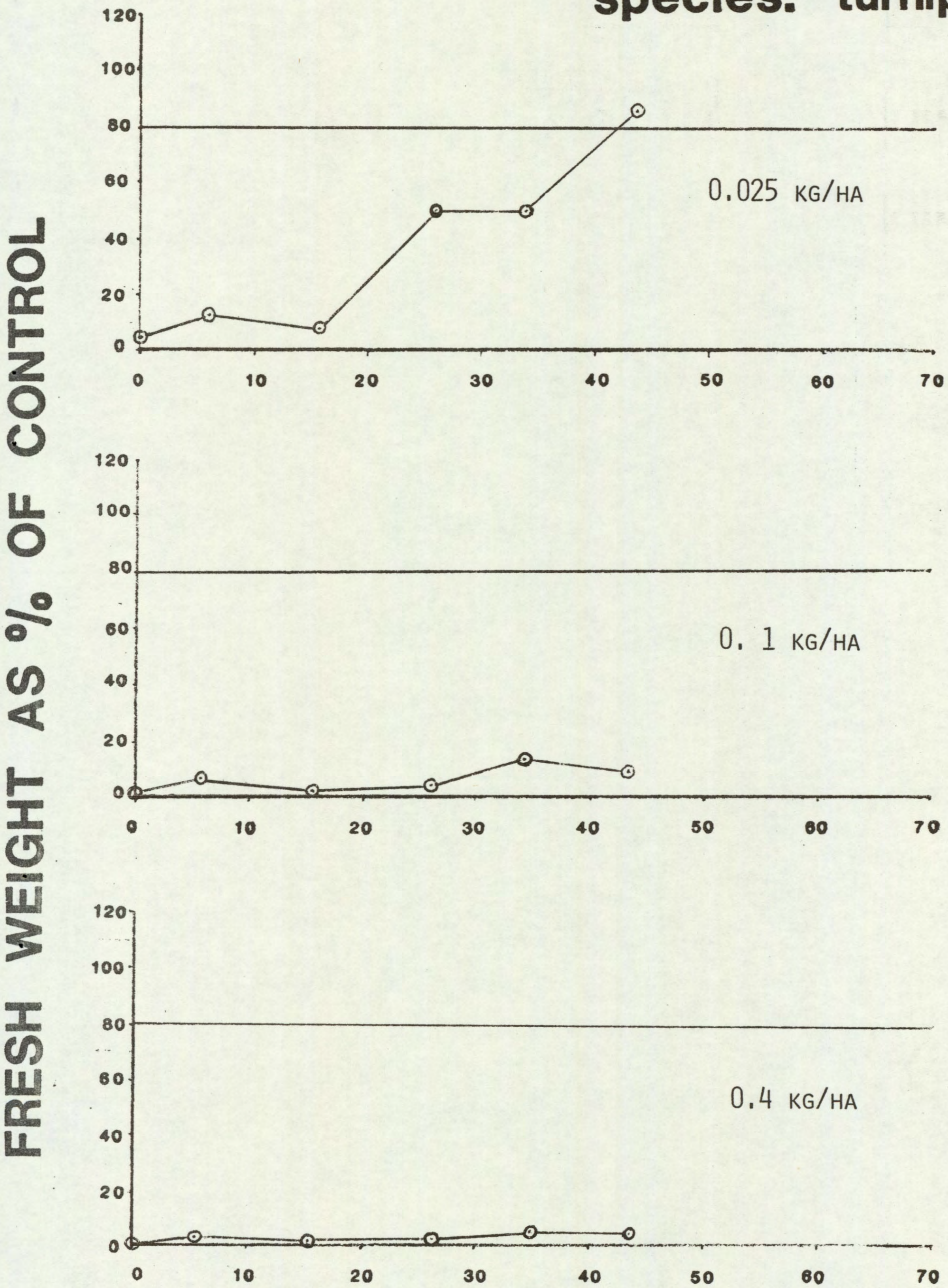
SPECIES	0.025 KG/HA		0.1 KG/HA		0.4 KG/HA	
SEN VULG	0		0		0	
(34)	0		0		0	
GAL APAR	98	XXXXXXXXXXXXXXXXXXX	81	XXXXXXXXXXXXXXX	63	XXXXXXXXXXXXX
(38)	50	XXXXXXXXXX	29	XXXXXX	21	XXXX
CHEN ALB	99	XXXXXXXXXXXXXXXXXXX	84	XXXXXXXXXXXXXXXX	92	XXXXXXXXXXXXXXXXX
(39)	29	XXXXXX	29	XXXXXX	14	XXX
STEL MED	118	XXXXXXXXXXXXXXXXXXX+	127	XXXXXXXXXXXXXXXXXXX+	109	XXXXXXXXXXXXXXXXXX+
(40)	21	XXXX	14	XXX	14	XXX
VER PERS	87	XXXXXXXXXXXXXXXX	62	XXXXXXXXXXX	50	XXXXXXXXX
(42)	43	XXXXXXXXX	21	XXXX	14	XXX
VI ARVE	63	XXXXXXXXXXXX	95	XXXXXXXXXXXXXXXXX	39	XXXXXXX
(43)	50	XXXXXXXXXX	36	XXXXXX	29	XXXXX
RUM OBTU	67	XXXXXXXXXXXX	78	XXXXXXXXXXXXXX	122	XXXXXXXXXXXXXXXXXX+
(44)	29	XXXXX	21	XXXX	14	XXX
EL REPEN	37	XXXXXX	0		0	
(47)	29	XXXXX	0		0	
ALL VIN	96	XXXXXXXXXXXXXXXXX	38	XXXXXXX	6	X
(49)	36	XXXXXX	29	XXXXX	7	X
CIRS ARV	50	XXXXXXXXX	0		0	
(50)	21	XXXX	0		0	

IMAZAQUIN

SPECIES	0.025 KG/HA		0.1 KG/HA		0.4 KG/HA	
TUS FARF	25	XXXXX	12	XX	0	
(51)	14	XXX	7	X	0	
CONV ARV	18	XXXX	53	XXXXXXXXXX	88	XXXXXXXXXXXXXXXXX
(52)	14	XXX	29	XXXXXX	21	XXXX
MAIZE+S	100	XXXXXXXXXXXXXXXXXXX	100	XXXXXXXXXXXXXXXXXXX	80	XXXXXXXXXXXXXXX
(56)	86	XXXXXXXXXXXXXXXX	79	XXXXXXXXXXXXXXX	21	XXXX
MAIZE	100	XXXXXXXXXXXXXXXXXXX	100	XXXXXXXXXXXXXXXXXXX	70	XXXXXXXXXXXXX
(57)	64	XXXXXXXXXXXX	50	XXXXXXXXX	21	XXXX
PHAL MIN	98	XXXXXXXXXXXXXXXXXXX	29	XXXXX	4	X
(84)	79	XXXXXXXXXXXXXXX	43	XXXXXXXX	14	XXX

PERSISTENCE OF IMAZAQUIN

species: turnip



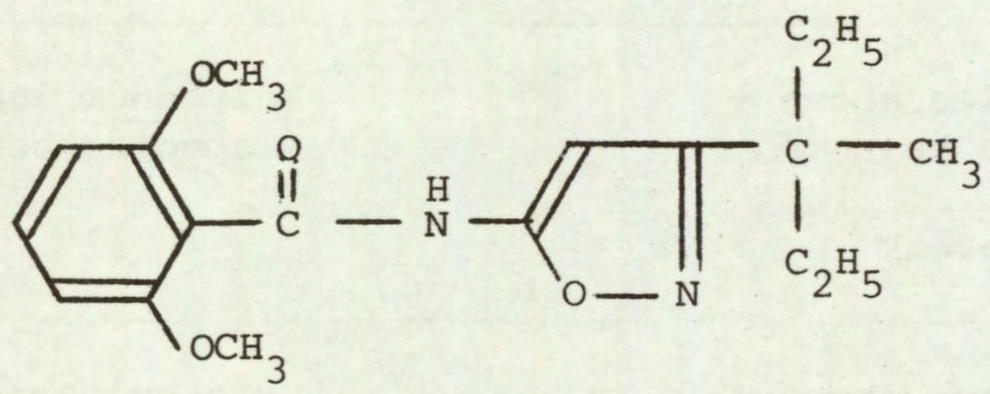
Isoxaben

Code number EL 107 **Trade name** Flexidor

Former common name Benzamizole

Chemical name N-[3-(1-ethyl-1-methylpropyl)-5-isoxazolyl]-2,6-dimethoxybenzamide

Structure



Source

Elanco Products Limited
Kingsclere Road
Basingstoke
Hants RG21 2XA

Information available and suggested uses

Pre-emergence control of broad-leaved weeds in cereals

Formulation used Suspension concentrate 50% w/w a.i.

Spray volume 373 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 less than 15%	WEEDS: number or vigour reduced by 70% or more
0.64	wheat±safener (NA) barley±safener (NA) oat maize±safener (NA)	Festuca rubra Poa trivialis Raphanus raphanistrum Galium aparine Phalaris paradoxa + + species below
0.16	species above + field bean pea fenugreek	Polygonum lapathifolium + + species below
0.04	species above + perennial ryegrass dwarf bean lucerne	Beta vulgaris Sinapis arvensis Chrysanthemum segetum Matricaria perforata Senecio vulgaris Chenopodium album Stellaria media Veronica persica Viola arvensis Rumex obtusifolius

+ not in histograms

Comments on results
Activity experiment

The foliar spray caused only minor effects on the four annual species. The soil drench was more active but there were no lethal effects on any of the species. Greatest activity was found pre-emergence, especially on the smaller-seed, kale and ryegrass, both of which were much more sensitive to the surface, rather than the incorporated pre-emergence treatments. The reverse trend was found on the two perennial species, the incorporation being the more active form of treatment, but phytotoxicity was generally much less. The larger-seeded annuals (dwarf bean and Avena fatua) showed considerable tolerance.

Symptoms on susceptible species

Symptoms on sprayed foliage were usually minor and transient, new leaves developing after spraying being healthy. The soil drench severely inhibited growth in the kale and ryegrass, new leaves appearing miniaturised in the former species while there was leaf trapping in the latter. Some chlorosis of leaves was seen in kale and Polygonum amphibium. Necrosis developed later in the latter species and ryegrass. At higher doses pre-emergence, plants often failed to emerge from the soil or died back soon after. At lower doses, some species appeared in miniaturised form, but did not survive. Several species ceased growth at the cotyledon leaf stage, these often being chlorotic before necrosis developed. Stem bases below cotyledons of brassicas were abnormally swollen. Some grasses tended to a prostrate habit and exhibited shortened, thickened

secondary roots. Poa annua leaves appeared dart-like and were darker green in colour. With Elymus repens, onion leafing was apparent.

Persistence in the soil

A long period of persistence in the soil exists with izoxaben. Using turnip as the test species, doses of 0.04, 0.16 and 0.64 kg/ha were reducing shoot fresh weight by 92, 99 and 100% respectively, 44 weeks after treatment.

Pre-emergence selectivity

Ten annual broad-leaved weeds were controlled at the lowest dose of 0.04 kg/ha. These included all three composites (Chrysanthemum segetum, Matricaria perforata, Senecio vulgaris) but more importantly, Viola arvensis and Veronica persica. At 0.16 kg/ha, Polygonum lapathifolium was controlled and a further five annual species at the highest dose of 0.64 kg/ha, including Galium aparine and three grasses (Poa trivialis, Phalaris paradoxa, Festuca rubra). Most other grasses, (Avena fatua, Alopecurus myosuroides, Bromus sterilis) and all perennials were resistant.

All four cereals (wheat, barley, oat, maize) tolerated the highest dose of 0.64 kg/ha. At 0.16 kg/ha three leguminous crops (field bean, pea, fenugreek) were tolerant. Two other legumes, dwarf bean and lucerne withstood 0.04 kg/ha as did perennial ryegrass.

The control of a wide spectrum of broad-leaved weeds is possible in cereals, most interestingly Veronica persica and Viola arvensis, two problem weeds of recent years. Also, the potential control of Galium aparine in cereals deserves further investigation. The tolerance of several legumes and perennial ryegrass may also be worth additional study. In all of these crops, the lack of grass weed control would be a disadvantage, such that mixture studies will be needed.

ACTIVITY EXPERIMENT

ISOXABEN

		0.025 kg/ha	0.125 kg/ha	0.625 kg/ha
DWARF BEAN	F	xxxxxxxxxxxxxx xxxxxxxxxxx	xxxxxxxxxxxxxx xxxxxxxxxx	xxxxxxxxxxxxxx xxxxxxxxxx
	S	xxxxxxxxxxxxxx xxxxxxxxxxxxx	xxxxxxxxxxxxxx xxxxxxxxxxxx	xxxxxxxxxxxxxx xxxxxxxxxx
	P	xxxxxxxxxxxxxx xxxxxxxxxxx	xxxxxxxxxxxxxx xxxxxxxxxx	xxxxxxxxxxxxxx xxxxxxxxx
	I	xxxxxxxxxxxxxx xxxxxxxxxxxxx	xxxxxxxxxxxxxx xxxxxxxxxxxx	xxxxxxxxxxxxxx xxxxxxxx
KALE	F	xxxxxxxxxxxxxx xxxxxxxxxxxx	xxxxxxxxxxxxxx xxxxxxxxxxxx	xxxxxxxxxxxxxx xxxxxxxxxx x
	S	xxxxxxxxxxxxxx xxxxxxxxxx	xxxxxxxxxxxxxx xxxxxxx	xxxxxxxxxxxxxx xxxx
	P	xxxx xxxxxxxx	o o	o o
	I	xxxxxxxxxx xxxxxxxx	xxxxxx xxxxx	x x
POLYGONUM AMPHIBIUM	F	xxxxxxxxxxxxxx xxxxxxxxxxxxx	xxxxxxxxxxxxxx xxxxxxxxxxxxx	xxxxxxxxxxxxxx xxxxxxxxxxxxx
	S	xxxxxxxxxxxxxx xxxxxxxxxxxxx	xxxxxxxxxxxxxx xxxxxxxxxxxx	xxxxxxxxxxxxxx xxxxxxxx
	P	xxxxxxxxxxxxxx xxxxxxxxxxxxx	xxxxxxxxxxxxxx xxxxxxxxxxxx	xxxxxxxxxxxxxx xxxxxxxxxxx
	I	xxxxxxxxxxxxxx xxxxxxxxxxxxx	xxxxxxxxxxxxxx xxxxxxxxx	xxxxxxxxxxxxxx xxxxx
PERENNIAL RYEGRASS	F	xxxxxxxxxxxxxx xxxxxxxxxxxxx	xxxxxxxxxxxxxx xxxxxxxxxxxxx	xxxxxxxxxxxxxx xxxxxxxxxxx
	S	xxxxxxxxxxxxxx xxxxxxxxxxxxx	xxxxxxxxxxxxxx xxxxxxxxxxxx	xxxxxxxxxxxxxx xxxxxxxx
	P	xxxxxxxxxxxxxx+ xxxxxxxxxxx	xxxxxxxxxxx xxxxxxxx	o o
	I	xxxxxxxxxxxxxx+ xxxxxxxxxxxxx	xxxxxxxxxxxxx xxxxxxxxx	xxxxxxxxxxxxxx+ xxxxxxx
AVENA FATUA	F	xxxxxxxxxxxxxx xxxxxxxxxxxxx	xxxxxxxxxxxxxx x xxxxxxxxxxxx x	xxxxxxxxxxxxxx xxxxxxxxxxxx
	S	xxxxxxxxxxxxxx xxxxxxxxxxxxx	xxxxxxxxxxxxxx x xxxxxxxxxxxx x	xxxxxxxxxxxxxx xxxxxxxxxxxx
	P	xxxxxxxxxxxxxx+ xxxxxxxxxxxxx	xxxxxxxxxxxxxx+ xxxxxxxxxxxxx	xxxxxxxxxxxxxx xxxxxxxxxxxxx
	I	xxxxxxxxxxxxxx xxxxxxxxxxxxx	xxxxxxxxxxxxxx xxxxxxxxxxxxx	xxxxxxxxxxxxxx+ xxxxxxxxxxxxx
ELYMUS REPENS	F	xxxxxxxxxxxxxx xxxxxxxxxxxxx	xxxxxxxxxxxxxx xxxxxxxxxxxxx	xxxxxxxxxxxxxx xxxxxxxxxxxxx
	S	xxxxxxxxxxxxxx xxxxxxxxxxxxx	xxxxxxxxxxxxxx xxxxxxxxxxxxx	xxxxxxxxxxxxxx xxxxxxxxxxx
	P	xxxxxxxxxxxxxx+ xxxxxxxxxxxxx	xxxxxxxxxxxxxx+ xxxxxxxxxxxxx	xxxxxxxxxxxxxx+ xxxxxxxxxxxxx
	I	xxxxxxxxxxxxxx xxxxxxxxxxxxx	xxxxxxxxxxxxxx xxxxxxxxxxxxx	xxxxxxxxxxxxxx xxxxxxxxxxx

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

ISOXABEN

SPECIES		0.04 KG/HA		0.16 KG/HA		0.64 KG/HA
WHEAT	96	XXXXXXXXXXXXXXXXXX	96	XXXXXXXXXXXXXXXXXX	102	XXXXXXXXXXXXXXXXXXX
(1)	100	XXXXXXXXXXXXXXXXXX	100	XXXXXXXXXXXXXXXXXX	100	XXXXXXXXXXXXXXXXXXX
WHEAT+S	94	XXXXXXXXXXXXXXXXXX	100	XXXXXXXXXXXXXXXXXX	100	XXXXXXXXXXXXXXXXXXX
(2)	100	XXXXXXXXXXXXXXXXXX	100	XXXXXXXXXXXXXXXXXX	100	XXXXXXXXXXXXXXXXXXX
BARLEY	102	XXXXXXXXXXXXXXXXXX	96	XXXXXXXXXXXXXXXXXX	102	XXXXXXXXXXXXXXXXXXX
(3)	100	XXXXXXXXXXXXXXXXXX	93	XXXXXXXXXXXXXXXXX	86	XXXXXXXXXXXXXXXX
BARLEY+S	100	XXXXXXXXXXXXXXXXXX	100	XXXXXXXXXXXXXXXXXX	100	XXXXXXXXXXXXXXXXXXX
(4)	100	XXXXXXXXXXXXXXXXXX	100	XXXXXXXXXXXXXXXXXX	100	XXXXXXXXXXXXXXXXXXX
OAT	104	XXXXXXXXXXXXXXXXXX+	104	XXXXXXXXXXXXXXXXXX+	98	XXXXXXXXXXXXXXXXXXX
(5)	100	XXXXXXXXXXXXXXXXXX	100	XXXXXXXXXXXXXXXXXX	93	XXXXXXXXXXXXXXXXXX
PER RYGR	93	XXXXXXXXXXXXXXXXXX	73	XXXXXXXXXXXXXX	4	X
(6)	93	XXXXXXXXXXXXXXXXXX	71	XXXXXXXXXXXXX	21	XXXX
ONION	66	XXXXXXXXXXXX	40	XXXXXXXX	0	
(8)	79	XXXXXXXXXXXXXX	50	XXXXXXXXX	0	
DWF BEAN	100	XXXXXXXXXXXXXXXXXXX	100	XXXXXXXXXXXXXXXXXXX	100	XXXXXXXXXXXXXXXXXXX
(9)	100	XXXXXXXXXXXXXXXXXXX	71	XXXXXXXXXXXXX	50	XXXXXXXXXX
FLD BEAN	79	XXXXXXXXXXXXXXX	95	XXXXXXXXXXXXXXXXXX	79	XXXXXXXXXXXXXXX
(10)	93	XXXXXXXXXXXXXXXXXX	86	XXXXXXXXXXXXXXXX	43	XXXXXXXXX
PEA	141	XXXXXXXXXXXXXXXXXXX+	106	XXXXXXXXXXXXXXXXXXX+	53	XXXXXXXXXXX
(11)	100	XXXXXXXXXXXXXXXXXXX	93	XXXXXXXXXXXXXXXXXXX	14	XXX

ISOXABEN

SPECIES		0.04 KG/HA		0.16 KG/HA		0.64 KG/HA	
W CLOVER	27	XXXXX	0		0		
(12)	21	XXXX	0		0		
LUCERNE	95	XXXXXXXXXXXXXXXXXX	11	XX	5	X	
(13)	93	XXXXXXXXXXXXXXXXXX	29	XXXXXX	21	XXXX	
RAPE	59	XXXXXXXXXXX	16	XXX	5	X	
(14)	50	XXXXXXXXXX	43	XXXXXXXXX	7	X	
KALE	60	XXXXXXXXXXX	42	XXXXXXXX	14	XXX	
(15)	79	XXXXXXXXXXXXXXX	36	XXXXXXX	29	XXXXXX	
SWEDE	34	XXXXXXX	4	X	0		
(17)	29	XXXXXX	7	X	0		
CARROT	50	XXXXXXXXXX	0		0		
(18)	64	XXXXXXXXXXXX	0		0		
LETTUCE	17	XXX	34	XXXXXXX	17	XXX	
(20)	64	XXXXXXXXXXXX	57	XXXXXXXXXX	21	XXXX	
FENUGREK	76	XXXXXXXXXXXXXX	98	XXXXXXXXXXXXXXXXXXX	65	XXXXXXXXXXXX	
(21)	100	XXXXXXXXXXXXXXXXXXX	100	XXXXXXXXXXXXXXXXXXX	64	XXXXXXXXXXXX	
SUG BEET	39	XXXXXXXX	9	XX	4	X	
(22)	43	XXXXXXXXX	14	XXX	7	X	
BETA VUL	27	XXXXX	8	XX	8	XX	
(23)	64	XXXXXXXXXXXX	29	XXXXX	21	XXXX	

ISOXABEN

SPECIES	0.04 KG/HA		0.16 KG/HA		0.64 KG/HA	
BROM STE	109	XXXXXXXXXXXXXXXXXXX+	105	XXXXXXXXXXXXXXXXXXX+	105	XXXXXXXXXXXXXXXXXXX+
(24)	100	XXXXXXXXXXXXXXXXXXX	100	XXXXXXXXXXXXXXXXXXX	100	XXXXXXXXXXXXXXXXXXX
FEST RUB	49	XXXXXXXXX	81	XXXXXXXXXXXXXXX	0	
(25)	86	XXXXXXXXXXXXXXXX	86	XXXXXXXXXXXXXXXX	0	
AVE FATU	107	XXXXXXXXXXXXXXXXXXX+	114	XXXXXXXXXXXXXXXXXXX+	114	XXXXXXXXXXXXXXXXXXX+
(26)	100	XXXXXXXXXXXXXXXXXXX	100	XXXXXXXXXXXXXXXXXXX	100	XXXXXXXXXXXXXXXXXXX
ALO MYOS	115	XXXXXXXXXXXXXXXXXXX+	92	XXXXXXXXXXXXXXXXX	98	XXXXXXXXXXXXXXXXXXX
(27)	100	XXXXXXXXXXXXXXXXXXX	93	XXXXXXXXXXXXXXXXXX	79	XXXXXXXXXXXXXXX
POA ANN	117	XXXXXXXXXXXXXXXXXXX+	91	XXXXXXXXXXXXXXXXX	36	XXXXXXX
(28)	100	XXXXXXXXXXXXXXXXXXX	71	XXXXXXXXXXXXX	43	XXXXXXXXX
POA TRIV	89	XXXXXXXXXXXXXXXXX	57	XXXXXXXXXX	0	
(29)	71	XXXXXXXXXXXXX	50	XXXXXXXXX	0	
SIN ARV	27	XXXXX	0		0	
(30)	57	XXXXXXXXXX	0		0	
RAPH RAP	61	XXXXXXXXXXX	36	XXXXXXX	0	
(31)	57	XXXXXXXXXX	36	XXXXXXX	0	
CHRY SEG	63	XXXXXXXXXXXXX	34	XXXXXXX	0	
(32)	29	XXXXXX	14	XXX	0	
MAT PERF	29	XXXXXX	0		0	
(33)	29	XXXXXX	0		0	

ISOXABEN

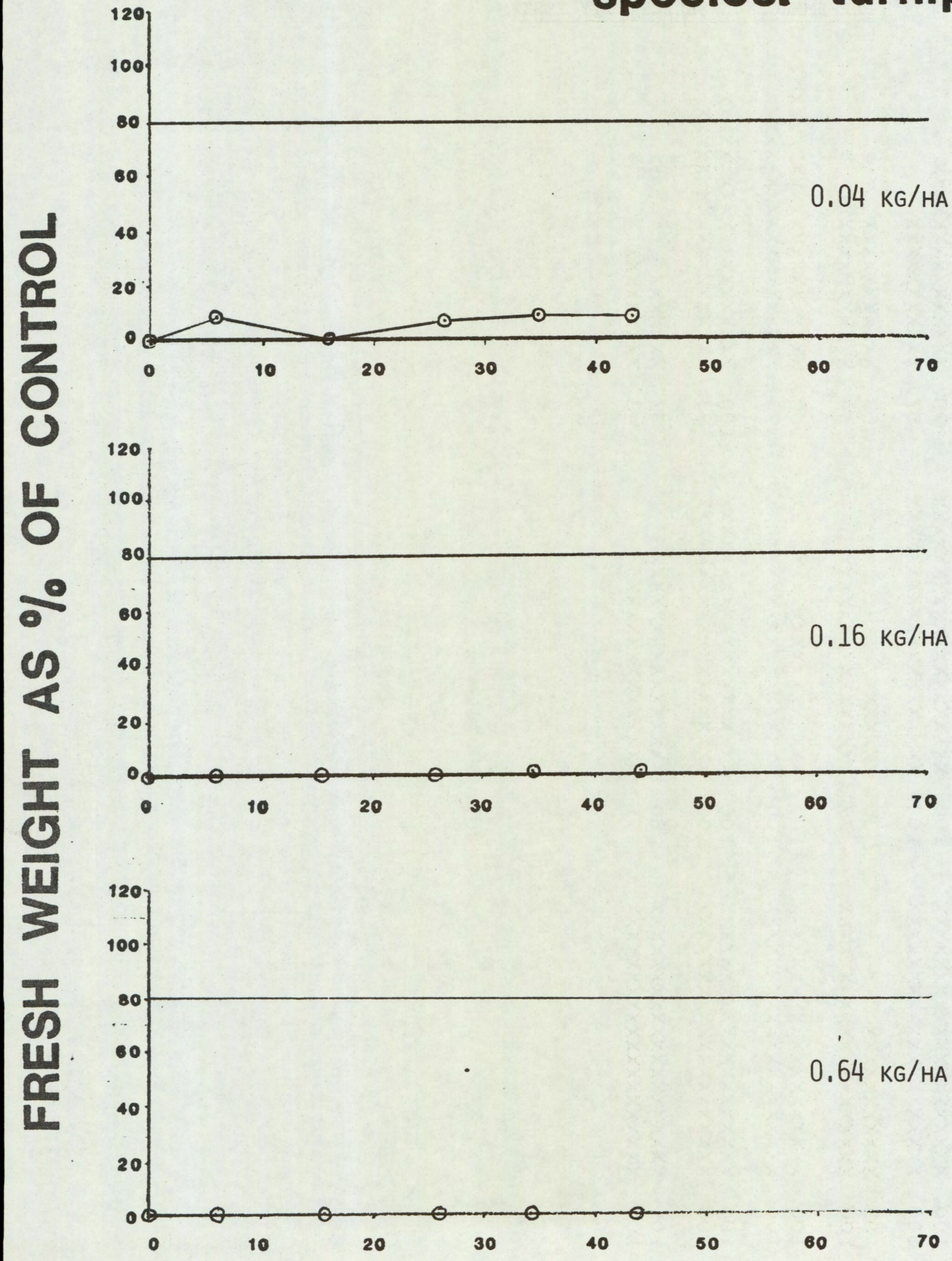
SPECIES		0.04 KG/HA		0.16 KG/HA		0.64 KG/HA	
SEN VULG	18	XXXX	0		0		
(34)	21	XXXX	0		0		
GAL APAR	69	XXXXXXXXXXXXXX	35	XXXXXXX	17	XXX	
(38)	86	XXXXXXXXXXXXXXXXX	43	XXXXXXXXX	14	XXX	
CHEN ALB	0		0		0		
(39)	0		0		0		
STEL MED	0		0		0		
(40)	0		0		0		
VER PERS	0		0		0		
(42)	0		0		0		
VI ARVE	8	XX	0		0		
(43)	21	XXXX	0		0		
RUM OBTU	0		0		0		
(44)	0		0		0		
EL REPEN	84	XXXXXXXXXXXXXXXX	84	XXXXXXXXXXXXXXXX	103	XXXXXXXXXXXXXXXXXXX+	
(47)	100	XXXXXXXXXXXXXXXXXXX	100	XXXXXXXXXXXXXXXXXXX	100	XXXXXXXXXXXXXXXXXXX	
ALL VIN	153	XXXXXXXXXXXXXXXXXXX+	77	XXXXXXXXXXXXXX	77	XXXXXXXXXXXXXX	
(49)	100	XXXXXXXXXXXXXXXXXXX	86	XXXXXXXXXXXXXXXX	64	XXXXXXXXXXXX	
CIRS ARV	117	XXXXXXXXXXXXXXXXXXX+	117	XXXXXXXXXXXXXXXXXXX+	67	XXXXXXXXXXXX	
(50)	100	XXXXXXXXXXXXXXXXXXX	64	XXXXXXXXXXXX	50	XXXXXXXXX	

ISOXABEN

SPECIES		0.04 KG/HA		0.16 KG/HA		0.64 KG/HA
TUS FARF	100	XXXXXXXXXXXXXXXXXXX	100	XXXXXXXXXXXXXXXXXXX	75	XXXXXXXXXXXXXX
(51)	100	XXXXXXXXXXXXXXXXXXX	100	XXXXXXXXXXXXXXXXXXX	57	XXXXXXXXXX
CONV ARV	53	XXXXXXXXXX	35	XXXXXX	53	XXXXXXXXXX
(52)	100	XXXXXXXXXXXXXXXXXXX	79	XXXXXXXXXXXXXXX	64	XXXXXXXXXXXX
MAIZE+S	100	XXXXXXXXXXXXXXXXXXX	100	XXXXXXXXXXXXXXXXXXX	100	XXXXXXXXXXXXXXXXXXX
(56)	100	XXXXXXXXXXXXXXXXXXX	100	XXXXXXXXXXXXXXXXXXX	93	XXXXXXXXXXXXXXXXXX
MAIZE	100	XXXXXXXXXXXXXXXXXXX	100	XXXXXXXXXXXXXXXXXXX	100	XXXXXXXXXXXXXXXXXXX
(57)	100	XXXXXXXXXXXXXXXXXXX	100	XXXXXXXXXXXXXXXXXXX	93	XXXXXXXXXXXXXXXXXX
PHAL MIN	101	XXXXXXXXXXXXXXXXXXX	80	XXXXXXXXXXXXXXX	33	XXXXXX
(84)	100	XXXXXXXXXXXXXXXXXXX	71	XXXXXXXXXXXXX	43	XXXXXXXX

PERSISTENCE ^{24} OF ISOXABEN

species: turnip

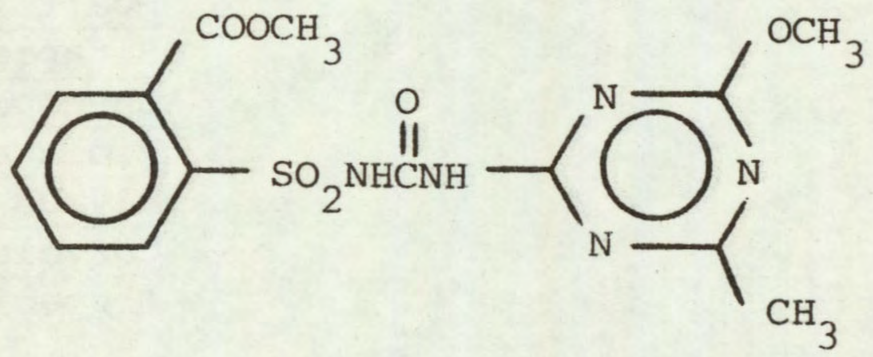


METSULFURON-METHYL

Code number DPX-T 6376

Chemical name Methyl 2-[3-(4-methoxy-6-methyl-1,3,5-triazin-2-yl) ureidosulphonyl]benzoate

Structure



Source

Du Pont (UK) Ltd
Wedgwood Way
Stevenage SG1 4QN
Herts.
U.K.

Information available and suggested uses

Control of broad-leaved weeds in cereals.

Formulation used Water dispersible granules 70% w/w a.i.

Spray volume 373 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 of vigour reduced by 70% or more
0.008	wheat±safener (NA) barley±safener (NA) maize±safener (NA) oat	Beta vulgaris Festuca rubra Poa annua Poa trivialis Sinapis arvensis Chenopodium album Viola arvensis Elymus repens Convolvulus arvensis + species below
0.002	as above + dwarf bean field bean* pea rape radish	Chrysanthemum segetum Matricaria perforata Senecio vulgaris Veronica persica Allium vineale Cirsium arvense Tussilago farfara + species below
0.0005	as above + lucerne swede carrot sugar beet	Stellaria media Rumex obtusifolius

* but note some stand reduction

Comments on results

The activity, post-emergence selectivity and symptoms produced on susceptible species were described in a previous report (Richardson et al., 1984). Symptoms were similar to those caused by chlorsulfuron, its chemical analogue, also described previously (Richardson et al. 1980). Metsulfuron-methyl was found to be one of the most active herbicides yet tested. It possesses considerable soil activity, particularly pre-emergence, with surface treatments being generally more active than when incorporated into the soil. A pronounced yellowing accompanied severe inhibition of growth prior to necrosis and die-back. However, in some species, notably Polygonaceae other colour effects such as an enhanced red pigmentation were often seen. A powerful inhibition of root systems is common, grass shoots consequently assuming a dart-like appearance, with needle-shaped leaves, reminiscent of symptoms caused by other root-inhibiting herbicides. At higher doses plants often failed to emerge from the soil or died back soon after.

Persistence in the soil

Metsulfuron-methyl persistence in the soil appears to be much less than for the related chlorsulfuron (Richardson et al. 1981). Using turnip as test species, the dose of 0.002 kg/ha could not be detected 7 weeks after treatment. The high dose of 0.008 kg/ha could not be detected 44 weeks after treatment.

Pre-emergence selectivity

Annual broad-leaved weeds were particularly susceptible. Stellaria media and Rumex obtusifolius were controlled even at the lowest dose of 0.0005 kg/ha (0.5 g/ha). At 0.002 kg/ha all five of the composite species were controlled including the perennials, Cirsium arvense and Tussilago farfara. Veronica persica and Allium vineale were controlled at this dose. A further nine weeds were suceptible to the highest dose of 0.008 kg/ha, including four of the grasses (Poa annua, Poa trivialis, Festuca rubra, and E. repens). More importantly, Viola arvensis was controlled at this dose. Galium aparine was outstandingly resistant, while Raphanus raphanistrum and all other grasses (Bromus sterilis, Avena fatua, Phalaris spp.) were not controlled.

All four cereals, wheat, barley, oat and maize tolerated the highest dose of 0.008 kg/ha such that it was not possible to determine safening with NA. Surprisingly, large-seeded legumes (peas and beans) tolerated 0.002 kg/ha as did radish. Onion and white clover were sensitive.

The wide-spectrum of control of annual broad-leaved weeds in wheat, barley and oat, corresponds to that found in the earlier post-emergence trial (Richardson et al., 1984a). Control of Viola arvensis and Veronica persica in wheat and barley is an important advantage over urea herbicides, for example, but the resistance of Galium aparine is a disadvantage, common to all of these herbicides. Some further examination of potential use in other crops e.g. maize and legumes is required, however, as such tolerance was not experienced in earlier work (Richardson et al., 1984).

METSULFURON-METHYL

SPECIES		0.0005 KG/HA		0.002 KG/HA		0.008 KG/HA
WHEAT	96	XXXXXXXXXXXXXXXXXX	102	XXXXXXXXXXXXXXXXXXX	96	XXXXXXXXXXXXXXXXXX
(1)	100	XXXXXXXXXXXXXXXXXX	100	XXXXXXXXXXXXXXXXXX	93	XXXXXXXXXXXXXXXXX
WHEAT+S	94	XXXXXXXXXXXXXXXXX	87	XXXXXXXXXXXXXXXX	87	XXXXXXXXXXXXXXXX
(2)	100	XXXXXXXXXXXXXXXXXX	93	XXXXXXXXXXXXXXXXX	93	XXXXXXXXXXXXXXXXX
BARLEY	89	XXXXXXXXXXXXXXXXX	102	XXXXXXXXXXXXXXXXXX	102	XXXXXXXXXXXXXXXXXX
(3)	100	XXXXXXXXXXXXXXXXXX	100	XXXXXXXXXXXXXXXXXX	93	XXXXXXXXXXXXXXXXX
BARLEY+S	100	XXXXXXXXXXXXXXXXXX	94	XXXXXXXXXXXXXXXXX	100	XXXXXXXXXXXXXXXXXX
(4)	100	XXXXXXXXXXXXXXXXXX	100	XXXXXXXXXXXXXXXXXX	93	XXXXXXXXXXXXXXXXX
OAT	104	XXXXXXXXXXXXXXXXXX+	104	XXXXXXXXXXXXXXXXXX+	104	XXXXXXXXXXXXXXXXXX+
(5)	100	XXXXXXXXXXXXXXXXXX	100	XXXXXXXXXXXXXXXXXX	86	XXXXXXXXXXXXXXXX
PER RYGR	85	XXXXXXXXXXXXXXXX	65	XXXXXXXXXXXX	41	XXXXXXX
(6)	71	XXXXXXXXXXXXX	57	XXXXXXXXXX	29	XXXXX
ONION	71	XXXXXXXXXXXXX	40	XXXXXXX	31	XXXXX
(8)	57	XXXXXXXXXX	50	XXXXXXXXX	21	XXX
DWF BEAN	100	XXXXXXXXXXXXXXXXXXX	100	XXXXXXXXXXXXXXXXXXX	100	XXXXXXXXXXXXXXXXXXX
(9)	100	XXXXXXXXXXXXXXXXXXX	100	XXXXXXXXXXXXXXXXXXX	79	XXXXXXXXXXXXXXX
FLD BEAN	79	XXXXXXXXXXXXXXX	63	XXXXXXXXXXXXX	95	XXXXXXXXXXXXXXXXXX
(10)	100	XXXXXXXXXXXXXXXXXX	86	XXXXXXXXXXXXXXXX	57	XXXXXXXXXX
PEA	71	XXXXXXXXXXXXXX	106	XXXXXXXXXXXXXXXXXXX+	106	XXXXXXXXXXXXXXXXXXX+
(11)	100	XXXXXXXXXXXXXXXXXX	93	XXXXXXXXXXXXXXXXXX	50	XXXXXXXXXX

METSULFURON-METHYL

SPECIES		0.0005 KG/HA		0.002 KG/HA		0.008 KG/HA
W CLOVER	123	XXXXXXXXXXXXXXXXXXX+	136	XXXXXXXXXXXXXXXXXXX+	95	XXXXXXXXXXXXXXXXXX
(12)	36	XXXXXXX	21	XXXX	14	XXX
LUCERNE	95	XXXXXXXXXXXXXXXXXX	100	XXXXXXXXXXXXXXXXXXX	89	XXXXXXXXXXXXXXXXXX
(13)	86	XXXXXXXXXXXXXXXX	71	XXXXXXXXXXXXX	29	XXXXXX
RAPE	100	XXXXXXXXXXXXXXXXXXX	100	XXXXXXXXXXXXXXXXXXX	95	XXXXXXXXXXXXXXXXXX
(14)	100	XXXXXXXXXXXXXXXXXXX	86	XXXXXXXXXXXXXXXX	43	XXXXXXXXX
KALE	81	XXXXXXXXXXXXXXX	78	XXXXXXXXXXXXXXX	85	XXXXXXXXXXXXXXXX
(15)	79	XXXXXXXXXXXXXXX	64	XXXXXXXXXXXX	29	XXXXXX
SWEDE	94	XXXXXXXXXXXXXXXXXX	86	XXXXXXXXXXXXXXXX	51	XXXXXXXXX
(17)	86	XXXXXXXXXXXXXXXX	64	XXXXXXXXXXXX	29	XXXXX
CARROT	92	XXXXXXXXXXXXXXXXX	83	XXXXXXXXXXXXXXXX	50	XXXXXXXXX
(18)	93	XXXXXXXXXXXXXXXXXX	64	XXXXXXXXXXXX	43	XXXXXXXX
LETTUCE	106	XXXXXXXXXXXXXXXXXXX+	85	XXXXXXXXXXXXXXXX	85	XXXXXXXXXXXXXXXXX
(20)	79	XXXXXXXXXXXXXXX	36	XXXXXX	14	XXX
FENUGREK	104	XXXXXXXXXXXXXXXXXXX+	98	XXXXXXXXXXXXXXXXXXX	93	XXXXXXXXXXXXXXXXXX
(21)	79	XXXXXXXXXXXXXXX	43	XXXXXXXX	29	XXXXX
SUG BEET	94	XXXXXXXXXXXXXXXXXX	64	XXXXXXXXXXXX	39	XXXXXXX
(22)	93	XXXXXXXXXXXXXXXXXX	64	XXXXXXXXXXXX	21	XXXX
BETA VUL	84	XXXXXXXXXXXXXXXX	45	XXXXXXXX	60	XXXXXXXXXX
(23)	71	XXXXXXXXXXXXX	36	XXXXXX	14	XXX

METSULFURON-METHYL

SPECIES		0.0005 KG/HA		0.002 KG/HA		0.008 KG/HA
BROM STE	109	XXXXXXXXXXXXXXXXXXX+	109	XXXXXXXXXXXXXXXXXXX+	109	XXXXXXXXXXXXXXXXXXX+
(24)	100	XXXXXXXXXXXXXXXXXXX	100	XXXXXXXXXXXXXXXXXXX	93	XXXXXXXXXXXXXXXXXX
FEST RUB	105	XXXXXXXXXXXXXXXXXXX+	89	XXXXXXXXXXXXXXXXX	57	XXXXXXXXXX
(25)	71	XXXXXXXXXXXXX	50	XXXXXXXXX	29	XXXXX
AVE FATU	129	XXXXXXXXXXXXXXXXXXX+	107	XXXXXXXXXXXXXXXXXXX+	100	XXXXXXXXXXXXXXXXXX
(26)	100	XXXXXXXXXXXXXXXXXX	100	XXXXXXXXXXXXXXXXXX	79	XXXXXXXXXXXXXX
ALO MYOS	75	XXXXXXXXXXXXX	92	XXXXXXXXXXXXXXXX	75	XXXXXXXXXXXXX
(27)	71	XXXXXXXXXXXXX	57	XXXXXXXXX	36	XXXXXX
POA ANN	85	XXXXXXXXXXXXXXXX	88	XXXXXXXXXXXXXXXX	55	XXXXXXXXXX
(28)	71	XXXXXXXXXXXXX	43	XXXXXXXX	29	XXXXX
POA TRIV	73	XXXXXXXXXXXXXX	32	XXXXX	8	XX
(29)	43	XXXXXXXXX	43	XXXXXXXX	7	X
SIN ARV	110	XXXXXXXXXXXXXXXXXXX+	90	XXXXXXXXXXXXXXXXX	77	XXXXXXXXXXXXXX
(30)	100	XXXXXXXXXXXXXXXXXXX	71	XXXXXXXXXXXXX	29	XXXXX
RAPH RAP	97	XXXXXXXXXXXXXXXXXX	107	XXXXXXXXXXXXXXXXXXX+	97	XXXXXXXXXXXXXXXXXX
(31)	100	XXXXXXXXXXXXXXXXXX	100	XXXXXXXXXXXXXXXXXX	43	XXXXXXXX
CHRY SEG	76	XXXXXXXXXXXXXX	63	XXXXXXXXXXXX	68	XXXXXXXXXXXXX
(32)	43	XXXXXXXX	21	XXXX	14	XXX
MAT PERF	68	XXXXXXXXXXXXX	55	XXXXXXXXXX	29	XXXXX
(33)	43	XXXXXXXX	14	XXX	14	XXX

METSULFURON-METHYL

SPECIES		0.0005 KG/HA		0.002 KG/HA		0.008 KG/HA	
SEN VULG	85	XXXXXXXXXXXXXXXX	0		0		
(34)	36	XXXXXXX	0		0		
GAL APAR	115	XXXXXXXXXXXXXXXXXXX+	92	XXXXXXXXXXXXXXXXX	110	XXXXXXXXXXXXXXXXXXX+	
(38)	100	XXXXXXXXXXXXXXXXXX	100	XXXXXXXXXXXXXXXXXX	100	XXXXXXXXXXXXXXXXXX	
CHEN ALB	107	XXXXXXXXXXXXXXXXXX+	107	XXXXXXXXXXXXXXXXXX+	89	XXXXXXXXXXXXXXXXX	
(39)	93	XXXXXXXXXXXXXXXXX	64	XXXXXXXXXXXX	29	XXXXXX	
STEL MED	173	XXXXXXXXXXXXXXXXXX+	136	XXXXXXXXXXXXXXXXXX+	118	XXXXXXXXXXXXXXXXXX+	
(40)	29	XXXXXX	14	XXX	14	XXX	
VER PERS	50	XXXXXXXXXX	0		0		
(42)	36	XXXXXXX	0		0		
VI ARVE	95	XXXXXXXXXXXXXXXXXX	55	XXXXXXXXXX	32	XXXXXX	
(43)	71	XXXXXXXXXXXXX	43	XXXXXXXXX	21	XXXX	
RUM OBTU	44	XXXXXXXXX	133	XXXXXXXXXXXXXXXXXXX+	78	XXXXXXXXXXXXXXX	
(44)	29	XXXXXX	29	XXXXXX	14	XXX	
EL REPEN	103	XXXXXXXXXXXXXXXXXX+	75	XXXXXXXXXXXXXX	56	XXXXXXXXXX	
(47)	100	XXXXXXXXXXXXXXXXXX	71	XXXXXXXXXXXXX	29	XXXXXX	
ALL VIN	83	XXXXXXXXXXXXXXXX	57	XXXXXXXXXX	19	XXXX	
(49)	57	XXXXXXXXXX	29	XXXXXX	14	XXX	
CIRS ARV	117	XXXXXXXXXXXXXXXXXX+	83	XXXXXXXXXXXXXXXXX	0		
(50)	71	XXXXXXXXXXXXX	29	XXXXXX	0		

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