LONG ASHTON RESEARCH STATION
WEED RESEARCH DIVISION

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THE PRE-EMERGENCE SELECTIVITY IN WARM-CLIMATE SPECIES OF SOME RECENTLY DEVELOPED HERBICIDES: METAZACHLOR, RST 20024H, ORBENCARB AND DIFLUFENICAN

RST 200024H is trimexachlor

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NOTE

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THE PRE-EMERGENCE SELECTIVITY IN WARM-CLIMATE SPECIES OF SOME RECENTLY DEVELOPED HERBICIDES: METAZACHLOR, RST 20024H, ORBENCARB AND DIFLUFENICAN

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SUMMARY

Four herbicides were evaluated as surface pre-emergence treatments in a glasshouse pot experiment on 28 warm-climate crop and weed species. Maize and sorghum were each included in two sets, with and without seed dressings of safeners, 1,8-naphthalic anhydride (NA) on maize, and CGA 92194 on sorghum.

Metazachlor was very much more active than RST 20024H but both showed the effects and selectivity typical of the anilide herbicide group with excellent selectivity against Amaranthus retroflexus and a range of annual grasses in large-seeded legume crops. Maize and sorghum showed moderate tolerance which was markedly increased by the respective safeners. Cyperus esculentus, Commelina diffusa and Rottboellia cochinchinensis were only controlled at the higher doses of each compound and advantages over the established members of this herbicide group are not clear.

Orbencarb, a thiolcarbamate which does not require pre-planting incorporation was highly selective against Amaranthus and many annual grasses in maize and large-seeded legumes but failed to control R. cochinchinensis or Cyperus species. Maize and sorghum each showed improved tolerance with safeners. Most notable was the control of C. diffusa at a low dose at which a wide range of crops was tolerant including all legumes, cotton, kenaf, aubergine, rice, millet and sorghum.

Diflufenican causes albinism in susceptible species which include A. retroflexus and some annual grasses but not Echinochloa crus-galli, R. cochinchinensis, C. diffusa or Cyperus spp. Highly resistant crops included rice, sorghum, maize and many legumes, while a much wider range including aubergine, jute and sesamum tolerated a dose which controlled A. retroflexus. Phalaris minor and Snowdenia polystachya were controlled at a dose known to be safe in wheat and barley.

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. After an interval during which funds were not available it was possible in 1985 to resume herbicide evaluation on species of relevance to developing countries under a new project, partially funded by the European Economic Community. This report covers the second 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 the previous tests are Richardson and West (1984, 1985a,b, 1986). Those 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	8.7.85
Main assessment completed	2.8.85
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	36
minimum	13
Relative humidity (%)	
mean	68
maximum	90
minimum	24

Pre-planting treatments to improve germination included a) the storage of Cyperus esculentus tubers at 5^{o}C for 2 weeks 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.

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' represents 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. were kept for an extra period to observe later effects and/or the recovery from injury.

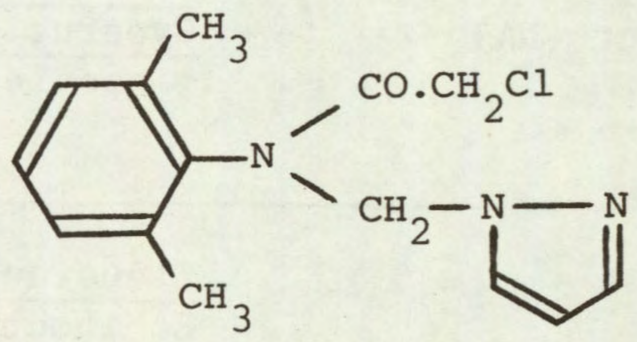
Metazachlor

Code numbers BAS 47900H
BAS 47902H

Trade name/s Butisan

Chemical name α-chloro-N-(1-pyrazolylmethyl)aceto-2',6'-xylidide

Structure



Source

BASF (UK) Ltd
Agricultural Division
Lady Lane
Hadleigh
Suffolk IP7 6BQ

Information available and suggested uses

Pre-emergence control of annual grass and broad-leaved weeds in winter rape at 1.25 kg a.i./ha; swedes at 1.0 to 1.25 kg a.i./ha; transplanted brassicas at 1.0 to 1.25 kg a.i./ha.

Formulation used: 50% a.i. suspension concentrate

Spray volume: 372 l/ha

RESULTS

Full results are given in the histograms on pages 6 to 8 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
1.0	groundnut	Rottboellia cochinchinensis Cyperus rotundus + species below
0.25	as above + maize + safener (NA) chickpea soyabean	Commelina diffusa Cyperus esculentus + species below
0.0625	as above + maize sorghum + safener (CGA 92194) cowpea mungbean cotton	Eleusine indica Echinochloa crus-galli Digitaria sanguinalis Bromus pectinatus Snowdenia polystachya Phalaris minor Amaranthus retroflexus

Comments on results

Metazachlor caused symptoms typical of the anilide herbicides and a somewhat comparable range of selectivity with large-seeded legumes showing the greatest tolerance, and Amaranthus retroflexus and many annual grasses highly sensitive. As with other members of this herbicide class, Cyperus esculentus was moderately susceptible but C. rotundus rather less so. After 4 months C. esculentus was still completely suppressed at 1 kg/ha but C. rotundus had recovered. Rottboellia was, as expected, relatively resistant. Cotton and maize (unprotected) tolerated only the lowest dose, but both maize and sorghum were protected about 4-fold by their respective safeners allowing maize to tolerate the higher dose of 0.25 kg/ha. Millet was extremely sensitive.

It is not easy to judge from this experiment what advantages this compound might have over the related alachlor or metolachlor in warmer climates, but it should be well worth including in any work on cruciferous crops (cf Richardson & West (1985a).

TRIAL NUMBER 8533

METAZACHLOR

SPECIES	0.0625 kg/ha		0.2500 kg/ha		1.0000 kg/ha	
MILLET	0		0		0	
(55)	0		0		0	
MAIZE+S	104	xxxxxxxxxxxxxxxxxxx+	104	xxxxxxxxxxxxxxxxxxx+	96	xxxxxxxxxxxxxxxxxx
(56)	93	xxxxxxxxxxxxxxxxxx	100	xxxxxxxxxxxxxxxxxx	64	xxxxxxxxxxxx
MAIZE	104	xxxxxxxxxxxxxxxxxxx+	104	xxxxxxxxxxxxxxxxxxx+	78	xxxxxxxxxxxxxxx
(57)	100	xxxxxxxxxxxxxxxxxx	64	xxxxxxxxxxxx	36	xxxxxxx
SORG+S	93	xxxxxxxxxxxxxxxxxx	73	xxxxxxxxxxxxxx	0	
(58)	100	xxxxxxxxxxxxxxxxxx	50	xxxxxxxxxx	0	
SORGHUM	21	xxxx	0		0	
(59)	50	xxxxxxxxxx	0		0	
PIGEON P	63	xxxxxxxxxxxx	0		0	
(61)	43	xxxxxxxxx	0		0	
COWPEA	100	xxxxxxxxxxxxxxxxxx	100	xxxxxxxxxxxxxxxxxx	100	xxxxxxxxxxxxxxxxxx
(62)	93	xxxxxxxxxxxxxxxxxx	71	xxxxxxxxxxxxx	43	xxxxxxxxx
CHICKPEA	100	xxxxxxxxxxxxxxxxxx	92	xxxxxxxxxxxxxxxxx	92	xxxxxxxxxxxxxxxxx
(63)	100	xxxxxxxxxxxxxxxxxx	100	xxxxxxxxxxxxxxxxxx	57	xxxxxxxxxx
GRNDNUT	93	xxxxxxxxxxxxxxxxxx	107	xxxxxxxxxxxxxxxxxxx+	107	xxxxxxxxxxxxxxxxxxx+
(64)	100	xxxxxxxxxxxxxxxxxx	100	xxxxxxxxxxxxxxxxxx	93	xxxxxxxxxxxxxxxxxx
SOYABEAN	100	xxxxxxxxxxxxxxxxxx	100	xxxxxxxxxxxxxxxxxx	100	xxxxxxxxxxxxxxxxxx
(65)	100	xxxxxxxxxxxxxxxxxx	86	xxxxxxxxxxxxxxxx	57	xxxxxxxxxx
COTTON	114	xxxxxxxxxxxxxxxxxxx+	67	xxxxxxxxxxxxx	95	xxxxxxxxxxxxxxxxxx
(66)	93	xxxxxxxxxxxxxxxxxx	57	xxxxxxxxxx	43	xxxxxxxxx
JUTE	0		0		0	
(67)	0		0		0	

TRIAL NUMBER 8533

METAZACHLOR

SPECIES		0.0625 kg/ha		0.2500 kg/ha		1.0000 kg/ha
KENAF	84	xxxxxxxxxxxxxxxx	100	xxxxxxxxxxxxxxxxxxxx	89	xxxxxxxxxxxxxxxxxx
(68)	79	xxxxxxxxxxxxxxx	57	xxxxxxxxxx	43	xxxxxxxxx
SESAMUM	59	xxxxxxxxxxxx	59	xxxxxxxxxxxx	18	xxxx
(70)	57	xxxxxxxxxx	36	xxxxxxx	14	xxx
RICE	85	xxxxxxxxxxxxxxxx	12	xx	0	
(72)	57	xxxxxxxxxx	14	xxx	0	
ELEU IND	0		0		0	
(74)	0		0		0	
ECH CRUS	0		0		0	
(75)	0		0		0	
ROTT EXA	109	xxxxxxxxxxxxxxxxxxx+	70	xxxxxxxxxxxxxx	30	xxxxxx
(76)	86	xxxxxxxxxxxxxxxx	43	xxxxxxxxx	29	xxxxxx
DIG SANG	0		0		0	
(77)	0		0		0	
AMAR RET	22	xxxx	0		0	
(78)	21	xxxx	0		0	
BROM PEC	10	xx	0		0	
(82)	29	xxxxxx	0		0	
SNO POL	0		0		0	
(83)	0		0		0	
PHAL MIN	0		0		0	
(84)	0		0		0	
CYP ESCU	147	xxxxxxxxxxxxxxxxxxx+	29	xxxxxx	0	
(85)	71	xxxxxxxxxxxxxx	29	xxxxxx	0	

TRIAL NUMBER 8533

METAZACHLOR

SPECIES		0.0625 kg/ha		0.2500 kg/ha		1.0000 kg/ha
CYP ROTU	87	xxxxxxxxxxxxxxxxx	62	xxxxxxxxxxxx	15	xxx
(86)	100	xxxxxxxxxxxxxxxxxxx	79	xxxxxxxxxxxxxxx	64	xxxxxxxxxxxx
AUBGIN	58	xxxxxxxxxxx	32	xxxxxx	6	x
(89)	57	xxxxxxxxxxx	21	xxxx	21	xxxx
LENTIL	21	xxxx	0		0	
(90)	36	xxxxxxx	0		0	
MUNGB	100	xxxxxxxxxxxxxxxxxxx	100	xxxxxxxxxxxxxxxxxxx	67	xxxxxxxxxxxx
(91)	100	xxxxxxxxxxxxxxxxxxx	57	xxxxxxxxxx	43	xxxxxxxxx
TEFF	0		0		0	
(92)	0		0		0	
COMMEL	78	xxxxxxxxxxxxxxx	17	xxx	0	
(93)	64	xxxxxxxxxxxxx	14	xxx	0	

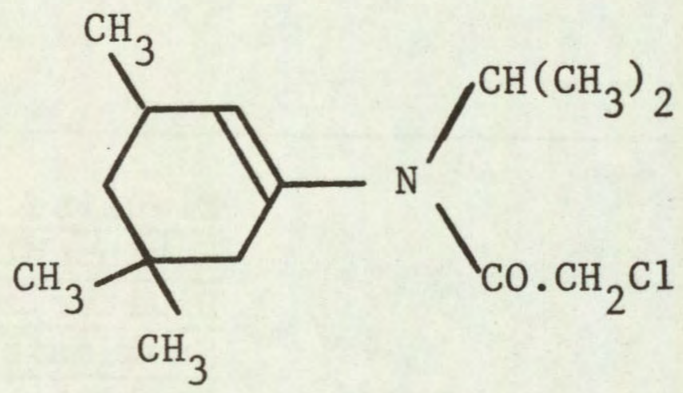
Code number RST 20024H
RST 20061H (+ atrazine)

Trade name/s
Atravit rustica (+ atrazine)

Common name Trimexachlor (proposed)

Chemical name α-chloroacetic-N-(3,5,5-trimethyl-cyclo-hexen-1-yl)-N-isopropylamide

Structure



Source

Ruhr-Stickstoff AG
Landwirtschaftliche Forschung
Hanninghof 35
D4408 Dülmen
Federal Republic of Germany

Information available and suggested uses

Broad-spectrum weed control in maize, winter rape, soyabeans etc. pre- and post-emergence.

Formulation used Emulsifiable concentrate 40% a.i.

Spray volume 372 l/ha

RESULTS

Full results are given in the histograms on pages 11-13 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
4.0	groundnut	Cyperus esculentus + species below
1.0	as above + maize + safener (NA) sorghum + safener (CGA 92194) cowpea soyabean mungbean kenaf	Rottboellia cochinchinensis Bromus pectinatus Commelina diffusa + species below
0.25	as above + lentil chickpea aubergine	Eleusine indica Echinochloa crus-galli Digitaria sanguinalis Snowdenia polystachya Phalaris minor Amaranthus retroflexus

Comments on results

As with the preceding compound, symptoms and selectivity were generally quite typical for the anilide herbicide class, but the level of activity was very much less. There is again good selectivity against Amaranthus and many annual grasses in larger seeded legumes with additional potential for kenaf, aubergine and lentil, not shown by metazachlor. Cyperus esculentus was relatively more tolerant requiring 4 kg/ha for temporary control (from which there was strong recovery after 3 months). Rottboellia was relatively a little more susceptible but a few plants recovered strongly from 1 kg/ha. Maize showed good tolerance and selective control of Rottboellia might just be possible, especially with the moderate protective effect of the safener NA. The safening effect of CGA 92194 on sorghum was particularly pronounced (well over 4-fold) allowing selective control of a wide range of annual weeds in this crop. Millet, however, was again extremely sensitive.

As for metazachlor it is difficult to judge the potential advantages of this compound over the related alachlor and metolachlor, but it deserves comparison with them in many crops if there is any possibility of a price advantage.

TRIAL NUMBER 8533

RST 20024H

SPECIES	0.2500 kg/ha		1.0000 kg/ha		4.0000 kg/ha	
MILLET	0		0		0	
(55)	0		0		0	
MAIZE+S	104	xxxxxxxxxxxxxxxxxxx+	104	xxxxxxxxxxxxxxxxxxx+	104	xxxxxxxxxxxxxxxxxxx+
(56)	93	xxxxxxxxxxxxxxxxxx	93	xxxxxxxxxxxxxxxxxx	79	xxxxxxxxxxxxxxx
MAIZE	104	xxxxxxxxxxxxxxxxxxx+	104	xxxxxxxxxxxxxxxxxxx+	104	xxxxxxxxxxxxxxxxxxx+
(57)	93	xxxxxxxxxxxxxxxxxx	93	xxxxxxxxxxxxxxxxxx	57	xxxxxxxxxx
SORG+S	100	xxxxxxxxxxxxxxxxxx	107	xxxxxxxxxxxxxxxxxxx+	93	xxxxxxxxxxxxxxxxxx
(58)	100	xxxxxxxxxxxxxxxxxx	100	xxxxxxxxxxxxxxxxxx	71	xxxxxxxxxxxxx
SORGHUM	110	xxxxxxxxxxxxxxxxxxx+	28	xxxxxx	7	x
(59)	79	xxxxxxxxxxxxxxx	50	xxxxxxxxxx	21	xxxx
PIGEON P	84	xxxxxxxxxxxxxxxx	32	xxxxxx	0	
(61)	50	xxxxxxxxxx	43	xxxxxxxxx	0	
COWPEA	100	xxxxxxxxxxxxxxxxxxx	100	xxxxxxxxxxxxxxxxxxx	100	xxxxxxxxxxxxxxxxxxx
(62)	100	xxxxxxxxxxxxxxxxxxx	93	xxxxxxxxxxxxxxxxxx	64	xxxxxxxxxxxx
CHICKPEA	83	xxxxxxxxxxxxxxxxx	100	xxxxxxxxxxxxxxxxxxx	100	xxxxxxxxxxxxxxxxxxx
(63)	100	xxxxxxxxxxxxxxxxxxx	71	xxxxxxxxxxxxx	57	xxxxxxxxxx
GRNDNUT	93	xxxxxxxxxxxxxxxxxx	80	xxxxxxxxxxxxxxxx	107	xxxxxxxxxxxxxxxxxxx+
(64)	100	xxxxxxxxxxxxxxxxxxx	93	xxxxxxxxxxxxxxxxxx	93	xxxxxxxxxxxxxxxxxx
SOYABEAN	100	xxxxxxxxxxxxxxxxxxx	100	xxxxxxxxxxxxxxxxxxx	100	xxxxxxxxxxxxxxxxxxx
(65)	100	xxxxxxxxxxxxxxxxxxx	86	xxxxxxxxxxxxxxxx	64	xxxxxxxxxxxx
COTTON	95	xxxxxxxxxxxxxxxxxx	105	xxxxxxxxxxxxxxxxxxx+	95	xxxxxxxxxxxxxxxxxx
(66)	79	xxxxxxxxxxxxxxx	79	xxxxxxxxxxxxxxx	57	xxxxxxxxxx
JUTE	76	xxxxxxxxxxxxxxx	31	xxxxxx	0	
(67)	50	xxxxxxxxxx	36	xxxxxxx	0	

TRIAL NUMBER 8533

RST 20024H

SPECIES	0.2500 kg/ha		1.0000 kg/ha		4.0000 kg/ha	
KENAF	100	xxxxxxxxxxxxxxxxxxx	95	xxxxxxxxxxxxxxxxxx	105	xxxxxxxxxxxxxxxxxxx+
(68)	93	xxxxxxxxxxxxxxxxxx	86	xxxxxxxxxxxxxxxx	71	xxxxxxxxxxxxx
SESAMUM	50	xxxxxxxxxx	59	xxxxxxxxxxx	14	xxx
(70)	57	xxxxxxxxxx	43	xxxxxxxxx	29	xxxxxx
RICE	109	xxxxxxxxxxxxxxxxxx+	24	xxxxx	0	
(72)	64	xxxxxxxxxxxx	36	xxxxxxx	0	
ELEU IND	0		0		0	
(74)	0		0		0	
ECH CRUS	0		0		0	
(75)	0		0		0	
ROTT EXA	113	xxxxxxxxxxxxxxxxxx+	9	xx	0	
(76)	86	xxxxxxxxxxxxxxxx	36	xxxxxxx	0	
DIG SANG	0		0		0	
(77)	0		0		0	
AMAR RET	22	xxxx	18	xxxx	0	
(78)	71	xxxxxxxxxxxxxx	21	xxxx	0	
BROM PEC	63	xxxxxxxxxxxxx	29	xxxxxx	0	
(82)	64	xxxxxxxxxxxxx	29	xxxxxx	0	
SNO POL	0		0		0	
(83)	0		0		0	
PHAL MIN	3	x	0		0	
(84)	14	xxx	0		0	
CYP ESCU	106	xxxxxxxxxxxxxxxxxxx+	53	xxxxxxxxxx	0	
(85)	71	xxxxxxxxxxxxxx	43	xxxxxxxxx	0	

TRIAL NUMBER 8533

RST 20024H

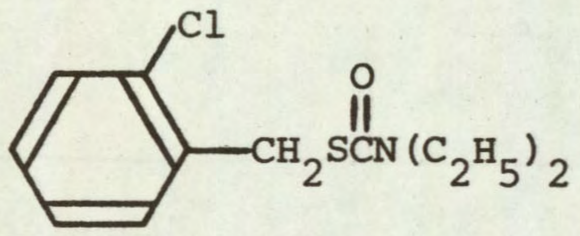
SPECIES		0.2500 kg/ha		1.0000 kg/ha		4.0000 kg/ha
CYP ROTU	87	xxxxxxxxxxxxxxxxx	98	xxxxxxxxxxxxxxxxxxxx	62	xxxxxxxxxxxx
(86)	100	xxxxxxxxxxxxxxxxxxx	79	xxxxxxxxxxxxxxx	79	xxxxxxxxxxxxxxx
AUBGIN	84	xxxxxxxxxxxxxxxxx	52	xxxxxxxxxx	0	
(89)	100	xxxxxxxxxxxxxxxxxxx	43	xxxxxxxxx	0	
LENTIL	103	xxxxxxxxxxxxxxxxxxx+	0		7	x
(90)	93	xxxxxxxxxxxxxxxxxx	0		21	xxxx
MUNGB	100	xxxxxxxxxxxxxxxxxxx	100	xxxxxxxxxxxxxxxxxxx	0	
(91)	86	xxxxxxxxxxxxxxxxx	86	xxxxxxxxxxxxxxxxx	0	
TEFF	0		0		0	
(92)	0		0		0	
COMMEL	70	xxxxxxxxxxxxxx	0		0	
(93)	50	xxxxxxxxxx	0		0	

Orbencarb

Other common name Orthobencarb (Japan) **Trade name** Lanray

Chemical name S-o-chlorobenzyl diethylthiocarbamate

Structure



Source Kumiai Chemical Industry Co Ltd.
4-26 Ikenohata 1-chome
Taito-ku
Tokyo 110
Japan

Information available and suggested uses

Pre-emergence after sowing until just before emergence of maize, sorghum, wheat, barley, potato, soyabean, carrot, groundnut, cotton, sunflower, sugar beet, kidney beans at 4.0 to 6.0 kg a.i./ha depending on soil type.

Formulation used Emulsifiable concentrate 50% w/v a.i.

Spray volume 372 l/ha

RESULTS

Full results are given in the histograms on pages 16-18 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
6.0	maize + safener (NA) groundnut soyabean	All species below
2.0	as above + maize cowpea chickpea mungbean	Bromus pectinatus Phalaris minor + species below
0.67	millet rice sorghum + safener (CGA 92194) pigeon pea lentil cotton kenaf aubergine	Eleusine indica Echinochloa crus-galli Digitaria sanguinalis Snowdenia polystachya Amaranthus retroflexus Commelina diffusa

Comments on results

Although unrelated to the preceding compounds, the pattern of selectivity was somewhat similar, being excellent in the large seeded legumes and in maize. As it is a thiocarbamate, it was a little surprising not to see better control of the Cyperus spp. but this could perhaps be due to the application being to the soil surface (which is possible with this compound) rather than incorporated pre-planting. Rottboellia also showed almost complete resistance but a very interesting strength was the good control of Commelina even at the lowest dose. Although cotton, kenaf and aubergine only tolerated this lowest dose, the selective contol of Commelina may be of particular interest. The selectivities in millet and rice also deserved further study.

There was evidence of some protection of maize by NA, as is to be expected with a thiolcarbamate. There was also moderate protection of sorghum by CGA 92194 but this was rather less than 4-fold.

TRIAL NUMBER 8533

ORBENCARB

SPECIES	0.6700 kg/ha		2.0000 kg/ha		6.0000 kg/ha	
MILLET	97	xxxxxxxxxxxxxxxxxxx	34	xxxxxxx	0	
(55)	86	xxxxxxxxxxxxxxxx	57	xxxxxxxxxxx	0	
MAIZE+S	96	xxxxxxxxxxxxxxxxxx	104	xxxxxxxxxxxxxxxxxxxx+	104	xxxxxxxxxxxxxxxxxxxx+
(56)	100	xxxxxxxxxxxxxxxxxx	93	xxxxxxxxxxxxxxxxxx	100	xxxxxxxxxxxxxxxxxx
MAIZE	104	xxxxxxxxxxxxxxxxxx+	104	xxxxxxxxxxxxxxxxxx+	104	xxxxxxxxxxxxxxxxxx+
(57)	100	xxxxxxxxxxxxxxxxxx	93	xxxxxxxxxxxxxxxxxx	79	xxxxxxxxxxxxxxx
SORG+S	93	xxxxxxxxxxxxxxxxxx	67	xxxxxxxxxxxxx	40	xxxxxxxx
(58)	100	xxxxxxxxxxxxxxxxxx	57	xxxxxxxxxxx	36	xxxxxxx
SORGHUM	76	xxxxxxxxxxxxxxx	41	xxxxxxxx	7	x
(59)	71	xxxxxxxxxxxxxx	43	xxxxxxxxx	14	xxx
PIGEON P	126	xxxxxxxxxxxxxxxxxxx+	74	xxxxxxxxxxxxxxx	74	xxxxxxxxxxxxxxx
(61)	93	xxxxxxxxxxxxxxxxxx	71	xxxxxxxxxxxxxx	50	xxxxxxxxxx
COWPEA	100	xxxxxxxxxxxxxxxxxxx	100	xxxxxxxxxxxxxxxxxxx	100	xxxxxxxxxxxxxxxxxxx
(62)	93	xxxxxxxxxxxxxxxxxx	86	xxxxxxxxxxxxxxxx	79	xxxxxxxxxxxxxxx
CHICKPEA	100	xxxxxxxxxxxxxxxxxxx	100	xxxxxxxxxxxxxxxxxxx	100	xxxxxxxxxxxxxxxxxxx
(63)	100	xxxxxxxxxxxxxxxxxxx	86	xxxxxxxxxxxxxxxx	57	xxxxxxxxxx
GRNDNUT	80	xxxxxxxxxxxxxxxx	107	xxxxxxxxxxxxxxxxxxx+	107	xxxxxxxxxxxxxxxxxxx+
(64)	86	xxxxxxxxxxxxxxxx	100	xxxxxxxxxxxxxxxxxx	100	xxxxxxxxxxxxxxxxxx
SOYABEAN	92	xxxxxxxxxxxxxxxxxx	100	xxxxxxxxxxxxxxxxxxx	100	xxxxxxxxxxxxxxxxxxx
(65)	100	xxxxxxxxxxxxxxxxxx	86	xxxxxxxxxxxxxxxx	86	xxxxxxxxxxxxxxxx
COTTON	105	xxxxxxxxxxxxxxxxxxx+	105	xxxxxxxxxxxxxxxxxxx+	114	xxxxxxxxxxxxxxxxxxx+
(66)	86	xxxxxxxxxxxxxxxx	79	xxxxxxxxxxxxxxx	50	xxxxxxxxxx
JUTE	93	xxxxxxxxxxxxxxxxxx	7	x	0	
(67)	50	xxxxxxxxxx	43	xxxxxxxxx	0	

TRIAL NUMBER 8533

ORBENCARB

SPECIES		0.6700 kg/ha		2.0000 kg/ha		6.0000 kg/ha
KENAF	105	xxxxxxxxxxxxxxxxxxx+	84	xxxxxxxxxxxxxxxx	63	xxxxxxxxxxxx
(68)	86	xxxxxxxxxxxxxxxx	64	xxxxxxxxxxxx	21	xxxx
SESAMUM	73	xxxxxxxxxxxxxx	55	xxxxxxxxxx	23	xxxxx
(70)	43	xxxxxxxxx	43	xxxxxxxxx	21	xxxx
RICE	115	xxxxxxxxxxxxxxxxxxx+	109	xxxxxxxxxxxxxxxxxxx+	97	xxxxxxxxxxxxxxxxxx
(72)	86	xxxxxxxxxxxxxxxx	79	xxxxxxxxxxxxxxxx	64	xxxxxxxxxxxx
ELEU IND	0		0		0	
(74)	0		0		0	
ECH CRUS	6	x	0		0	
(75)	21	xxxx	0		0	
ROTT EXA	104	xxxxxxxxxxxxxxxxxxx+	109	xxxxxxxxxxxxxxxxxxx+	113	xxxxxxxxxxxxxxxxxxx+
(76)	79	xxxxxxxxxxxxxxxx	79	xxxxxxxxxxxxxxxx	86	xxxxxxxxxxxxxxxx
DIG SANG	4	x	0		0	
(77)	21	xxxx	0		0	
AMAR RET	22	xxxx	25	xxxxx	0	
(78)	71	xxxxxxxxxxxxxx	36	xxxxxxx	0	
BROM PEC	63	xxxxxxxxxxxxx	0		0	
(82)	64	xxxxxxxxxxxxx	0		0	
SNO POL	11	xx	0		0	
(83)	14	xxx	0		0	
PHAL MIN	87	xxxxxxxxxxxxxxxxx	15	xxx	0	
(84)	64	xxxxxxxxxxxxx	29	xxxxxx	0	
CYP ESCU	94	xxxxxxxxxxxxxxxxxxx	94	xxxxxxxxxxxxxxxxxxx	41	xxxxxxxx
(85)	86	xxxxxxxxxxxxxxxxx	71	xxxxxxxxxxxxxx	57	xxxxxxxxxxx

TRIAL NUMBER 8533

ORBENCARB

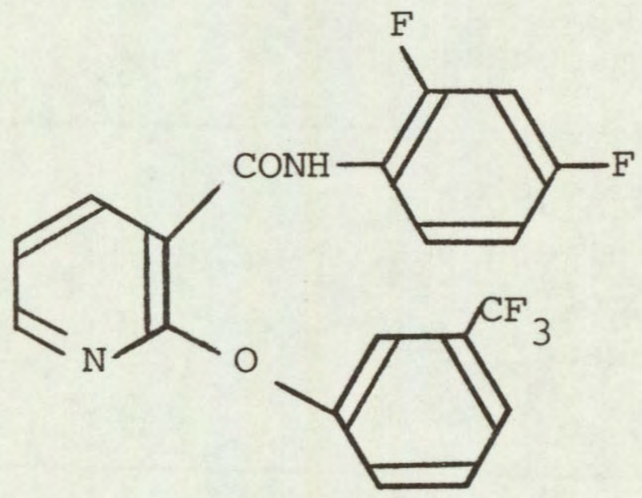
SPECIES		0.6700 kg/ha		2.0000 kg/ha		6.0000 kg/ha
CYP ROTU	120	xxxxxxxxxxxxxxxxxxxx+	87	xxxxxxxxxxxxxxxxx	91	xxxxxxxxxxxxxxxxxx
(86)	100	xxxxxxxxxxxxxxxxxxx	64	xxxxxxxxxxxxx	64	xxxxxxxxxxxxx
AUBGIN	97	xxxxxxxxxxxxxxxxxx	97	xxxxxxxxxxxxxxxxxx	32	xxxxxx
(89)	93	xxxxxxxxxxxxxxxxxx	64	xxxxxxxxxxxxx	43	xxxxxxxxx
LENTIL	90	xxxxxxxxxxxxxxxxx	62	xxxxxxxxxxxx	28	xxxxxx
(90)	86	xxxxxxxxxxxxxxxx	64	xxxxxxxxxxxxx	29	xxxxxx
MUNGB	100	xxxxxxxxxxxxxxxxxxx	100	xxxxxxxxxxxxxxxxxxx	100	xxxxxxxxxxxxxxxxxxx
(91)	86	xxxxxxxxxxxxxxxx	93	xxxxxxxxxxxxxxxxxx	79	xxxxxxxxxxxxxxxx
TEFF	0		0		0	
(92)	0		0		0	
COMMEL	26	xxxxx	17	xxx	0	
(93)	21	xxxx	21	xxxx	0	

Diflufenican

Code number MB 38544

Chemical name 2',4'-difluoro-2-(α,α,α-trifluoro-m-tolyloxy)nicotinanilide

Structure



Source May and Baker Limited
Ongar Research Station
Fyfield Road
Ongar
Essex CN5 OHW

Information and available and suggested uses

Control of broad-leaved weeds (Galium, Veronica, Viola spp., Polygonum aviculare, Stellaria media), pre- and early post-emergence in wheat and barley at 0.125 to 0.25 kg a.i./ha. Also pre-emergence in maize for control of Setaria, Digitaria, Amaranthus, Chenopodium, Solanum spp.

Formulation used: Wettable power 50% w/w a.i.

Spray volume: 372 l/ha

RESULTS

Full results are given in the histograms on pages 21-23 and potential selectivities are summarised in the tables.

Rate (kg a.i./ha)	CROPS: vigour reduced by less than 15%	WEEDS: number or vigour reduced by 70% or more
1.0	rice maize ± safener (NA) sorghum ± safener (CGA 92194) cowpea chickpea groundnut soyabean mungbean	Species below
0.25	as above + pigeon pea cotton kenaf	Eleusine indica Digitaria sanguinalis Snowdenia polystachya Phalaris minor + species below
0.0625	as above + millet lentil jute sesamum aubergine	Amaranthus retroflexus

Comments on results

This herbicide has a totally different type of action to the others in this experiment, causing inhibition of chlorophyll synthesis and complete albinism in susceptible species. Maize, sorghum, rice and the larger seeded legumes were outstandingly tolerant but the range of weeds controlled was limited to the Amaranthus and a few annual grasses which did not include Echinochloa or Rottboellia. The Cyperus species and Commelina were also unaffected. If some other important annual broad-leaved weeds are proved to be susceptible there could be a use for this compound in lentil, kenaf, jute, sesamum and aubergine for which the range of options is still limited but this will require further evaluation.

Another potential use in warm-climate areas could be for control of Phalaris minor and Snowdenia in wheat and barley which have shown high tolerance in other tests (Richardson & West, 1985b). Bromus pectinatus, however, is highly resistant.

TRIAL NUMBER 8533

DIFLUFENICAN

SPECIES		0.6250 kg/ha		0.2500 kg/ha		1.0000 kg/ha
MILLET	83	xxxxxxxxxxxxxxxxx	90	xxxxxxxxxxxxxxxxxx	34	xxxxxxx
(55)	93	xxxxxxxxxxxxxxxxxx	71	xxxxxxxxxxxxxx	36	xxxxxxx
MAIZE+S	104	xxxxxxxxxxxxxxxxxxx+	104	xxxxxxxxxxxxxxxxxxx+	104	xxxxxxxxxxxxxxxxxxx+
(56)	100	xxxxxxxxxxxxxxxxxxx	93	xxxxxxxxxxxxxxxxxx	93	xxxxxxxxxxxxxxxxxx
MAIZE	104	xxxxxxxxxxxxxxxxxxx+	104	xxxxxxxxxxxxxxxxxxx+	104	xxxxxxxxxxxxxxxxxxx+
(57)	100	xxxxxxxxxxxxxxxxxxx	100	xxxxxxxxxxxxxxxxxxx	86	xxxxxxxxxxxxxxxxx
SORG+S	100	xxxxxxxxxxxxxxxxxxx	93	xxxxxxxxxxxxxxxxxx	87	xxxxxxxxxxxxxxxxx
(58)	100	xxxxxxxxxxxxxxxxxxx	93	xxxxxxxxxxxxxxxxxx	86	xxxxxxxxxxxxxxxxx
SORGHUM	103	xxxxxxxxxxxxxxxxxxx+	103	xxxxxxxxxxxxxxxxxxx+	110	xxxxxxxxxxxxxxxxxxx+
(59)	93	xxxxxxxxxxxxxxxxxx	93	xxxxxxxxxxxxxxxxxx	86	xxxxxxxxxxxxxxxxx
PIGEON P	126	xxxxxxxxxxxxxxxxxxx+	126	xxxxxxxxxxxxxxxxxxx+	74	xxxxxxxxxxxxxxx
(61)	93	xxxxxxxxxxxxxxxxxx	93	xxxxxxxxxxxxxxxxxx	57	xxxxxxxxxxx
COWPEA	100	xxxxxxxxxxxxxxxxxxx	83	xxxxxxxxxxxxxxxxx	100	xxxxxxxxxxxxxxxxxxx
(62)	93	xxxxxxxxxxxxxxxxxx	93	xxxxxxxxxxxxxxxxxx	86	xxxxxxxxxxxxxxxxx
CHICKPEA	100	xxxxxxxxxxxxxxxxxxx	67	xxxxxxxxxxxxx	92	xxxxxxxxxxxxxxxxx
(63)	100	xxxxxxxxxxxxxxxxxxx	86	xxxxxxxxxxxxxxxxx	86	xxxxxxxxxxxxxxxxx
GRNDNUT	107	xxxxxxxxxxxxxxxxxxx+	107	xxxxxxxxxxxxxxxxxxx+	107	xxxxxxxxxxxxxxxxxxx+
(64)	100	xxxxxxxxxxxxxxxxxxx	93	xxxxxxxxxxxxxxxxxx	100	xxxxxxxxxxxxxxxxxxx
SOYABEAN	100	xxxxxxxxxxxxxxxxxxx	100	xxxxxxxxxxxxxxxxxxx	92	xxxxxxxxxxxxxxxxx
(65)	100	xxxxxxxxxxxxxxxxxxx	100	xxxxxxxxxxxxxxxxxxx	100	xxxxxxxxxxxxxxxxxxx
COTTON	76	xxxxxxxxxxxxxxx	95	xxxxxxxxxxxxxxxxxxx	95	xxxxxxxxxxxxxxxxxxx
(66)	57	xxxxxxxxxxx	86	xxxxxxxxxxxxxxxx	79	xxxxxxxxxxxxxxx
JUTE	97	xxxxxxxxxxxxxxxxxxx	100	xxxxxxxxxxxxxxxxxxx	86	xxxxxxxxxxxxxxxxx
(67)	86	xxxxxxxxxxxxxxxxx	71	xxxxxxxxxxxxxx	43	xxxxxxxxx

TRIAL NUMBER 8533

DIFLUFENICAN

SPECIES		0.6250 kg/ha		0.2500 kg/ha		1.0000 kg/ha
KENAF	84	xxxxxxxxxxxxxxxxx	89	xxxxxxxxxxxxxxxxx	89	xxxxxxxxxxxxxxxxx
(68)	93	xxxxxxxxxxxxxxxxxx	86	xxxxxxxxxxxxxxxx	71	xxxxxxxxxxxxx
SESAMUM	118	xxxxxxxxxxxxxxxxxx+	123	xxxxxxxxxxxxxxxxxx+	50	xxxxxxxxxx
(70)	100	xxxxxxxxxxxxxxxxxx	79	xxxxxxxxxxxxxxx	50	xxxxxxxxxx
RICE	115	xxxxxxxxxxxxxxxxxx+	103	xxxxxxxxxxxxxxxxxx+	115	xxxxxxxxxxxxxxxxxx+
(72)	100	xxxxxxxxxxxxxxxxxx	93	xxxxxxxxxxxxxxxxx	86	xxxxxxxxxxxxxxxx
ELEU IND	57	xxxxxxxxxx	0		0	
(74)	50	xxxxxxxxx	0		0	
ECH CRUS	90	xxxxxxxxxxxxxxxxx	93	xxxxxxxxxxxxxxxxx	48	xxxxxxxxx
(75)	100	xxxxxxxxxxxxxxxxxx	71	xxxxxxxxxxxxx	36	xxxxxx
ROTT EXA	96	xxxxxxxxxxxxxxxxxx	117	xxxxxxxxxxxxxxxxxx+	91	xxxxxxxxxxxxxxxxx
(76)	79	xxxxxxxxxxxxxxx	79	xxxxxxxxxxxxxxx	57	xxxxxxxxxx
DIG SANG	57	xxxxxxxxxxx	0		0	
(77)	71	xxxxxxxxxxxxx	0		0	
AMAR RET	86	xxxxxxxxxxxxxxxxx	18	xxxx	0	
(78)	29	xxxxxx	7	x	0	
BROM PEC	98	xxxxxxxxxxxxxxxxxxx	93	xxxxxxxxxxxxxxxxxx	93	xxxxxxxxxxxxxxxxxx
(82)	86	xxxxxxxxxxxxxxxxx	86	xxxxxxxxxxxxxxxxx	71	xxxxxxxxxxxxx
SNO POL	52	xxxxxxxxxx	22	xxxx	0	
(83)	71	xxxxxxxxxxxxx	36	xxxxxxx	0	
PHAL MIN	104	xxxxxxxxxxxxxxxxxxx+	42	xxxxxxxx	0	
(84)	79	xxxxxxxxxxxxxxx	29	xxxxxx	0	
CYP ESCU	112	xxxxxxxxxxxxxxxxxxx+	124	xxxxxxxxxxxxxxxxxxx+	118	xxxxxxxxxxxxxxxxxxx+
(85)	86	xxxxxxxxxxxxxxxxx	100	xxxxxxxxxxxxxxxxxxx	100	xxxxxxxxxxxxxxxxxxx

TRIAL NUMBER 8533

DIFLUFENICAN

SPECIES		0.6250 kg/ha		0.2500 kg/ha		1.0000 kg/ha
CYP ROTU	80	xxxxxxxxxxxxxxxx	109	xxxxxxxxxxxxxxxxxxxx+	98	xxxxxxxxxxxxxxxxxxx
(86)	100	xxxxxxxxxxxxxxxxxxx	86	xxxxxxxxxxxxxxxx	100	xxxxxxxxxxxxxxxxxxx
AUBGIN	97	xxxxxxxxxxxxxxxxxx	97	xxxxxxxxxxxxxxxxxx	52	xxxxxxxxxx
(89)	100	xxxxxxxxxxxxxxxxxx	64	xxxxxxxxxxxxx	36	xxxxxxx
LENTIL	110	xxxxxxxxxxxxxxxxxxx+	97	xxxxxxxxxxxxxxxxxx	90	xxxxxxxxxxxxxxxxx
(90)	100	xxxxxxxxxxxxxxxxxx	71	xxxxxxxxxxxxxx	64	xxxxxxxxxxxxx
MUNGB	100	xxxxxxxxxxxxxxxxxx	100	xxxxxxxxxxxxxxxxxx	100	xxxxxxxxxxxxxxxxxx
(91)	100	xxxxxxxxxxxxxxxxxx	93	xxxxxxxxxxxxxxxxxx	86	xxxxxxxxxxxxxxxx
TEFF	50	xxxxxxxxxx	0		0	
(92)	43	xxxxxxxxx	0		0	
COMMEL	70	xxxxxxxxxxxxxx	104	xxxxxxxxxxxxxxxxxxx+	122	xxxxxxxxxxxxxxxxxxx+
(93)	100	xxxxxxxxxxxxxxxxxx	93	xxxxxxxxxxxxxxxxxx	71	xxxxxxxxxxxxx

ACKNOWLEDGEMENTS

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REFERENCES

RICHARDSON, W.G. and DEAN, M.L. (1973) The pre-emergence selectivity of some recently developed herbicides: lenacil, RU 12068, metribuzin, cyprazine, EMD-IT 5914 and benthiocarb. Technical Report Agricultural Research Council Weed Research Organization, 25, pp. 57.

RICHARDSON, W.G. and WEST, T.M. (1984) The activity and pre-emergence selectivity of some recently developed herbicides: imazaquin, isoxaben, metsulfuron-methyl, aclonifen and orbencarb. Technical Report, Agricultural Research Council, Weed Research Organization, 80, pp. 57.

RICHARDSON, W.G. and WEST, T.M. (1985a) The activity and pre-emergence selectivity of some recently developed herbicides: metazachlor, butamifos, MT-124, tridiphane, MK 616 and prodiamine. Technical Report, Long Ashton Research Station, Weed Research Division, 86, pp.63.

RICHARDSON, W.G. and WEST, T.M. (1985b) The activity, pre- and post-emergence selectivity of diflufenican. Technical Report, Long Ashton Research Station, Weed Research Division, 89, pp.30.

RICHARDSON, W.G. and WEST, T.M. (1986) The activity and pre-emergence selectivity and persistence of some recently developed herbicides: DOWCO 453, quizalofop-ethyl, BAS 517 00H, cinmethylin, AC 263,499 and RST 20024H. Technical Report, Long Ashton Research Station, Weed Research Division, 91, pp. 62.

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	4-5 leaves
Maize (Zea mays)	MAIZE (57)	LG 11	6	2	5-6 leaves
Sorghum + safener Sorghum bicolor)	SORG + S (58)	TUB 22	8	1	5-6 leaves
Sorghum (Sorghum bicolor)	SORG (59)	TUB 22	8	1	5-6 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	11-12 leaves
Groundnut (Arachis hypogaea)	GRNDNUT (64)	NC 6	4	2	4-5 leaves
Soyabean (Glycine max)	SOYABEAN (65)	Amsoy	6	1	1-2 trifoliates
Cotton (Gossypium hirsutum)	COTTON (66)	Coker 315	6	1	2-3 leaves
Jute (Corchorus capsularis)	JUTE (67)	India	15	0.5	4-5 leaves
Kenaf (Hibiscus cannabinus)	KENAF (68)	WRO 1981	10	0.5	4-5 leaves
Sesamum (Sesamum indicum)	SESAMUM (70)	Sudan	15	0.5	4-6 leaves
Rice (Oryza sativa)	RICE (72)	IR 36	10	1	5-6 leaves

Eleusine indica	ELEU IND (74)	Zimbabwe 1980	20	0.5	6-7 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	5-6 leaves
Digitaria sanguinalis	DIG SANG (77)	WRO 1979	20	0.25	5-6 leaves
Amaranthus retroflexus	AMAR RET (78)	WRO 1980	20	0.25	8-9 leaves
Bromus pectinatus	BROM PEC (82)	Tanzania 1981	12	0.5	3-4 leaves
Snowdenia polystachya	SNO POL (83)	Ethiopia 1980	30	0.25	5-6 leaves
Phalaris minor	PHAL MIN (84)	WRO 1979	20	0.25	3-4 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	8-10 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	9-11 leaves
Mungbean (Phaseolus aureus)	MUNGB (91)	CES-ID-21	6	1	1-2 trifoliates
Teff (Eragrostis tef	TEFF (92)	Ethiopia 1981	20	0.25	2-5 leaves
Commelina diffusa	COMMEL (93)	USA	8	1	3-4 leaves

ABBREVIATIONS

ångstrom	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*	$\sqrt{}$
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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