LONG ASHTON RESEARCH STATION

WEED RESEARCH DIVISION

TECHNICAL REPORT No. 90

THE PRE-EMERGENCE SELECTIVITY IN WARM-CLIMATE SPECIES OF SOME RECENTLY DEVELOPED HERBICIDES: IMAZAQUIN, AC 263,499, CINMETHYLIN AND ISOXABEN

NB: AC 263,499 is imazethapyr

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THE PRE-EMERGENCE SELECTIVITY IN WARM-CLIMATE SPECIES OF SOME RECENTLY DEVELOPED HERBICIDES: IMAZAQUIN, AC 263,499, CINMETHYLIN AND ISOXABEN

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SUMMARY

Four herbicides were evaluated in a glasshouse pot experiment for their pre-emergence selectivity as soil surface sprays on 16 crop and 11 weed species of tropical or warm temperate regions. Maize and sorghum were each included in two sets, one of which was treated with seed dressings of safeners, 1,8-naphthalic anhydride (NA) on maize, and CGA 92194 on sorghum.

Imazaquin and AC 263,499 gave very similar results which suggest useful selectivity against a range of annual grasses and Amaranthus in soyabean, groundnut, pigeon pea, cowpea and mungbean. The perennials Cyperus rotundus, C. esculentus and Oxalis latifolia were also well suppressed and selective control may be possible in some large-seeded legumes. Safeners provided considerable protection on both maize and sorghum but selectivity was still inadequate in these or any other non-legume crop.

Cinmethylin showed excellent selectivity against annual grasses in a range of legume crops, cotton, sesamum and aubergine, but Amaranthus and the perennials were resistant. Phalaris minor and Bromus pectinatus were controlled at doses which should be selective on wheat.

Isoxaben was extremely well tolerated by maize and cotton and selectivity was also shown against most annual grasses and Amaranthus in the large-seeded legume crops. The possibility of selective control of Rottboellia in maize particularly deserves further study; also the control of Phalaris and Snowdenia in wheat and of Amaranthus and other broad-leaved weeds in jute and sesamum.

INTRODUCTION

Until March 1982, warm-climate crop and weed species were regularly included in the herbicide evaluation programme at the Weed Research Organization (WRO) under funding from HM Overseas Development Administration (ODA), and results were published jointly between the Herbicide and Tropical Weeds Groups in the WRO Technical Report series. Funding from ODA was no longer available for this purpose after March 1982 but in April 1985 it was possible to resume herbicide evaluation on warm-climate species under a new project, partially funded by the European Economic Community under their programme 'Science and Technology for Development'. This report covers the first of two 'back-log' experiments conducted to evaluate, on warm-climate species, a number of compounds already tested at WRO on temperate species. Relevant reports on those tests are Richardson and West (1984) - for imazaquin and isoxaben and Richardson and West (1986) for AC 263,499 and cinmethylin. These reports provide information on the relative importance of foliar and soil activity and also on the soil persistence of these compounds.

The objectives of the work reported here are exactly as indicated in previous reports in this series, i.e. to provide a guide to the potential usefulness of new compounds in the crops tested. Owing to the relatively artificial conditions of glasshouse pot experiments it must be emphasized

that the results are to be regarded only as a guide, and that further field testing is essential to confirm any of the interesting leads revealed.

This report gives pre-emergence selectivity data for four new herbicides.

METHODS AND MATERIALS

Techniques were as described by Richardson and Dean (1973), all herbicides being applied as surface pre-emergence treatments. Species were sown as detailed in Appendix I, each being replicated twice for each treatment. Soil and environmental details are given in Table 1.

Table 1.

Soil and environmental conditions

Date of spraying	24.5.85
Main assessment completed	17.6.85
organic matter %	1.3
clay content %	16.0
pH	7.5
ammonium sulphate g/kg	0.5
superphosphate g/kg	1.0
potassium sulphate g/kg	0.6
fritted trace elements g/kg	0.1
hydrated magnesium sulphate g/kg	0.4
Temperature (^{o}C)	
mean	24
maximum	38
minimum	13
Relative humidity (%)	
mean	70
maximum	100
minimum	30

Pre-planting treatments to improve germination included a) the storage of Cyperus esculentus tubers and Oxalis latifolia bulbs at 5^{o}C for 18 hours before planting and b) the soaking of Amaranthus retroflexus seeds in 0.1 M potassium nitrate.

To protect against soil-borne pathogens, most seeds were pre-treated with thiram. Some had been pre-dressed with unknown compounds. Those not treated at all were rice, Snowdenia polystachya and Bromus pectinatus.

Maize and sorghum were each set up with and without a seed treatment of 'safener'. For maize, the seeds were shaken with a quantity of technical 1,8-naphthalic anhydride (NA) equivalent to 0.5% of seed weight. For sorghum, the seeds were shaken with a quantity of 70% CGA 92194 (N-1(1,3-dioxolan-2-yl-methoxy)-imino-benzene acetonitrile) equivalent to 0.2% a.i. of seed weight.

Herbicides were applied using a laboratory sprayer embodying an 8002E Spraying Systems Tee Jet operating at a pressure of 207 kpa (30 lb/in^2) and moving at 0.54 m/sec 30 cm above the soil. Subsequent watering was from overhead.

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 = no different from the untreated control. Oxalis latifolia showed erratic germination and was not systematically scored but some observations on this species are noted in the text.

Pairs of histograms are presented for each treatment, the upper representing the plant survival and the lower vigour score, both calculated as percentages of untreated controls. Each 'x' repre-sents a 5% increment. A '+' indicates a value in excess of 100%.

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

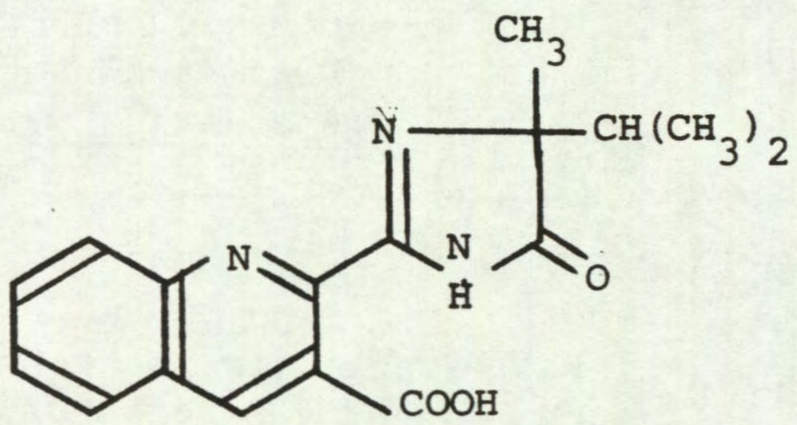
The perennial Cyperus spp. and Oxalis were kept for an extra period to observe later effects and/or the recovery from injury.

Imazaquin

Code number AC 252214 Trade name: Scepter

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 372 l/ha

RESULTS

Full results are given in the histograms on pages 7-9 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	None	None listed as no crops tolerant
0.025	pigeon pea groundnut soyabean	Echinochloa crus-galli Digitaria sanguinalis Amaranthus retroflexus

Comments on results

The table above shows a high level of activity on crops and a rather narrow range of weeds controlled at the lowest dose of 0.025 g/ha. It may, however, be seen from the full histograms that the three legume crops tolerating 0.025 kg/ha, together with cowpea and mungbean, were only a little more damaged at 0.1 kg/ha, and at this higher dose a much wider range of weeds was controlled including Rottboellia cochinchinensis and both perennial Cyperus species. The latter showed quite prolonged suppression at 0.1 kg/ha and after five months 0.4 kg/ha was still causing considerable retardation. Oxalis latifolia was severely retarded by 0.1 and 0.4 kg/ha for 3 months but appeared likely to make eventual recovery.

Maize and sorghum both showed approximately 4-fold protection by their respective safeners but there is no indication that useful selectivity could be achieved in any of the cereal or non-leguminous crops. Further field testing will, however, be justified in groundnut, cowpea, pigeon pea and mungbean as well as in soyabean for which it is already recommended. Possible selectivity against Cyperus species and Oxalis latifolia will be particularly worth exploring.

IMAZAQUIN

SPECIES		0.025 kg/ha		0.100 kg/ha		0.400 kg/ha
MILLET	73	xxxxxxxxxxxxxxx	27	xxxxx	0	
(55)	43	xxxxxxxxx	7	x	0	
MAIZE+S	100	xxxxxxxxxxxxxxxxxxx	92	xxxxxxxxxxxxxxxxxx	42	xxxxxxxx
(56)	79	xxxxxxxxxxxxxxx	50	xxxxxxxxxx	21	xxxx
MAIZE	100	xxxxxxxxxxxxxxxxxxx	75	xxxxxxxxxxxxxxx	17	xxx
(57)	43	xxxxxxxxx	29	xxxxxx	7	x
SORG+S	97	xxxxxxxxxxxxxxxxxx	84	xxxxxxxxxxxxxxxxx	19	xxxx
(58)	71	xxxxxxxxxxxxxx	36	xxxxxxx	14	xxx
SORGHUM	96	xxxxxxxxxxxxxxxxxx	8	xx	0	
(59)	36	xxxxxxx	14	xxx	0	
PIGEON P	94	xxxxxxxxxxxxxxxxxx	82	xxxxxxxxxxxxxxx	59	xxxxxxxxxxx
(61)	93	xxxxxxxxxxxxxxxxxx	57	xxxxxxxxxx	43	xxxxxxxxx
COWPEA	104	xxxxxxxxxxxxxxxxxxx+	104	xxxxxxxxxxxxxxxxxxx+	96	xxxxxxxxxxxxxxxxxx
(62)	71	xxxxxxxxxxxxxx	71	xxxxxxxxxxxxxx	64	xxxxxxxxxxxx
CHICKPEA	73	xxxxxxxxxxxxxxx	82	xxxxxxxxxxxxxxx	0	
(63)	50	xxxxxxxxxx	36	xxxxxxx	0	
GRNDNUT	114	xxxxxxxxxxxxxxxxxxx+	114	xxxxxxxxxxxxxxxxxxx+	114	xxxxxxxxxxxxxxxxxxx+
(64)	93	xxxxxxxxxxxxxxxxxx	71	xxxxxxxxxxxxxx	43	xxxxxxxxx
SOYABEAN	100	xxxxxxxxxxxxxxxxxxx	83	xxxxxxxxxxxxxxxxx	92	xxxxxxxxxxxxxxxxx
(65)	100	xxxxxxxxxxxxxxxxxxx	64	xxxxxxxxxxxxx	64	xxxxxxxxxxxxx
COTTON	96	xxxxxxxxxxxxxxxxxx	96	xxxxxxxxxxxxxxxxxx	87	xxxxxxxxxxxxxxxxx
(66)	50	xxxxxxxxxx	29	xxxxxx	29	xxxxxx
JUTE	55	xxxxxxxxxx	48	xxxxxxxxx	10	xx
(67)	29	xxxxxx	21	xxxx	7	x

IMAZAQUIN

SPECIES		0.025 kg/ha		0.100 kg/ha		0.400 kg/ha
KENAF	97	xxxxxxxxxxxxxxxxxx	123	xxxxxxxxxxxxxxxxxxx+	97	xxxxxxxxxxxxxxxxxx
(68)	36	xxxxxxx	29	xxxxxx	29	xxxxxx
SESAMUM	81	xxxxxxxxxxxxxxx	49	xxxxxxxxxx	32	xxxxxx
(70)	43	xxxxxxxxx	29	xxxxxx	21	xxxx
RICE	36	xxxxxxx	0		0	
(72)	43	xxxxxxxxx	0		0	
ELEU IND	78	xxxxxxxxxxxxxxx	27	xxxxx	27	xxxxx
(74)	50	xxxxxxxxxx	29	xxxxxx	29	xxxxxx
ECH CRUS	87	xxxxxxxxxxxxxxxx	0		0	
(75)	29	xxxxxx	0		0	
ROTT EXA	95	xxxxxxxxxxxxxxxxx	95	xxxxxxxxxxxxxxxxxx	55	xxxxxxxxxx
(76)	57	xxxxxxxxxx	29	xxxxxx	21	xxxx
DIG SANG	28	xxxxxx	7	x	0	
(77)	29	xxxxxx	14	xxx	0	
AMAR RET	33	xxxxxxx	10	xx	0	
(78)	21	xxxx	21	xxxx	0	
BROM PEC	46	xxxxxxxxx	5	x	0	
(82)	36	xxxxxxx	14	xxx	0	
SNO POL	31	xxxxxx	11	xx	0	
(83)	36	xxxxxxx	21	xxxx	0	
PHAL MIN	79	xxxxxxxxxxxxxxx	9	xx	0	
(84)	57	xxxxxxxxxx	14	xxx	0	
CYP ESCU	69	xxxxxxxxxxxxx	6	x	0	
(85)	50	xxxxxxxxxx	21	xxxx	0	

IMAZAQUIN

SPECIES		0.025 kg/ha		0.100 kg/ha		0.400 kg/ha
CYP ROTU	55	xxxxxxxxxxx	14	xxx	0	
(86)	36	xxxxxxx	21	xxxx	0	
AUBGIN	83	xxxxxxxxxxxxxxxxx	83	xxxxxxxxxxxxxxxxx	97	xxxxxxxxxxxxxxxxxx
(89)	50	xxxxxxxxxx	43	xxxxxxxxx	29	xxxxxx
LENTIL	112	xxxxxxxxxxxxxxxxxxx+	48	xxxxxxxxxx	24	xxxxx
(90)	43	xxxxxxxxx	29	xxxxxx	14	xxx
MUNGB	100	xxxxxxxxxxxxxxxxxxx	100	xxxxxxxxxxxxxxxxxxx	100	xxxxxxxxxxxxxxxxxxx
(91)	79	xxxxxxxxxxxxxxx	71	xxxxxxxxxxxxx	57	xxxxxxxxxx

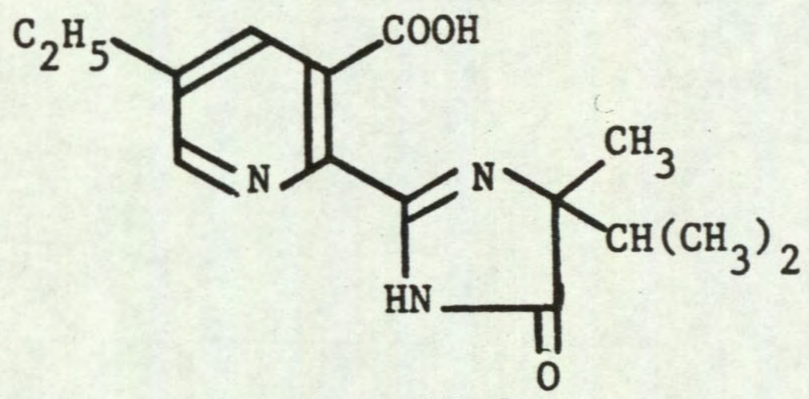
NB: AC 263,499 is imazethapyr

Code number AC 263, 499 **Trade name**

Common name -

Chemical name (±)-5-ethyl-2-(4-isopropyl-4-methyl-5-oxo-2-imidazolin-2-yl) nicotinic acid

Structure



Source

Cyanamid International Limited
Fareham Road
Gosport
Hants PO13 0AS, UK

Information available and suggested uses

Annual grass and broad-leaved control in soyabeans, several other leguminous crops, tobacco, coffee and established tree crops, pre-and/or post-emergence at doses ranging from 0.07 to 0.84 kg/ha.

Formulation used Aqueous concentrate 24.2% a.i.

Spray volume 372 l/ha

RESULTS

Full results are given in the histograms on pages 13-15 and potential selectivities are summarised in the following table.

NB: AC 263,499 is imazethapyr

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	soyabean	Eleusine indica Rottboellia cochinchinensis Phalaris minor Cyperus rotundus Cyperus esculentus + species below
0.025	as above + maize + safener (NA) mungbean	Echinochloa crus-galli Digitaria sanguinalis Bromus pectinatus Snowdenia polystachya Amaranthus retroflexus

Comments on results

AC 263,499 showed slightly higher activity on the annual grass weeds and some greater safety in soyabean than the closely related imazaquin. Groundnut and pigeon pea did not show complete tolerance of the lowest dose of 0.025 kg/ha but mungbean in this case did and once again these legumes, plus cowpea were only moderately affected at 0.1 kg/ha at which the range of weeds controlled was very similar to that by imazaquin. In fact the differences in activity between the two compounds were very small indeed the most marked perhaps being that AC 263,499 was appreciably more active on sorghum, yet less active on maize. There was again a pronounced safening effect from NA on maize allowing some selectivity at 0.025 kg/ha but sorghum was not perceptibly protected by CGA 92194.

Both perennial Cyperus species were well suppressed for several months by 0.1 kg/ha and after 5 months there was no recovery of C. rotundus from 0.4 kg/ha and only the beginnings of recovery by C. esculentus. Oxalis latifolia was severely affected, even at 0.025 kg/ha, and after 3 months it was doubtful that there would be any recovery from 0.4 kg/ha.

This compound deserves further testing in the field alongside imazaquin on all the larger-seeded legume crops and particularly where Cyperus and Oxalis species are problems.

AC263499

SPECIES		0.025 kg/ha		0.100 kg/ha		0.400 kg/ha
MILLET	80	xxxxxxxxxxxxxxxx	33	xxxxxxx	0	
(55)	43	xxxxxxxxx	14	xxx	0	
MAIZE+S	100	xxxxxxxxxxxxxxxxxxxx	100	xxxxxxxxxxxxxxxxxxxx	83	xxxxxxxxxxxxxxxx
(56)	93	xxxxxxxxxxxxxxxxxx	79	xxxxxxxxxxxxxxxx	43	xxxxxxxxx
MAIZE	92	xxxxxxxxxxxxxxxxxx	100	xxxxxxxxxxxxxxxxxxxx	42	xxxxxxxx
(57)	71	xxxxxxxxxxxxxx	43	xxxxxxxxx	21	xxxx
SORG+S	58	xxxxxxxxxxxx	0		0	
(58)	29	xxxxxx	0		0	
SORGHUM	64	xxxxxxxxxxxxx	0		0	
(59)	29	xxxxxx	0		0	
PIGEON P	82	xxxxxxxxxxxxxxxx	118	xxxxxxxxxxxxxxxxxxxx+	118	xxxxxxxxxxxxxxxxxxx+
(61)	71	xxxxxxxxxxxxxx	79	xxxxxxxxxxxxxxx	57	xxxxxxxxxx
COWPEA	104	xxxxxxxxxxxxxxxxxxxx+	104	xxxxxxxxxxxxxxxxxxxx+	104	xxxxxxxxxxxxxxxxxxx+
(62)	71	xxxxxxxxxxxxxx	71	xxxxxxxxxxxxxx	57	xxxxxxxxxx
CHICKPEA	91	xxxxxxxxxxxxxxxxxx	73	xxxxxxxxxxxxxxx	9	xx
(63)	57	xxxxxxxxxx	29	xxxxxx	14	xxx
GRNDNUT	114	xxxxxxxxxxxxxxxxxxx+	86	xxxxxxxxxxxxxxxx	114	xxxxxxxxxxxxxxxxxxx+
(64)	64	xxxxxxxxxxxx	71	xxxxxxxxxxxxx	71	xxxxxxxxxxxxx
SOYABEAN	75	xxxxxxxxxxxxxx	92	xxxxxxxxxxxxxxxxx	92	xxxxxxxxxxxxxxxxx
(65)	71	xxxxxxxxxxxxx	86	xxxxxxxxxxxxxxxx	79	xxxxxxxxxxxxxxx
COTTON	104	xxxxxxxxxxxxxxxxxxx+	104	xxxxxxxxxxxxxxxxxxx+	78	xxxxxxxxxxxxxxx
(66)	50	xxxxxxxxxx	29	xxxxxx	29	xxxxxx
JUTE	90	xxxxxxxxxxxxxxxxx	21	xxxx	28	xxxxxx
(67)	29	xxxxxx	14	xxx	14	xxx

AC263499

SPECIES	0.025 kg/ha		0.100 kg/ha		0.400 kg/ha	
KENAF	97	xxxxxxxxxxxxxxxxxxx	103	xxxxxxxxxxxxxxxxxxx+	97	xxxxxxxxxxxxxxxxxxx
(68)	43	xxxxxxxxx	29	xxxxxx	21	xxxx
SESAMUM	65	xxxxxxxxxxxxx	43	xxxxxxxxx	16	xxx
(70)	29	xxxxxx	29	xxxxxx	29	xxxxxx
RICE	12	xx	0		0	
(72)	29	xxxxxx	0		0	
ELEU IND	95	xxxxxxxxxxxxxxxxxxx	31	xxxxxx	7	x
(74)	57	xxxxxxxxxxx	21	xxxx	14	xxx
ECH CRUS	81	xxxxxxxxxxxxxxxx	3	x	0	
(75)	21	xxxx	7	x	0	
ROTT EXA	120	xxxxxxxxxxxxxxxxxxxx+	85	xxxxxxxxxxxxxxxxx	60	xxxxxxxxxxx
(76)	36	xxxxxxx	29	xxxxxx	21	xxxx
DIG SANG	48	xxxxxxxxxx	0		0	
(77)	29	xxxxxx	0		0	
AMAR RET	37	xxxxxxx	3	x	20	xxxx
(78)	14	xxx	7	x	14	xxx
BROM PEC	26	xxxxx	0		0	
(82)	29	xxxxxx	0		0	
SNO POL	29	xxxxxx	3	x	0	
(83)	21	xxxx	7	x	0	
PHAL MIN	60	xxxxxxxxxxx	0		9	xx
(84)	50	xxxxxxxxxx	0		14	xxx
CYP ESCU	94	xxxxxxxxxxxxxxxxxx	12	xx	0	
(85)	43	xxxxxxxxx	29	xxxxxx	0	

AC263499

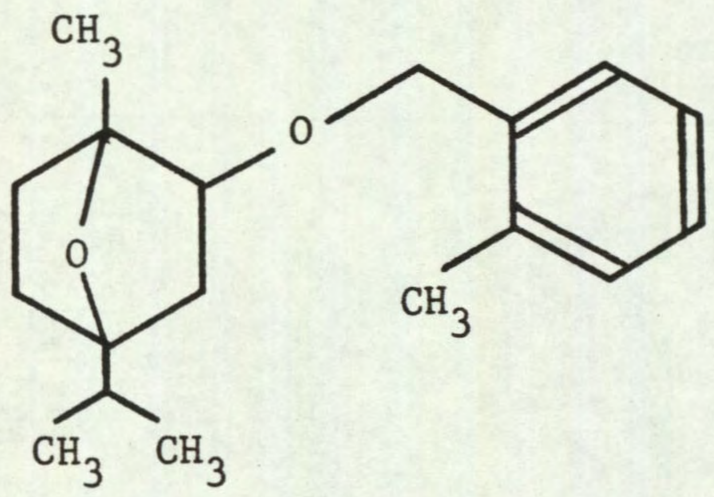
SPECIES		0.025 kg/ha		0.100 kg/ha		0.400 kg/ha
CYP ROTU	32	xxxxxx	5	x	0	
(86)	43	xxxxxxxxx	14	xxx	0	
AUBGIN	83	xxxxxxxxxxxxxxxx	83	xxxxxxxxxxxxxxxx	76	xxxxxxxxxxxxxx
(89)	43	xxxxxxxxx	29	xxxxxx	29	xxxxxx
LENTIL	144	xxxxxxxxxxxxxxxxxxx+	120	xxxxxxxxxxxxxxxxxxx+	64	xxxxxxxxxxxx
(90)	71	xxxxxxxxxxxxx	36	xxxxxxx	29	xxxxxx
MUNGB	100	xxxxxxxxxxxxxxxxxxx	92	xxxxxxxxxxxxxxxxx	100	xxxxxxxxxxxxxxxxxxx
(91)	86	xxxxxxxxxxxxxxxx	71	xxxxxxxxxxxxx	57	xxxxxxxxxx

Cinmethylin

Code number SD 95481 **Trade name** Cinch

Chemical name 7-oxabicyclo (2.2.1) heptane, 1-methyl-4-(1-methylethyl)-2-(2-methylphenylmethoxy)-, exo-.

Structure



Source

Shell Biosciences Laboratory
Sittingbourne Research Centre
Sittingbourne
Kent ME9 8AG

Information available and suggested uses

Pre-emergence annual grass weed control in soyabean, cotton and groundnuts at 0.75 to 1.0 kg/ha.

Formulation used Emulsifiable concentrate 83.9% a.i.

Spray volume 372 l/ha

RESULTS

Full results are given in the histograms on pages 19-21 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
1.6	groundnut soyabean cotton	All species below
0.4	as above + pigeon pea chick pea mungbean sesamum aubergine	Rottboellia cochinchinensis + species below
0.1	as above + maize + safener (NA) sorghum + safener (CGA 92194) cowpea lentil	Eleusine indica Echinochloa crus-galli Digitaria sanguinalis Bromus pectinatus Snowdenia polystachya Phalaris minor

Comments on results

Cinmethylin showed excellent selectivity against annual grasses particularly in groundnut, soyabean and cotton but also in three further legumes plus sesamum and aubergine. All these species tolerated 0.4 kg/ha at which dose all the annual grasses were controlled, including Rottboellia. At the lowest dose of 0.1 kg/ha all but the latter were controlled and cowpea and lentil were undamaged. Amaranthus retroflexus was not controlled at any dose, nor were the perennial Cyperus species or Oxalis latifolia.

Maize tolerated the lowest dose and there was relatively little influence of NA on the damaging effects at higher doses. Sorghum was almost undamaged at the lowest dose and there was a small protective effect of CGA 92194 which resulted in an acceptable score at that dose.

Cinmethylin is related to trifluralin and other dinitroanilines and may usefully be compared with pendimethalin and oryzalin as members of this group do not usually require incorporation to prevent loss of activity. The performance in broad-leaved crops should be at least as interesting as that of pendimethalin. For control of Rottboellia in maize, it appears the selectivity is not adequate but it will be worth further testing for this possibility too.

The susceptibility of Phalaris and Bromus to 0.1 kg/ha is of interest in the light of the results reported by Richardson and West (1986), showing that wheat tolerated 0.25 kg/ha (or 1.0 kg/ha when protected by NA).

CYNMETHALIN

SPECIES	0.100 kg/ha	0.400 kg/ha	1.600 kg/ha
MILLET	0	0	0
(55)	0	0	0
MAIZE+S	100 xxxxxxxxxxxxxxxxxxxx	100 xxxxxxxxxxxxxxxxxxxx	50 xxxxxxxxxx
(56)	86 xxxxxxxxxxxxxxxxx	71 xxxxxxxxxxxxxx	36 xxxxxxx
MAIZE	100 xxxxxxxxxxxxxxxxxxxx	92 xxxxxxxxxxxxxxxxxx	58 xxxxxxxxxxxx
(57)	86 xxxxxxxxxxxxxxxxx	50 xxxxxxxxxx	36 xxxxxxx
SORG+S	90 xxxxxxxxxxxxxxxxxx	90 xxxxxxxxxxxxxxxxxx	58 xxxxxxxxxxxx
(58)	86 xxxxxxxxxxxxxxxxx	64 xxxxxxxxxxxxx	36 xxxxxxx
SORGHUM	120 xxxxxxxxxxxxxxxxxxxx+	80 xxxxxxxxxxxxxxxx	0
(59)	79 xxxxxxxxxxxxxxxxx	43 xxxxxxxxx	0
PIGEON P	106 xxxxxxxxxxxxxxxxxxxx+	129 xxxxxxxxxxxxxxxxxxxx+	12 xx
(61)	79 xxxxxxxxxxxxxxxxx	86 xxxxxxxxxxxxxxxxx	7 x
COWPEA	96 xxxxxxxxxxxxxxxxxxx	96 xxxxxxxxxxxxxxxxxxx	96 xxxxxxxxxxxxxxxxxxx
(62)	93 xxxxxxxxxxxxxxxxxxx	64 xxxxxxxxxxxxx	43 xxxxxxxxx
CHICKPEA	100 xxxxxxxxxxxxxxxxxxxx	100 xxxxxxxxxxxxxxxxxxxx	91 xxxxxxxxxxxxxxxxx
(63)	100 xxxxxxxxxxxxxxxxxxxx	93 xxxxxxxxxxxxxxxxxx	50 xxxxxxxxxx
GRNDNUT	114 xxxxxxxxxxxxxxxxxxxx+	100 xxxxxxxxxxxxxxxxxxxx	100 xxxxxxxxxxxxxxxxxxxx
(64)	93 xxxxxxxxxxxxxxxxxx	86 xxxxxxxxxxxxxxxxx	93 xxxxxxxxxxxxxxxxxx
SOYABEAN	100 xxxxxxxxxxxxxxxxxxx	100 xxxxxxxxxxxxxxxxxxx	92 xxxxxxxxxxxxxxxxx
(65)	100 xxxxxxxxxxxxxxxxxxx	79 xxxxxxxxxxxxxxx	100 xxxxxxxxxxxxxxxxxxx
COTTON	96 xxxxxxxxxxxxxxxxxx	87 xxxxxxxxxxxxxxxxx	70 xxxxxxxxxxxxx
(66)	100 xxxxxxxxxxxxxxxxxxx	93 xxxxxxxxxxxxxxxxxxx	86 xxxxxxxxxxxxxxxx
JUTE	97 xxxxxxxxxxxxxxxxxx	62 xxxxxxxxxxx	66 xxxxxxxxxxxx
(67)	50 xxxxxxxxxx	29 xxxxxx	14 xxx

CYNMETHALIN

SPECIES	0.100 kg/ha		0.400 kg/ha		1.600 kg/ha	
KENAF	65	xxxxxxxxxxxxx	103	xxxxxxxxxxxxxxxxxxxx+	90	xxxxxxxxxxxxxxxxx
(68)	79	xxxxxxxxxxxxxxx	79	xxxxxxxxxxxxxxx	57	xxxxxxxxxx
SESAMUM	108	xxxxxxxxxxxxxxxxxxxx+	86	xxxxxxxxxxxxxxxxx	103	xxxxxxxxxxxxxxxxxxx+
(70)	100	xxxxxxxxxxxxxxxxxxx	86	xxxxxxxxxxxxxxxxx	64	xxxxxxxxxxxx
RICE	55	xxxxxxxxxxx	6	x	6	x
(72)	57	xxxxxxxxxxx	21	xxxx	21	xxxx
ELEU IND	0		0		0	
(74)	0		0		0	
ECH CRUS	0		0		0	
(75)	0		0		0	
ROTT EXA	75	xxxxxxxxxxxxxxx	25	xxxxx	0	
(76)	50	xxxxxxxxxx	21	xxxx	0	
DIG SANG	0		0		0	
(77)	0		0		0	
AMAR RET	97	xxxxxxxxxxxxxxxxxx	47	xxxxxxxxx	110	xxxxxxxxxxxxxxxxxxx+
(78)	79	xxxxxxxxxxxxxxx	64	xxxxxxxxxxxxx	50	xxxxxxxxxx
BROM PEC	26	xxxxx	0		0	
(82)	43	xxxxxxxxx	0		0	
SNO POL	3	x	0		0	
(83)	14	xxx	0		0	
PHAL MIN	0		0		0	
(84)	0		0		0	
CYP ESCU	100	xxxxxxxxxxxxxxxxxxx	44	xxxxxxxxx	31	xxxxxx
(85)	100	xxxxxxxxxxxxxxxxxxx	100	xxxxxxxxxxxxxxxxxxx	50	xxxxxxxxxx

CYNMETHALIN

SPECIES	0.100 kg/ha		0.400 kg/ha		1.600 kg/ha	
CYP ROTU	109	xxxxxxxxxxxxxxxxxxxx+	100	xxxxxxxxxxxxxxxxxxx	82	xxxxxxxxxxxxxxx
(86)	100	xxxxxxxxxxxxxxxxxxx	100	xxxxxxxxxxxxxxxxxxx	71	xxxxxxxxxxxxx
AUBGIN	76	xxxxxxxxxxxxxxx	90	xxxxxxxxxxxxxxxxx	97	xxxxxxxxxxxxxxxxxx
(89)	100	xxxxxxxxxxxxxxxxxxx	93	xxxxxxxxxxxxxxxxx	79	xxxxxxxxxxxxxxx
LENTIL	88	xxxxxxxxxxxxxxxxx	16	xxx	0	
(90)	93	xxxxxxxxxxxxxxxxxx	21	xxxx	0	
MUNGB	100	xxxxxxxxxxxxxxxxxxx	100	xxxxxxxxxxxxxxxxxxx	42	xxxxxxxx
(91)	93	xxxxxxxxxxxxxxxxxx	93	xxxxxxxxxxxxxxxxxx	50	xxxxxxxxxx

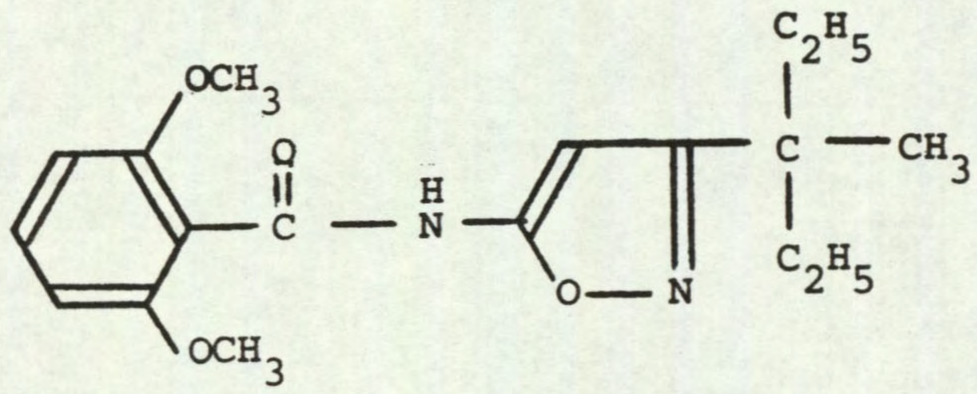
Isoxaben

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 372 l/ha.

RESULTS

Full results are given in the histograms on pages 25-27 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	maize ± safener (NA) cotton	Rottboellia cochinchinensis Phalaris minor + species below
0.16	as above + sorghum + safener (CGA 92194) cowpea chickpea groundnut soyabean	Eleusine indica Echinochloa crus-galli Snowdenia polystachya + species below
0.04	as above + rice sorghum millet mungbean jute sesamum*	Digitaria sanguinalis Amaranthus retroflexus

* but numbers seriously reduced

Comments on results

Isoxaben at 0.64 kg/ha showed excellent selectivity in maize and cotton against Amaranthus retroflexus and all of the annual grasses other than Bromus pectinatus. The large seeded legumes tolerated 0.16 kg/ha at which most of the annual grasses were controlled but not Rottboellia. Sorghum was moderately protected by CGA 92194, such that it could also tolerate 0.16 kg/ha. Millet was comparable to unprotected sorghum in not quite tolerating this dose. These, together with several others such as jute and sesamum were quite safe at 0.04 kg/ha at which dose Amaranthus was completely killed but only Digitaria was susceptible among the grasses. Cyperus species and Oxalis were highly tolerant.

This compound has a characteristic stunting effect on roots but following the main assessment on the shoot systems, an examination of roots showed that there was no serious, unseen effect below ground which required an alteration of the scores. It is, however, likely that depth of germination of both crops and weeds will have an influence on selectivity.

The striking selectivities in cotton and maize are of greatest interest with the possibility of selective control of Rottboellia in maize particularly deserving further study. General weed control in the large-seeded legumes could also be of interest as a broader range of broad-leaved weeds is likely to be susceptible. As wheat and barley have been shown to be highly resistant (Richardson and West, 1984) isoxaben could be of interest in sub-tropical and highland tropical wheat growing areas where Phalaris minor and the more tropical species, including Snowdenia, are predominant. The Avena and Bromus species will not, however, be controlled.

ISOXABEN

SPECIES	0.040 kg/ha		0.160 kg/ha		0.640 kg/ha	
MILLET	100	xxxxxxxxxxxxxxxxxxx	113	xxxxxxxxxxxxxxxxxxx+	20	xxxx
(55)	100	xxxxxxxxxxxxxxxxxxx	79	xxxxxxxxxxxxxxx	21	xxxx
MAIZE+S	100	xxxxxxxxxxxxxxxxxxx	100	xxxxxxxxxxxxxxxxxxx	100	xxxxxxxxxxxxxxxxxxx
(56)	86	xxxxxxxxxxxxxxxx	86	xxxxxxxxxxxxxxxx	86	xxxxxxxxxxxxxxxx
MAIZE	100	xxxxxxxxxxxxxxxxxxx	100	xxxxxxxxxxxxxxxxxxx	100	xxxxxxxxxxxxxxxxxxx
(57)	100	xxxxxxxxxxxxxxxxxxx	100	xxxxxxxxxxxxxxxxxxx	86	xxxxxxxxxxxxxxxx
SORG+S	90	xxxxxxxxxxxxxxxxx	103	xxxxxxxxxxxxxxxxxxx+	77	xxxxxxxxxxxxxxx
(58)	93	xxxxxxxxxxxxxxxxxx	100	xxxxxxxxxxxxxxxxxx	64	xxxxxxxxxxxx
SORGHUM	120	xxxxxxxxxxxxxxxxxxx+	112	xxxxxxxxxxxxxxxxxxx+	72	xxxxxxxxxxxxxx
(59)	100	xxxxxxxxxxxxxxxxxx	79	xxxxxxxxxxxxxxx	50	xxxxxxxxxx
PIGEON P	141	xxxxxxxxxxxxxxxxxxx+	82	xxxxxxxxxxxxxxx	47	xxxxxxxxx
(61)	79	xxxxxxxxxxxxxxx	50	xxxxxxxxxx	29	xxxxxx
COWPEA	104	xxxxxxxxxxxxxxxxxxx+	104	xxxxxxxxxxxxxxxxxxx+	78	xxxxxxxxxxxxxxx
(62)	100	xxxxxxxxxxxxxxxxxxx	86	xxxxxxxxxxxxxxxx	43	xxxxxxxxx
CHICKPEA	91	xxxxxxxxxxxxxxxxxx	64	xxxxxxxxxxxxx	9	xx
(63)	93	xxxxxxxxxxxxxxxxxx	86	xxxxxxxxxxxxxxxx	29	xxxxxx
GRNDNUT	86	xxxxxxxxxxxxxxxxx	114	xxxxxxxxxxxxxxxxxxx+	114	xxxxxxxxxxxxxxxxxxx+
(64)	86	xxxxxxxxxxxxxxxxx	86	xxxxxxxxxxxxxxxx	71	xxxxxxxxxxxxxx
SOYABEAN	100	xxxxxxxxxxxxxxxxxxx	100	xxxxxxxxxxxxxxxxxxx	67	xxxxxxxxxxxxx
(65)	100	xxxxxxxxxxxxxxxxxxx	93	xxxxxxxxxxxxxxxxxx	50	xxxxxxxxxx
COTTON	87	xxxxxxxxxxxxxxxxx	87	xxxxxxxxxxxxxxxxx	87	xxxxxxxxxxxxxxxxx
(66)	86	xxxxxxxxxxxxxxxxx	93	xxxxxxxxxxxxxxxxxx	86	xxxxxxxxxxxxxxxxx
JUTE	76	xxxxxxxxxxxxxxx	90	xxxxxxxxxxxxxxxxx	17	xxx
(67)	93	xxxxxxxxxxxxxxxxxx	71	xxxxxxxxxxxxxx	50	xxxxxxxxxx

ISOXABEN

SPECIES		0.040 kg/ha		0.160 kg/ha		0.640 kg/ha
KENAF	103	xxxxxxxxxxxxxxxxxxx+	84	xxxxxxxxxxxxxxxx	52	xxxxxxxxxx
(68)	57	xxxxxxxxxxx	71	xxxxxxxxxxxxx	57	xxxxxxxxxxx
SESAMUM	38	xxxxxxxx	0		0	
(70)	86	xxxxxxxxxxxxxxxx	0		0	
RICE	109	xxxxxxxxxxxxxxxxxxx+	97	xxxxxxxxxxxxxxxxxx	97	xxxxxxxxxxxxxxxxxx
(72)	100	xxxxxxxxxxxxxxxxxxx	64	xxxxxxxxxxxxx	43	xxxxxxxxx
ELEU IND	41	xxxxxxxx	0		0	
(74)	57	xxxxxxxxxxx	0		0	
ECH CRUS	84	xxxxxxxxxxxxxxxx	42	xxxxxxxx	3	x
(75)	100	xxxxxxxxxxxxxxxxxx	29	xxxxxx	7	x
ROTT EXA	105	xxxxxxxxxxxxxxxxxxx+	105	xxxxxxxxxxxxxxxxxx+	20	xxxx
(76)	100	xxxxxxxxxxxxxxxxxxx	86	xxxxxxxxxxxxxxxx	21	xxxx
DIG SANG	14	xxx	0		0	
(77)	21	xxxx	0		0	
AMAR RET	0		0		0	
(78)	0		0		0	
BROM PEC	87	xxxxxxxxxxxxxxxx	97	xxxxxxxxxxxxxxxxx	82	xxxxxxxxxxxxxxx
(82)	86	xxxxxxxxxxxxxxxx	79	xxxxxxxxxxxxxxx	57	xxxxxxxxxx
SNO POL	43	xxxxxxxxx	11	xx	0	
(83)	57	xxxxxxxxxxx	36	xxxxxxx	0	
PHAL MIN	88	xxxxxxxxxxxxxxxxx	42	xxxxxxxx	19	xxxx
(84)	93	xxxxxxxxxxxxxxxxx	50	xxxxxxxxxx	21	xxxx
CYP ESCU	100	xxxxxxxxxxxxxxxxxxx	100	xxxxxxxxxxxxxxxxxxx	94	xxxxxxxxxxxxxxxxxx
(85)	100	xxxxxxxxxxxxxxxxxxx	100	xxxxxxxxxxxxxxxxxxx	86	xxxxxxxxxxxxxxxxx

ISOXABEN

SPECIES		0.040 kg/ha		0.160 kg/ha		0.640 kg/ha
CYP ROTU	95	xxxxxxxxxxxxxxxxxxx	105	xxxxxxxxxxxxxxxxxxxx+	100	xxxxxxxxxxxxxxxxxxx
(86)	100	xxxxxxxxxxxxxxxxxxx	86	xxxxxxxxxxxxxxxx	93	xxxxxxxxxxxxxxxxxx
AUBGIN	7	x	0		0	
(89)	14	xxx	0		0	
LENTIL	0		0		0	
(90)	0		0		0	
MUNGB	92	xxxxxxxxxxxxxxxxxx	67	xxxxxxxxxxxxx	8	xx
(91)	100	xxxxxxxxxxxxxxxxxxx	79	xxxxxxxxxxxxxxx	29	xxxxxx

NB: AC 263,499 is imazethapyr

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Appendix 1. Species, abbreviations, cultivars and stage of growth at assessment

	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)
Millet (Pennisetum americanum)	MILLET (55)	ex Bornu	10	0.5	6-7 leaves
Maize + safener (Zea mays)	MAIZE + S (56)	LG 11	6	2	5-6 leaves
Maize (Zea mays)	MAIZE (57)	LG 11	6	2	5-6 leaves
Sorghum + safener Sorghum bicolor)	SORG + S (58)	TUB 22	8	1	6-7 leaves
Sorghum (Sorghum bicolor)	SORG (59)	TUB 22	8	1	6-7 leaves
Pigeon pea (Cajanus cajan)	PIGEON P (61)	ICRISAT T	6	1	2-3 trifoliates
Cowpea (Vigna unguiculata)	COWPEA (62)	Blackeye (TRS)	6	1	2 trifoliates
Chickpea (Cicer arietinum)	CHICKPEA (63)	ILC 482	6	1	10-13 leaves
Groundnut (Arachis hypogaea)	GRNDNUT (64)	NC 6	4	2	5 leaves
Soyabean (Glycine max)	SOYABEAN (65)	Amsoy	6	1	2-3 trifoliates
Cotton (Gossypium hirsutum)	COTTON (66)	Coker 315	6	1	2 leaves
Jute (Corchorus capsularis)	JUTE (67)	India	15	0.5	4-6 leaves
Kenaf (Hibiscus cannabinus)	KENAF (68)	WRO 1981	10	0.5	4-5 leaves
Sesamum (Sesamum indicum)	SESAMUM (70)	Sudan	15	0.5	4 leaves
Rice (Oryza sativa)	RICE (72)	IR 36	10	1	3-6 leaves

Eleusine indica	ELEU IND (74)	Zimbabwe 1980	20	0.5	7-8 leaves
Echinochloa crus-galli	ECH CRUS (75)	WRO 1979	20	0.5	5-6 leaves
Rottboellia cochinchinensis (= R. exaltata)	ROTT EXA (76)	Zambia 1978	15	0.5	4-6 leaves
Digitaria sanguinalis	DIG SANG (77)	WRO 1979	20	0.25	3 leaves
Amaranthus retroflexus	AMAR RET (78)	WRO 1980	20	0.25	7-9 leaves
Bromus pectinatus	BROM PEC (82)	Tanzania 1981	12	0.5	3 leaves
Snowdenia polystachya	SNO POL (83)	Ethiopia 1980	30	0.25	5-7 leaves
Phalaris minor	PHAL MIN (84)	WRO 1979	20	0.25	2-4 leaves
Cyperus esculentus	CYP ESCU (85)	WRO clone 2 (ex S. Africa)	8	2	7-8 leaves
Cyperus rotundus	CYP ROTU (86)	WRO clone 1 (Zimbabwe)	5	2	8-9 Leaves
Aubergine (Solanum melongena)	AUBGIN (89)	Money Maker (F.1. hybrid)	8	0.5	2-3 leaves
Lentil (Lens culinaris)	LENTIL (90)	Syrian local	8	1	8-9 leaves
Mungbean (Phaseolus aureus)	MUNGB (91)	CES-ID-21	6	1	2 trifoliates
Oxalis latifolia	(results not computerised)	WRO clone 2 ('Cornwall B')	10	1	-

ABBREVIATIONS

ångström	Å	freezing point	f.p.
Abstract	Abs.	from summary	F.s.
acid equivalent*	a.e.	gallon	gal
acre	ac	gallons per hour	gal/h
active ingredient*	a.i.	gallons per acre	gal/ac
approximately equal to*	≃	gas liquid chromatography	GLC
aqueous concentrate	a.c.	gramme	g
bibliography	bibl.	hectare	ha
boiling point	b.p.	hectokilogram	hkg
bushel	bu	high volume	HV
centigrade	C	horse power	hp
centimetre*	cm	hour	h
concentrated	concd	hundredweight*	cwt
concentration	concn	hydrogen ion concentration*	pH
concentration x time product	ct	inch	in.
concentration required to kill 50% test animals	LC50	infra red	i.r.
		kilogramme	kg
cubic centimetre*	cm^3	kilo ($x10^3$)	k
cubic foot*	ft^3	less than	<
cubic inch*	in^3	litre	l.
cubic metre*	m^3	low volume	LV
cubic yard*	yd^3	maximum	max.
cultivar(s)	cv.	median lethal dose	LD50
curie*	Ci	medium volume	MV
degree Celsius*	^oC	melting point	m.p.
degree centigrade	^oC	metre	m
degree Fahrenheit*	^oF	micro ($x10^{-6}$)	μ
diameter	diam.	microgramme*	μg
diameter at breast height	d.b.h.	micromicro (pico: $x10^{-12}$)*	μμ
divided by*	÷ or /	micrometre (micron)*	μm (or μ)
dry matter	d.m.	micron (micrometre)*†	μm (or μ)
emulsifiable concentrate	e.c.	miles per hour*	mile/h
		milli ($x10^{-3}$)	m
equal to*	=	milliequivalent*	m.equiv.
fluid	fl.	milligramme	mg
foot	ft	millilitre	ml

† The name micrometre is preferred to micron and μm is preferred to μ.

millimetre*	mm
millimicro* (nano: $x10^{-9}$)	n or mμ
minimum	min.
minus	-
minute	min
molar concentration*	M (small cap)
molecule, molecular	mol.
more than	>
multiplied by*	x
normal concentration*	N (small cap)
not dated	n.d.
oil miscible concentrate	o.m.c. (tables only)
organic matter	o.m.
ounce	oz
ounces per gallon	oz/gal
page	p.
pages	pp.
parts per million	ppm
parts per million by volume	ppmv
parts per million by weight	ppmw
percent(age)	%
pico (micromicro: $x10^{-12}$)	p or μμ
pint	pint
pints per acre	pints/ac
plus or minus*	±
post-emergence	post-em
pound	lb
pound per acre*	lb/ac
pounds per minute	lb/min
pound per square inch*	lb/in^2
powder for dry application	p. (tables only)
power take off	p.t.o.
precipitate (noun)	ppt.
pre-emergence	pre-em.
quart	quart
relative humidity	r.h.
revolution per minute*	rev/min
second	s
soluble concentrate	s.c.
soluble powder	s.p.
solution	soln
species (singular)	sp.
species (plural)	spp.
specific gravity	sp. gr.
square foot*	ft^2
square inch	in^2
square metre*	m^2
square root of*	$\surd$
sub-species*	ssp.
summary	s.
temperature	temp.
ton	ton
tonne	t
ultra-low volume	ULV
ultra violet	u.v.
vapour density	v.d.
vapour pressure	v.p.
varietas	var.
volt	V
volume	vol.
volume per volume	v/v
water soluble powder	w.s.p. (tables only)
watt	W
weight	wt
weight per volume*	w/v
weight per weight*	w/w
wettable powder	w.p.
yard	yd
yards per minute	yd/min

* Those marked * should normally be used in the text as well as in tables etc.

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87. The potential use of grass growth retardants at Sullom Voe terminal, Shetland. A report prepared for W J Cairns and Partners, 16 Randolph Crescent, Edinburgh, Environmental Consultants to BP Petroleum Development Ltd as Operators of Sullom Voe Terminal. May 1985. E J P Marshall. Price - £3.00.

88. A further study of the effect of six cereal herbicide treatments on a range of broad-leaved field margin plants. June 1985. J E Birnie. Price - £2.50

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