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THE ACTIVITY AND PRE-EMERGENCE SELECTIVITY OF SOME RECENTLY DEVELOPED HERBICIDES: CHLOMETHOXYNIL, NC 20484 AND MBR 18337

NC 20484 is benfuresate MBR 18337 is benzofluor

W G Richardson, T M West and C Parker

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

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NOTE

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THE ACTIVITY AND PRE-EMERGENCE SELECTIVITY OF SOME RECENTLY DEVELOPED HERBICIDES: CHLOMETHOXYNIL, NC 20484 and MBR 18337

W.G. Richardson*, T.M. West* and C. Parker**

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

SUMMARY

In a series of pot experiments in the glasshouse, three herbicides were examined for pre-emergence selectivity as soil surface sprays on 69 temperate and tropical crop and weed species. Additional sets of wheat, barley, maize and sorghum were each treated with seed dressings of safeners 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 33 weeks.

Chlomethoxynil had most effect as a surface pre-emergence spray but activity was in general low. Veronica persica was highly sensitive but few other weeds were controlled. Several crops were highly tolerant.

NC 20484 exhibited most activity when applied pre-emergence. Cyperus species (C. rotundus and C. esculentus) and a wide spectrum of annual and perennial broad-leaved and grass weeds were susceptible while many broad-leaved crops, notably, cotton, dwarf bean and cowpea showed tolerance. NA seed dressing caused a marked safening effect on wheat, barley and maize.

MBR 18337 active mainly as a pre-emergence treatment, also caused severe growth retardant effects as a foliar spray. A wide range of mainly grass weeds was controlled pre-emergence, while many broad-leaved crops were tolerant e.g. the brassicas and legumes. In addition, marked safening effects were obtained by the NA seed dressing on wheat and barley.

Persistence in the soil was as long for chlomethoxynil as for simazine. Persistence of NC 20484 and MBR 18337 was longer than cyanazine (short persistence) but not as long as 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, at the same time obtaining experience of the type of effects produced by each compound. 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 intraspecific competition. Consequently the results should only be used as a guide for further work, as plant responses in pot experiments can be very different from those in the field.

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* Herbicide Group
** ODA Tropical Weeds Group

This report gives pre-emergence selectivity data on chlomethoxynil, NC 20484 and MBR 18337. Results of activity experiments are also included to provide information on levels of phytotoxicity, type and route of action.

METHODS AND MATERIALS

Activity experiments (AE1 and AE2) were 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.

Experiment details are summarised in Tables 1 and 2.

Table 1. Plant data for activity experiments

Species	Cultivar /source	No. per pot at spraying		Depth of planting (cm)	Stage of growth		
					Spraying	Assessment	
		pre-	post-		post-em	pre-em	post-em
Dwarf bean (*Phaseolus vulgaris*)	The Prince	3	2	2	2 unifoliate leaves	1½-2 trifoliate leaves	2-3 trifoliate leaves
Kale (*Brassica oleraceae acephala*)	Marrowstem	10-15	3-5	0.5	2-2½ leaves	2½-4 leaves	3-4½ leaves
Polygonum amphibium	WRO Clone 1	6	4-5	1	4-6 leaves	6-10 leaves	8-10 leaves
Perennial ryegrass (*Lolium perenne*)	S 23	10-15	10	0.5	2½-5 leaves	8-9 leaves, tillering	8-12 leaves, tillering
Avena fatua	WRO 1976 WRO 1978 Bourton-on-the-Water 1973	8-10	4-5	1	2½-3 leaves	6-9 leaves, tillering	6½-13 leaves, tillering
Agropyron repens	WRO Clone 1	6	4-5	1	2-3½ leaves	5-8 leaves, tillering	5-10 leaves, tillering

Table 2. Soil and environment conditions

Experiment number, type and herbicide(s) included	AE 1 chlomethoxynil	AE 2 NC 20484 MBR 18337	Pre-emergence selectivity test chlomethoxynil NC 20484 MBR 18337	
Date of spraying	19.6.80	19.5.81	12.11.80	
Main assessment completed	24.7.80	30.6.81	12.1.81	
Organic matter (%)	4.1	4.1	4.1	
Clay content (%)	15.0	15.0	15.0	
pH (water; 1:2 soil/water)	7.0	7.0	7.0	
Ammonium sulphate (g/kg)	-	-	0.7	
Superphosphate (g/kg)	1.0	-	1.7	
Potassium sulphate (g/kg)	-	-	0.7	
Vitax QS3 (g/kg) fertilizer	3.0	2.5	-	
DDT (5% dust) (g/kg)	0.4	0.4	0.4	
Hydrated Mg SO_4 (g/kg)	1.0	1.0	0.9	
Temperature (°C)			Temperate	Tropical
Mean	20	18	14	21
Maximum	35	32	20	32
Minimum	11	8	7	10
Relative humidity (%)				
Mean	55	65	68	63
Maximum	90	91	94	88
Minimum	30	25	30	42

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 of certain species, the following treatments were applied:- seeds of Chrysanthemum segetum were pricked; seeds of Polygonum aviculare were kept at 2°C for 10 weeks prior to planting; seeds of Chenopodium album were kept in 0.1 M potassium nitrate for 48 hours in the light; tubers of Cyperus esculentus and bulbs of Oxalis latifolia were kept at 2°C for 6 weeks prior to planting. Dwarf bean seeds were selected by testing their electrical conductivity, after soaking for one hour in water, discarding those whose conductivity was greater than 10 mhos.

Seeds of fenugreek were inoculated by pipetting a 10 ml infusion of Rhizobium meliloti Dang (Rothamsted Catalogue No 2012) directly onto the soil beneath plants which had reached the cotyledon stage.

To protect from soil-borne pathogens, all seeds (except wheat, barley, oat, fenugreek, P. aviculare, C. segetum) were pre-treated with one of the following:- thiram, captan, thiram + methyl bromide (for onion only), Milcol 30 (pea only), ethylmercuric phosphate + thiram (sugar beet only), aldrin (cotton only). Maize seeds were purchased already treated with captan A + teraquinone. The seeds of kale, radish, dwarf bean and Amaranthus retroflexus 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 and sprays respectively, 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, maize and sorghum in which seeds were treated with safeners to investigate possible protection from herbicide injury. Wheat, barley and maize seeds were treated with NA (1,8-naphthalic anhydride) at 0.5% w/w of seeds, while sorghum seeds were acquired from Ciba-Geigy already dressed with cyometrinil (CGA 43089), α - (cyanomethoximino) benzacetonitrile. Metolachlor, which is commercially recommended for sorghum treated with cyometrinil, was included as a standard for comparison.

Herbicides were applied using a laboratory sprayer embodying an 8002E Spraying Systems Tee Jet operated at a pressure of 207 k Pa (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 high pressure sodium lighting to provide a 14 hour photoperiod for temperate species and a 12 hour photoperiod for tropical species.

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. Polygonum aviculare, P. lapathifolium, Eleusine indica, Solanum nigrum and Oxalis latifolia failed to germinate. To improve growth, dwarf bean was germinated under tropical conditions and then transferred to the temperate glasshouse. Conversely, Phalaris minor was raised under temperate conditions until emergence, then transferred to the tropical glasshouse.

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 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) both as surface and incorporated treatments. For the surface treatments, tins containing soil were sprayed directly with the herbicides. For incorporated treatments, tins containing soil were emptied immediately after spraying and the soil passed six times through a large polyethylene funnel before filling the tins. All tins were then transferred to the temperate glasshouse together with untreated controls and watered as necessary, from overhead. Soil moisture before watering was 15%.

For the surface treatments, the soil in the tins was divided into six equal compartments by aluminium plates and sensitive species were periodically sown shallowly, disturbing the soil as little as possible. For incorporated treatments, the soil was emptied into a polythene bag, shaken vigorously and sampled into 6.5 cm diameter plastic pots and the same species sown and covered with soil to the same depth as in the surface treatments. Plants were harvested three or four weeks after sowing at a predetermined growth stage, the number and fresh weight of shoots being recorded. Bioassays were repeated at six to eight week intervals for one year, 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 38). Average temperature during this period was 16°C (minimum 3°C, maximum 33°C) and relative humidity 60% (minimum 22%, maximum 90%).

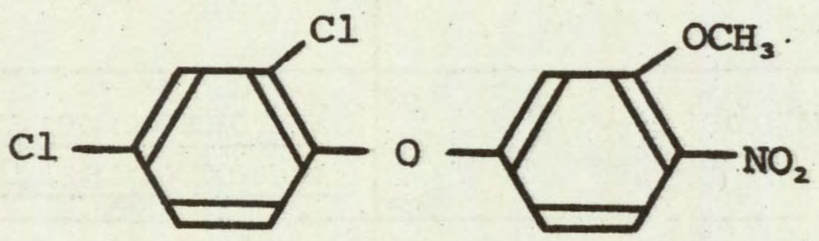
Results are given for the period up to 33 weeks only, as difficulties with germination and growth of the plants were found in later assays, possibly due to contamination.

CHLOMETHOXYNIL

Code number X-52

Chemical name 2,4-dichlorophenyl-3'-methoxy-4'-nitrophenyl ether

Structure



Source

Nihon Nohyaku Co Ltd
2-5, Nihonbashi, 1-chome
Chuo-ku
Tokyo 103
Japan

Information available and suggested uses

Pre- and early post-emergence in paddy rice at 2.1 to 2.8 kg a.i./ha.

Formulation used

for activity experiment 99% w/w a.i. technical material dissolved in 50% acetone/water
for selectivity experiment 50% w/w a.i. wettable powder

Spray volume

for activity experiment 370 l/ha
for selectivity experiment 367 l/ha

RESULTS

Full results are given in the histograms on pages 9-15 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	wheat ± safener (NA) barley ± safener (NA) oat dwarf bean field bean pea white clover* kale swede carrot lettuce fenugreek radish maize ± safener (NA) cowpea groundnut soyabean cotton† kenaf	Beta vulgaris Senecio vulgaris Chenopodium album + species below

RATE (kg a.i./ha)	CROPS: vigour reduced by less than 15%	WEEDS: number or vigour reduced by 70% or more
2.0	species above + rape sugar beet sorghum ± safener rice pigeon pea chickpea sesamum*	Poa trivialis Holcus lanatus Amaranthus retroflexus Snowdenia polystachya Phalaris minor + species below
0.67	species above + tomato	Veronica persica Rumex obtusifolius

* Note some reduction in plant number
† Note reductions in plant number at lower doses but not due to herbicide

Comments on results

Activity experiment

The foliar spray affected all species initially, more so the broad-leaved species, but all treated plants recovered eventually. The soil drench had little or no effect. Most activity resulted from the pre-emergence spray but effects were lethal only on perennial ryegrass. Incorporated treatments were either inactive or much less active than the surface pre-emergence spray. Some similarities to other diphenyl-ether herbicides are apparent, but chlomethoxynil is less active.

Symptoms

Contact scorch was found on all six species in the activity experiment within a few days of application of the foliar spray. However, the plants recovered even though some of the new leaves were deformed. With the pre-emergence surface treatments at the higher doses, plants either failed to emerge or died back soon after emergence. At lower doses leaves were trapped consequently causing deformity, with chlorosis and/or necrosis. Some plants which were stunted had glossy leaf surfaces, eg sugar beet. Symptoms are, therefore, comparable to those caused by other diphenyl-ether herbicides although chlomethoxynil caused more chlorosis.

Persistence in the soil

Surface treatments at all doses were still severely affecting or killing Veronica persica, 33 weeks after spraying, indicating a long period of persistence in the soil (graph not presented).

Pre-emergence selectivity among temperate species

Veronica persica was the most sensitive species tested, being killed at 0.67 kg/ha. Rumex obtusifolius was also controlled at this dose. The only other species to be controlled were two annual grass weeds (Poa trivialis and Holcus lanatus) at 2.0 kg/ha and three annual broad-leaved weeds at 6.0 kg/ha (Beta vulgaris, Senecio vulgaris and Chenopodium album). All perennial weeds and many other species were resistant, notably Stellaria media, Galium aparine and the two crucifers, Sinapis arvensis and Raphanus raphanistrum.

Many crops tolerated the highest dose of 6.0 kg/ha, including all the cereals, legumes and most of the brassica crops. Onion and perennial ryegrass were sensitive.

Although many crops were tolerant to a high degree, weed control was generally disappointing. The resistance of Stellaria media is a serious disadvantage, in common with other herbicides of the diphenyl-ether group. The high sensitivity of Veronica persica could be of some interest in certain vegetable crops and also in cereals, where many of the residual urea herbicides fail to give control.

Selectivity among tropical species

Activity was generally low on weeds and even the major rice weed, Echinochloa was not controlled at the highest dose, perhaps suggesting that the very wet conditions of a rice paddy are needed for full activity. A few weeds were controlled at 2 and 6 kg/ha and a number of crops tolerated the highest dose but no particularly important uses are indicated. The potential selectivity against Phalaris minor in wheat is comparable to that shown by other substituted ethers such as nitrofen. There was some apparent protection provided by safeners on maize and sorghum but the high tolerance of the crops left little scope for the protection to be demonstrated.

ACTIVITY EXPERIMENT

CHLOMETHOXYNIL

		0.25 kg/ha	1.0 kg/ha	4.0 kg/ha
DWARF BEAN	F	xxxxxxxxxxxxxxx xxxxxxxx	xxxxxxxxxxxxxxx xxxxxxxx	xxxxxxxxxxxxxxx xxxxxxxx
	S	xxxxxxxxxxxxxxx xxxxxxxxxxxxxx	xxxxxxxxxxxxxxx xxxxxxxxxxxxxx	xxxxxxxxxxxxxxx xxxxxxxxxxxx
	P	xxxxxxxxxxxxxxx xxxxxxxxxxxxxx	xxxxxxxxxxxxxxx xxxxxxxxxxxxxx	xxxxxxxxxxxxxxx xxxxxxxxxxxxxx
	I	xxxxxxxxxxxxxxx xxxxxxxxxxxxxx +	xxxxxxxxxxxxxxx xxxxxxxxxxxxx +	xxxxxxxxxxx xxxxxxxxxxxxx
KALE	F	xxxxxxxxxxxxxxx xxxxxxxxxx	xxxxxxxxxxxxxxx xxxxxxxxxx	xxxxxxxxxxxxxxx xxxxxxxxxx
	S	xxxxxxxxxxxxxxx xxxxxxxxxxxxx	xxxxxxxxxxxxxxx xxxxxxxxxxxxx	xxxxxxxxxxxxxxx xxxxxxxxxxxxx
	P	xxxxxxxxxxxxxxx xxxxxxxxxxxxx +	xxxxxxxxxxxxxxx xxxxxxxxxxxxx +	xxxxxxx xxxxxxxxxxxxx
	I	xxxxxxxxxxxxx xxxxxxxxxxxxxx	xxxxxxxxxxxxxx xxxxxxxxxxxxx	xxxxxxxxxxxxxx xxxxxxxxxxxxx +
POLYGONUM AMPHIBIUM	F	xxxxxxxxxxxxxx xxxxxxxxxx	xxxxxxxxxxxxxx xxxxxxxxx	xxxxxxxxxxxxxx xxxxxxxxx
	S	xxxxxxxxxxxxxx xxxxxxxxxxxxx	xxxxxxxxxxxxxx xxxxxxxxxxxxx	xxxxxxxxxxxxxx xxxxxxxxxxxxx
	P	xxxxxxxxxxxxxx xxxxxxxxxxxxx	xxxxxxxxxxxxx xxxxxx	xxxxxxxxxxxxxx xxxxxxxxxxxx +
	I	xxxxxx xxxxxxxxxxxxxx	xxxxxxxxxxxxx xxxxxxxxxxxxx	xxxxxxxxxxx xxxxxxxxxxxxx
PERENNIAL RYEGRASS	F	xxxxxxxxxxxxxx xxxxxxxxxxx	xxxxxxxxxxxxxx xxxxxxxxxxx	xxxxxxxxxxxxxx xxxxxxxxxxx
	S	xxxxxxxxxxxxxx xxxxxxxxxxxxx	xxxxxxxxxxxxxx xxxxxxxxxxxxx	xxxxxxxxxxxxxx xxxxxxxxxxx
	P	xxxxxxxxxxxxx xxxxxxxxxxxxx	xxxxxxxx xxxxxxxxxxx	xxx xxxxxx
	I	xxxxxxxxxxxxx xxxxxxxxxxxxx	xxxxxxxxxxxxx xxxxxxxxxxxxx +	xxxxxxxxxxx xxxxxxxx
AVENA FATUA	F	xxxxxxxxxxxxxx xxxxxxxxxxx	xxxxxxxxxxxxxx xxxxxxxxxxx	xxxxxxxxxxxxxx xxxxxxxxxx
	S	xxxxxxxxxxxxxx xxxxxxxxxxxx	xxxxxxxxxxxxxx xxxxxxxxxxxx	xxxxxxxxxxxxxx xxxxxxxxxxx
	P	xxxxxxxxxxxxxx xxxxxxxxxxx +	xxxxxx xxxxxxxxxxx	xxxxxxxxxxxxxx xxxxxxxxx +
	I	xxxxxxxxxxxxxx xxxxxxxxxxxx +	xxxxxxxxxxxxxx xxxxxxxxxxxx	xxxxxxxxxxxxxx xxxxxxxxxxxx +
AGROPYRON REPENS	F	xxxxxxxxxxxxxx xxxxxxxxxxx	xxxxxxxxxxxxxx xxxxxxxxxxx	xxxxxxxxxxxxxx xxxxxxxxxxx
	S	xxxxxxxxxxxxxx xxxxxxxxxxxx	xxxxxxxxxxxxxx xxxxxxxxxxxx	xxxxxxxxxxxxxx xxxxxxxxxxx
	P	xxxxxxxxxxxxxx xxxxxxxxxxxx +	xxxxxxxxxxxxx xxxxxxxxxxxx	xxxxxxxxxxxxx xxxxxxxxxxxx
	I	xxxxxxxxxxxxxx xxxxxxxxxxxx	xxxxxxxxxxxxx xxxxxxxxxxxx	xxxxxxxxxxxxx xxxxxxxxxxxx

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

UNTREATED	xxxxxxxxxxxxx	no. of survivors
CONTROL	xxxxxxxxxxxxx	vigour of survivors

PRE-EMERGENCE SELECTIVITY TEST

CHLOMETHOXYNIL

SPECIES		0.67 kg/ha		2.0 kg/ha		6.0 kg/ha
WHEAT	112	xxxxxxxxxxxxxxxxxxxx +	105	xxxxxxxxxxxxxxxxxxxx +	120	xxxxxxxxxxxxxxxxxxxx +
(1)	100	xxxxxxxxxxxxxxxxxxxx	93	xxxxxxxxxxxxxxxxxx	100	xxxxxxxxxxxxxxxxxxxx
WHEAT + S	102	xxxxxxxxxxxxxxxxxxxx	102	xxxxxxxxxxxxxxxxxxxx	89	xxxxxxxxxxxxxxxxxx
(2)	100	xxxxxxxxxxxxxxxxxxxx	100	xxxxxxxxxxxxxxxxxxxx	100	xxxxxxxxxxxxxxxxxxxx
BARLEY	100	xxxxxxxxxxxxxxxxxxxx	100	xxxxxxxxxxxxxxxxxxxx	100	xxxxxxxxxxxxxxxxxxxx
(3)	100	xxxxxxxxxxxxxxxxxxxx	100	xxxxxxxxxxxxxxxxxxxx	100	xxxxxxxxxxxxxxxxxxxx
BARLEY + S	96	xxxxxxxxxxxxxxxxxx	102	xxxxxxxxxxxxxxxxxxxx	102	xxxxxxxxxxxxxxxxxxxx
(4)	100	xxxxxxxxxxxxxxxxxxxx	100	xxxxxxxxxxxxxxxxxxxx	100	xxxxxxxxxxxxxxxxxxxx
OAT	91	xxxxxxxxxxxxxxxxxx	85	xxxxxxxxxxxxxxxxx	98	xxxxxxxxxxxxxxxxxxx
(5)	100	xxxxxxxxxxxxxxxxxxxx	100	xxxxxxxxxxxxxxxxxxxx	93	xxxxxxxxxxxxxxxxxx
PER RYGR	82	xxxxxxxxxxxxxxxx	74	xxxxxxxxxxxxxxx	55	xxxxxxxxxx
(6)	71	xxxxxxxxxxxxxx	64	xxxxxxxxxxxxx	36	xxxxxxx
ONION	53	xxxxxxxxxx	27	xxxxx	7	x
(8)	79	xxxxxxxxxxxxxxxx	57	xxxxxxxxxx	21	xxxx
DWF BEAN	104	xxxxxxxxxxxxxxxxxxxx +	104	xxxxxxxxxxxxxxxxxxxx +	104	xxxxxxxxxxxxxxxxxxxx +
(9)	100	xxxxxxxxxxxxxxxxxxxx	100	xxxxxxxxxxxxxxxxxxxx	93	xxxxxxxxxxxxxxxxxxx
FLD BEAN	82	xxxxxxxxxxxxxxxx	82	xxxxxxxxxxxxxxxx	95	xxxxxxxxxxxxxxxxxx
(10)	93	xxxxxxxxxxxxxxxxxx	86	xxxxxxxxxxxxxxxxx	86	xxxxxxxxxxxxxxxxx
PEA	95	xxxxxxxxxxxxxxxxxx	82	xxxxxxxxxxxxxxxx	82	xxxxxxxxxxxxxxxx
(11)	93	xxxxxxxxxxxxxxxxxx	86	xxxxxxxxxxxxxxxxx	93	xxxxxxxxxxxxxxxxxx
W CLOVER	83	xxxxxxxxxxxxxxxxx	90	xxxxxxxxxxxxxxxxxx	61	xxxxxxxxxxx
(12)	93	xxxxxxxxxxxxxxxxxx	100	xxxxxxxxxxxxxxxxxx	86	xxxxxxxxxxxxxxxxx

SPECIES		CHLOMETHOXYNIL 0.67 kg/ha		CHLOMETHOXYNIL 2.0 kg/ha		CHLOMETHOXYNIL 6.0 kg/ha
RAPE	90	xxxxxxxxxxxxxxxxxx	93	xxxxxxxxxxxxxxxxxxx	90	xxxxxxxxxxxxxxxxxx
(14)	100	xxxxxxxxxxxxxxxxxxx	93	xxxxxxxxxxxxxxxxxxx	79	xxxxxxxxxxxxxxx
KALE	109	xxxxxxxxxxxxxxxxxxx +	118	xxxxxxxxxxxxxxxxxxx +	109	xxxxxxxxxxxxxxxxxxx +
(15)	100	xxxxxxxxxxxxxxxxxxx	100	xxxxxxxxxxxxxxxxxxx	100	xxxxxxxxxxxxxxxxxxx
SWEDE	102	xxxxxxxxxxxxxxxxxxx	106	xxxxxxxxxxxxxxxxxxx +	97	xxxxxxxxxxxxxxxxxx
(17)	100	xxxxxxxxxxxxxxxxxxx	93	xxxxxxxxxxxxxxxxxx	93	xxxxxxxxxxxxxxxxxx
CARROT	60	xxxxxxxxxxxx	97	xxxxxxxxxxxxxxxxxx	120	xxxxxxxxxxxxxxxxxx +
(18)	100	xxxxxxxxxxxxxxxxxxx	100	xxxxxxxxxxxxxxxxxxx	100	xxxxxxxxxxxxxxxxxxx
LETTUCE	120	xxxxxxxxxxxxxxxxxxx +	87	xxxxxxxxxxxxxxxx	87	xxxxxxxxxxxxxxxx
(20)	100	xxxxxxxxxxxxxxxxxxx	93	xxxxxxxxxxxxxxxxxx	100	xxxxxxxxxxxxxxxxxxx
FENUGREK	100	xxxxxxxxxxxxxxxxxxx	100	xxxxxxxxxxxxxxxxxxx	100	xxxxxxxxxxxxxxxxxx
(21)	93	xxxxxxxxxxxxxxxxxx	93	xxxxxxxxxxxxxxxxxx	100	xxxxxxxxxxxxxxxxxx
SUG BEET	107	xxxxxxxxxxxxxxxxxxx +	103	xxxxxxxxxxxxxxxxxxx +	69	xxxxxxxxxxxxx
(22)	100	xxxxxxxxxxxxxxxxxxx	93	xxxxxxxxxxxxxxxxxx	71	xxxxxxxxxxxxx
BETA VUL	82	xxxxxxxxxxxxxxxx	107	xxxxxxxxxxxxxxxxxxx +	29	xxxxxx
(23)	93	xxxxxxxxxxxxxxxxxx	86	xxxxxxxxxxxxxxxx	93	xxxxxxxxxxxxxxxxxx
BROM STE	100	xxxxxxxxxxxxxxxxxxx	95	xxxxxxxxxxxxxxxxxx	105	xxxxxxxxxxxxxxxxxxx +
(24)	93	xxxxxxxxxxxxxxxxxxx	93	xxxxxxxxxxxxxxxxxx	93	xxxxxxxxxxxxxxxxxx
FEST RUB	74	xxxxxxxxxxxxxxx	72	xxxxxxxxxxxxxx	44	xxxxxxxxx
(25)	50	xxxxxxxxxx	71	xxxxxxxxxxxxxx	57	xxxxxxxxxxx
AVE FATU	129	xxxxxxxxxxxxxxxxxxx +	94	xxxxxxxxxxxxxxxxxx	86	xxxxxxxxxxxxxxxx
(26)	100	xxxxxxxxxxxxxxxxxxx	93	xxxxxxxxxxxxxxxxxx	93	xxxxxxxxxxxxxxxxxx

PRE-EMERGENCE SELECTIVITY TEST

CHLOMETHOXYNIL

SPECIES		0.67 kg/ha		2.0 kg/ha		6.0 kg/ha
ALO MYOS	122	xxxxxxxxxxxxxxxxxxxxxx +	98	xxxxxxxxxxxxxxxxxxxx	37	xxxxxxx
(27)	79	xxxxxxxxxxxxxxxx	86	xxxxxxxxxxxxxxxxx	43	xxxxxxxxx
POA ANN	108	xxxxxxxxxxxxxxxxxxxxx +	99	xxxxxxxxxxxxxxxxxxxx	71	xxxxxxxxxxxxxx
(28)	71	xxxxxxxxxxxxxx	57	xxxxxxxxxxx	43	xxxxxxxxx
POA TRIV	53	xxxxxxxxxxx	14	xxx	0	
(29)	64	xxxxxxxxxxxxx	50	xxxxxxxxxx	0	
SIN ARV	102	xxxxxxxxxxxxxxxxxxxx	118	xxxxxxxxxxxxxxxxxxxx +	91	xxxxxxxxxxxxxxxxx
(30)	100	xxxxxxxxxxxxxxxxxxxx	100	xxxxxxxxxxxxxxxxxxxx	93	xxxxxxxxxxxxxxxxxx
RAPH RAP	93	xxxxxxxxxxxxxxxxxxx	108	xxxxxxxxxxxxxxxxxxxx +	103	xxxxxxxxxxxxxxxxxxx +
(31)	100	xxxxxxxxxxxxxxxxxxxx	93	xxxxxxxxxxxxxxxxxx	100	xxxxxxxxxxxxxxxxxx
CHRY SEG	50	xxxxxxxxxx	100	xxxxxxxxxxxxxxxxxxxx	50	xxxxxxxxxx
(32)	71	xxxxxxxxxxxxxx	86	xxxxxxxxxxxxxxxxx	71	xxxxxxxxxxxxxx
TRIP MAR	84	xxxxxxxxxxxxxxxxx	27	xxxxx	50	xxxxxxxxxx
(33)	79	xxxxxxxxxxxxxxxx	57	xxxxxxxxxxx	57	xxxxxxxxxxx
SEN VULG	91	xxxxxxxxxxxxxxxxxx	63	xxxxxxxxxxxxx	14	xxx
(34)	86	xxxxxxxxxxxxxxxxx	79	xxxxxxxxxxxxxxxx	29	xxxxxx
GAL APAR	69	xxxxxxxxxxxxxx	119	xxxxxxxxxxxxxxxxxxxx +	75	xxxxxxxxxxxxxxx
(38)	93	xxxxxxxxxxxxxxxxxxx	93	xxxxxxxxxxxxxxxxxx	79	xxxxxxxxxxxxxxxx
CHEN ALB	36	xxxxxxx	33	xxxxxxx	0	
(39)	64	xxxxxxxxxxxxx	50	xxxxxxxxxx	0	
STEL MED	88	xxxxxxxxxxxxxxxxxx	99	xxxxxxxxxxxxxxxxxxxx	81	xxxxxxxxxxxxxxxx
(40)	93	xxxxxxxxxxxxxxxxxxx	100	xxxxxxxxxxxxxxxxxxxx	86	xxxxxxxxxxxxxxxxx

CHLOMETHOXYNIL

SPECIES		0.67 kg/ha		2.0 kg/ha		6.0 kg/ha
VER PERS	0		0		0	
(42)	0		0		0	
RUM OBTU	23	xxxxx	0		0	
(44)	36	xxxxxxx	0		0	
HOLC LAN	146	xxxxxxxxxxxxxxxxxxxx +	26	xxxxx	0	
(45)	100	xxxxxxxxxxxxxxxxxxxx	64	xxxxxxxxxxxxx	0	
AG REPEN	86	xxxxxxxxxxxxxxxxx	94	xxxxxxxxxxxxxxxxxxx	94	xxxxxxxxxxxxxxxxxxx
(47)	100	xxxxxxxxxxxxxxxxxxxx	100	xxxxxxxxxxxxxxxxxxxx	86	xxxxxxxxxxxxxxxxx
ALL VIN	65	xxxxxxxxxxxxx	88	xxxxxxxxxxxxxxxxx	88	xxxxxxxxxxxxxxxxx
(49)	86	xxxxxxxxxxxxxxxxx	79	xxxxxxxxxxxxxxxx	79	xxxxxxxxxxxxxxxx
CIRS ARV	131	xxxxxxxxxxxxxxxxxxxx +	112	xxxxxxxxxxxxxxxxxxxx +	131	xxxxxxxxxxxxxxxxxxxx +
(50)	100	xxxxxxxxxxxxxxxxxxxx	100	xxxxxxxxxxxxxxxxxxxx	86	xxxxxxxxxxxxxxxxx
TUS FARF	109	xxxxxxxxxxxxxxxxxxxx +	109	xxxxxxxxxxxxxxxxxxxx +	95	xxxxxxxxxxxxxxxxxx
(51)	100	xxxxxxxxxxxxxxxxxxxx	100	xxxxxxxxxxxxxxxxxxxx	93	xxxxxxxxxxxxxxxxxx
MILLET	76	xxxxxxxxxxxxxx	27	xxxxx	4	x
(55)	64	xxxxxxxxxxxx	43	xxxxxxxxx	21	xxxx
MAIZE + S	91	xxxxxxxxxxxxxxxxx	104	xxxxxxxxxxxxxxxxxxx +	104	xxxxxxxxxxxxxxxxxxx +
(56)	100	xxxxxxxxxxxxxxxxxxxx	71	xxxxxxxxxxxxxx	100	xxxxxxxxxxxxxxxxxxx
MAIZE	100	xxxxxxxxxxxxxxxxxxx	74 R	xxxxxxxxxxxxxxx	100	xxxxxxxxxxxxxxxxxx
(57)	93	xxxxxxxxxxxxxxxxxx	86	xxxxxxxxxxxxxxxxx	86	xxxxxxxxxxxxxxxx
SORG + S	117	xxxxxxxxxxxxxxxxxxx +	91	xxxxxxxxxxxxxxxxx	98	xxxxxxxxxxxxxxxxxx
(58)	100	xxxxxxxxxxxxxxxxxxx	86	xxxxxxxxxxxxxxxxx	79	xxxxxxxxxxxxxxx

PRE-EMERGENCE SELECTIVITY TEST

CHLOMETHOXYNIL

SPECIES		0.67 kg/ha			2.0 kg/ha		6.0 kg/ha
SORGHUM	102	xxxxxxxxxxxxxxxxxxxx	96		xxxxxxxxxxxxxxxxxxxx	109	xxxxxxxxxxxxxxxxxxxx +
(59)	100	xxxxxxxxxxxxxxxxxxxx	86		xxxxxxxxxxxxxxxxx	71	xxxxxxxxxxxxxx
RICE	98	xxxxxxxxxxxxxxxxxxxx	98		xxxxxxxxxxxxxxxxxxxx	104	xxxxxxxxxxxxxxxxxxxx +
(60)	100	xxxxxxxxxxxxxxxxxxxx	100		xxxxxxxxxxxxxxxxxxxx	79	xxxxxxxxxxxxxxxx
PIGEON P	236	xxxxxxxxxxxxxxxxxxxx +	129		xxxxxxxxxxxxxxxxxxxx +	214	xxxxxxxxxxxxxxxxxxxx +
(61)	100	xxxxxxxxxxxxxxxxxxxx	86		xxxxxxxxxxxxxxxxx	64	xxxxxxxxxxxx
COWPEA	72	xxxxxxxxxxxxxx	84		xxxxxxxxxxxxxxxxx	96	xxxxxxxxxxxxxxxxxx
(62)	100	xxxxxxxxxxxxxxxxxxxx	86		xxxxxxxxxxxxxxxxx	86	xxxxxxxxxxxxxxxxx
CHICKPEA	83	xxxxxxxxxxxxxxxxx	83		xxxxxxxxxxxxxxxxx	83	xxxxxxxxxxxxxxxxx
(63)	100	xxxxxxxxxxxxxxxxxxxx	100		xxxxxxxxxxxxxxxxxxxx	79	xxxxxxxxxxxxxxxx
GRNDNUT	56	xxxxxxxxxx	112	R	xxxxxxxxxxxxxxxxxxxx +	112	xxxxxxxxxxxxxxxxxxxx +
(64)	93	xxxxxxxxxxxxxxxxxx	100		xxxxxxxxxxxxxxxxxxxx	100	xxxxxxxxxxxxxxxxxxxx
SOYABEAN	105	xxxxxxxxxxxxxxxxxxxx +	105		xxxxxxxxxxxxxxxxxxxx +	120	xxxxxxxxxxxxxxxxxxxx +
(65)	100	xxxxxxxxxxxxxxxxxxxx	100		xxxxxxxxxxxxxxxxxxxx	100	xxxxxxxxxxxxxxxxxxxx
COTTON	67	xxxxxxxxxxxxx	67		xxxxxxxxxxxx	111	xxxxxxxxxxxxxxxxxxx +
(66)	100	xxxxxxxxxxxxxxxxxxx	100		xxxxxxxxxxxxxxxxxxxx	86	xxxxxxxxxxxxxxxxx
JUTE	17	xxx	0			0	
(67)	36	xxxxxxx	0			0	
KENAF	133	xxxxxxxxxxxxxxxxxxx +	107		xxxxxxxxxxxxxxxxxxx +	133	xxxxxxxxxxxxxxxxxxx +
(68)	100	xxxxxxxxxxxxxxxxxxx	93		xxxxxxxxxxxxxxxxxx	86	xxxxxxxxxxxxxxxxx
SESAMUM	82	xxxxxxxxxxxxxxxx	41	R	xxxxxxxx	27	xxxxx
(70)	93	xxxxxxxxxxxxxxxxxx	86		xxxxxxxxxxxxxxxx	71	xxxxxxxxxxxxx

PRE-EMERGENCE SELECTIVITY TEST

CHLOMETHOXYNIL

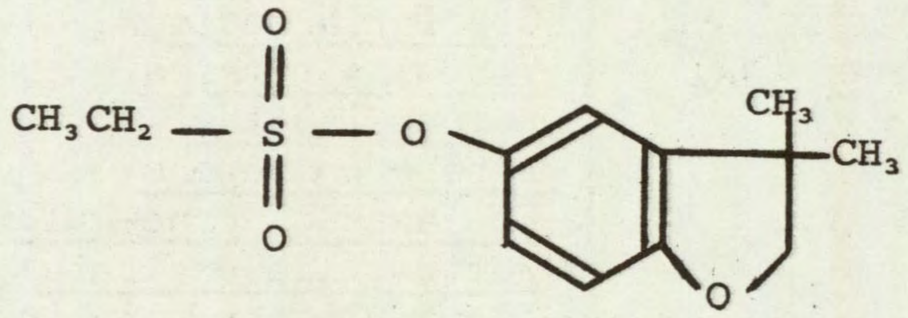
SPECIES		0.67 kg/ha		2.0 kg/ha		6.0 kg/ha
TOMATO	100	xxxxxxxxxxxxxxxxxxxx	50	xxxxxxxxxx	33	xxxxxxx
(71)	86	xxxxxxxxxxxxxxxxx	79	xxxxxxxxxxxxxxxxx	64	xxxxxxxxxxxxx
OR BART	102	xxxxxxxxxxxxxxxxxxxx	102	xxxxxxxxxxxxxxxxxxxx	102	xxxxxxxxxxxxxxxxxxxx
(73)	100	xxxxxxxxxxxxxxxxxxxx	93	xxxxxxxxxxxxxxxxxxxx	79	xxxxxxxxxxxxxxxx
ECH CRUS	103	xxxxxxxxxxxxxxxxxxxx +	93	xxxxxxxxxxxxxxxxxxxx	66	xxxxxxxxxxxxx
(75)	71	xxxxxxxxxxxxxx	64	xxxxxxxxxxxxx	50	xxxxxxxxxx
ROTT EXA	93	xxxxxxxxxxxxxxxxxx	113	xxxxxxxxxxxxxxxxxxx +	93	xxxxxxxxxxxxxxxxxx
(76)	100	xxxxxxxxxxxxxxxxxxxx	93	xxxxxxxxxxxxxxxxxxxx	79	xxxxxxxxxxxxxxxx
DIG SANG	108	xxxxxxxxxxxxxxxxxxx +	91	xxxxxxxxxxxxxxxxx	74	xxxxxxxxxxxxxx
(77)	93	xxxxxxxxxxxxxxxxxxx	79	xxxxxxxxxxxxxxxx	64	xxxxxxxxxxxxx
AMAR RET	50	xxxxxxxxxx	0		0	
(78)	93	xxxxxxxxxxxxxxxxxx	0		0	
BROM PEC	87	xxxxxxxxxxxxxxxxx	71	xxxxxxxxxxxxxx	71	xxxxxxxxxxxxxx
(82)	93	xxxxxxxxxxxxxxxxxx	71	xxxxxxxxxxxxxx	64	xxxxxxxxxxxxx
SNO POL	123	xxxxxxxxxxxxxxxxxxx +	15	xxx	31	xxxxxx
(83)	79	xxxxxxxxxxxxxxxx	50	xxxxxxxxxx	57	xxxxxxxxxxx
PHAL MIN	78	xxxxxxxxxxxxxxxx	18	xxxx	14	xxx
(84)	64	xxxxxxxxxxxxx	29	xxxxxx	21	xxxx
CYP ESCU	150	xxxxxxxxxxxxxxxxxxx +	58	xxxxxxxxxxxx	108	xxxxxxxxxxxxxxxxxxx +
(85)	100	xxxxxxxxxxxxxxxxxxxx	100	xxxxxxxxxxxxxxxxxxxx	93	xxxxxxxxxxxxxxxxxxx
CYP ROTU	88	xxxxxxxxxxxxxxxxx	93	xxxxxxxxxxxxxxxxxx	109	xxxxxxxxxxxxxxxxxxx +
(86)	100	xxxxxxxxxxxxxxxxxxx	100	xxxxxxxxxxxxxxxxxxx	100	xxxxxxxxxxxxxxxxxxx

NC 20484

Code number NC 20484

Chemical name 2,3-dihydro-3,3-dimethyl-5-benzofuranyl ethane sulphonate

Structure



Source

FBC Limited
Agrochemical Division
Chesterford Park Research Station
Saffron Walden
Essex CB10 1XL
UK

Information available and suggested uses

Control of Cyperus spp and annual grass and broad-leaved weeds in cotton at 0.5 to 2.0 kg a.i./ha pre-plant or pre-emergence; tobacco 0.5 to 2.0 kg a.i./ha pre- or post-transplanting; orchard/plantation crops, pre-weed emergence.

Formulation used 40% w/v a.i. emulsifiable concentrate

Spray volume for activity experiment 386 l/ha
for selectivity experiment 367 l/ha

RESULTS

Full results are given in the histograms on pages 19-25 and potential selectivities are summarised in the following table.

RATE (kg a.i./ha)	CROPS: vigour reduced by 15% or less	WEEDS: number or vigour reduced by 70% or more
4.0	None	None listed as no crops tolerant
1.0	dwarf bean cowpea	Bromus sterilis Avena fatua Tripleurospermum maritimum Chenopodium album Rumex obtusifolius Cirsium arvense Oryza barthii + species below

(Continued overleaf)

RATE (kg a.i./ha)	CROPS: vigour reduced by 15% or less	WEEDS: number or vigour reduced by 70% or more
0.25	species above + field bean pea kale carrot* sugar beet maize + safener (NA) groundnut* cotton jute	Festuca rubra Alopecurus myosuroides Poa annua Poa trivialis Galium aparine Stellaria media Veronica persica Holcus lanatus Agropyron repens Echinochloa crus-galli Rottboellia exaltata Digitaria sanguinalis Amaranthus retroflexus Bromus pectinatus Snowdenia polystachya Phalaris minor Cyperus esculentus Cyperus rotundus

* Note reductions in number of plants, but not due to herbicide

Comments on results

Activity experiment

The foliar spray was active on dwarf bean and kale. With other species the soil drenches, post-emergence were more effective. However, pre-emergence treatments were generally the most effective of the four application methods. With the smaller-seeded ryegrass and kale, surface treatments tended to be more active than incorporated, but the reverse was true for the two larger-seeded species, A. fatua and dwarf bean as well as the perennial Agropyron repens. With Polygonum amphibium there was little difference between surface and incorporated treatments. These effects should be considered when interpreting the results of the current pre-emergence experiment where the herbicide was applied to the surface only.

Symptoms

The foliar spray caused a moderate scorch within a few days of spraying, especially on dwarf bean and kale, resulting in some leaf deformities, such as "cupping". The soil drench brought about a severe inhibition of grasses usually accompanied by a darker green leaf colour. Pre-emergence, plants often failed to emerge from the soil, especially the grasses. At lower doses severe inhibition of leaves and apical meristems occurred, usually accompanied by a darker colour, a glossy appearance of surfaces and often with deformities because of fusion of leaves. Necrosis usually developed later. Some epinasty or twisting of cotyledons, stems or petioles was often observed on broad-leaved species and extra large cotyledons were seen, for example on wild beet and sugar beet. Root development and inhibition was of the same order as that of the shoots. A feature which became obvious during the course of these experiments was the ability for NC 20484 to work through the vapour phase. Symptoms identical to those described above developed on a number of untreated controls of the most sensitive species, such as white clover and Stellaria media.

Persistence in the soil

Perennial ryegrass was used as the sensitive test species. Surface and incorporated treatments of 0.25 and 1.0 kg/ha were undetectable 11 and 33 weeks respectively after spraying. At 4.0 kg/ha both types of application were still causing severe shoot fresh weight reductions 33 weeks after spraying.

Pre-emergence selectivity among temperate species

At the lowest dose nine weeds were controlled, most of which were grasses, but Galium aparine, Veronica persica and Stellaria media were also controlled. At 1.0 kg/ha a further six weeds were controlled including Avena fatua and Bromus sterilis. Only two of the Compositae were controlled at this dose (Tripleurospermum maritimum and Cirsium arvense), and two of the Cruciferae (Raphanus raphanistrum and Sinapis arvensis) were much reduced but not controlled.

Dwarf bean was the only crop to tolerate 1.0 kg/ha. At 0.25 kg/ha another five broad-leaved crops were tolerant (field bean, pea, kale, carrot and sugar beet). Onion, white clover, swede and lettuce were very sensitive as were the cereals, wheat and barley. However, damage symptoms at the lowest dose on both of these cereals were considerably less where seeds had recieved the NA seed dressing. At the two higher doses of the herbicide there was no evidence of protection.

A very interesting broad-spectrum of grass and broad-leaved weeds were controlled, many of which are problems in dwarf bean and the other tolerant crops. Further testing on perennial ryegrass may also be worthwhile. Although this species was not completely tolerant at 0.25 kg/ha, some important weeds such as the Poa species, Festuca rubra and Alopecurus myosuroides were very sensitive. The sensitivity of white clover, however, is a possible disadvantage in this situation.

Selectivity among tropical species

Excellent control of all the tropical weeds was achieved at 1 kg/ha and of most at 0.25 kg/ha. Cowpea was particularly tolerant but cotton, jute and groundnut were also undamaged at 0.25 kg/ha and maize was unaffected at this dose, when protectedbby NA. The degree of protection provided by NA on maize was very marked, approaching four-fold and some further work is already in progress to confirm the possible selectivity of NC 20484 against Rottboellia with use of safener. Sorghum was appreciably protected by cyometrinil but still seriously damaged at 0.25 kg/ha.

Control of Cyperus species was outstanding and there was clear selectivity at 0.25 kg/ha for several weeks in cowpea, cotton, jute and groundnut. The middle dose of 1 kg/ha suppressed growth for about six weeks and 4 kg/ha was still preventing growth after six months, though tubers were still sound at this time and could perhaps eventually recover. Further work reported elsewhere (Parker, 1981) suggests that NC 20484 is probably the best of available compounds for selective control of Cyperus rotundus in cotton.

ACTIVITY EXPERIMENT

NC 20484

		0.1 kg/ha	0.5 kg/ha	2.5 kg/ha
DWARF BEAN	F	xxxxxxxxxxxxxx xxxxxxxxxxx	xxxxxxxxxxxxxx xxxxxxxxx	xxxxxxxxxxxxxx xxxxxxx
	S	xxxxxxxxxxxxxx xxxxxxxxxxxxx	xxxxxxxxxxxxxx xxxxxxxxxxxx	xxxxxxxxxxxxxx xxxxxxxx
	P	xxxxxxxxxxxxxx xxxxxxxxxxxxx	xxxxxxxxxxxxxx xxxxxxxxxxxx	xxxxxxxxxxxxxx xxxxxxxx
	I	xxxxxxxxxxxxxx xxxxxxxxxxxxx	xxxxxxxxxxxxxx xxxxxxxxxxxx	xxxxxxxxxxxx xxxxxx
KALE	F	xxxxxxxxxxxxxx xxxxxxxxxx	xxxxxxxxxxxxxx xxxxxxxx	xxxxxxxxxxxxxx xxxxx
	S	xxxxxxxxxxxxxx xxxxxxxxxxx	xxxxxxxxxxxxxx xxxxxxxxx	xxxxxxxxxxxxxx xxxxxx
	P	xxxxxxxxxxxxx xxxxxxxxxxx	xxxxxxxxxx xxxxxxxxx	xxxxx xxxxx
	I	xxxxxxxxxx xxxxxxxxxxx	xxxxxxxxxxxxxx xxxxxxxxxx	xxxxxxxxxx xxxxx
POLYGONUM AMPHIBIUM	F	xxxxxxxxxxxxxx xxxxxxxxxx	xxxxxxxxxxxxxx xxxxxxxxx	xxxxxxxxxxxxxx xxxxxxxx
	S	xxxxxxxxxxxxxx xxxxxxxxx	xxxxxxxxxxxxxx xxxxxxxx	xxxxxxxxxxxx xxxxxx
	P	xxxxxxxxxx xxxxxxxxx	xxxxx xxxxx	xxx xx
	I	xxxxxxxxxxxxx xxxxxxxxxx +	xxxxxxxxx xxxxx	o o
PERENNIAL RYEGRASS	F	xxxxxxxxxxxxxx xxxxxxxxxxxxx	xxxxxxxxxxxxxx xxxxxxxxxxxxx	xxxxxxxxxxxxxx xxxxxxxxxxxx
	S	xxxxxxxxxxxxx xxxxxxxxxxxxx	xxxxxxxxxxxxx xxxxxxxxxx	xxxxxxxxxxxxx xxxxxx
	P	xxxxxxxxxxxxx xxxxxxxxxxxxx +	xxxxxxxx xxxxxxxxxx	o o
	I	xxxxxxxxxxxxx xxxxxxxxxxxxx +	xxxxxxxxxxxxx xxxxxxxxxxxxx +	xxxxx xxxxxxx
AVENA FATUA	F	xxxxxxxxxxxxx xxxxxxxxxxxxx	xxxxxxxxxxxxx xxxxxxxxxxxxx	xxxxxxxxxxxxx xxxxxxxxxxxx
	S	xxxxxxxxxxxxx xxxxxxxxxxxxx	xxxxxxxxxxxxx xxxxxxxxxx	xxxxxxxxxxxxx xxxxx
	P	xxxxxxxxxxxxx xxxxxxxxxxxxx +	xxxxxxxxxxxxx xxxxxxxxxxxxx +	x xxxx
	I	xxxxxxxxxx xxxxxxxxxxxxxx	xxxxxxxx xxxxxxxxxxxxxx	o o
AGROPYRON REPENS	F	xxxxxxxxxxxxx xxxxxxxxxxxxx	xxxxxxxxxxxxx xxxxxxxxxxxxx	xxxxxxxxxxxxx xxxxxxxxxx
	S	xxxxxxxxxxxxx xxxxxxxxxxxx	xxxxxxxxxxxxx xxxxxx	xxxxxxxxxxxxx xxxxxx
	P	xxxxxxxxxxxxx xxxxxxxxx	xxx xx	o o
	I	xxxxxxxxx xxxxxxxxxxxx	xx xxx	o o

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

SPECIES		NC 20484 0.25 kg/ha		NC 20484 1.0 kg/ha		NC 20484 4.0 kg/ha
WHEAT	120	xxxxxxxxxxxxxxxxxxxx +	15	xxx	0	
(1)	21	xxxx	7	x	0	
WHEAT + S	89	xxxxxxxxxxxxxxxxx	96	xxxxxxxxxxxxxxxxxxx	83	xxxxxxxxxxxxxxxx
(2)	71	xxxxxxxxxxxxxx	14	xxx	14	xxx
BARLEY	100	xxxxxxxxxxxxxxxxxxx	94	xxxxxxxxxxxxxxxxxxx	87	xxxxxxxxxxxxxxxx
(3)	14	xxx	14	xxx	14	xxx
BARLEY + S	96	xxxxxxxxxxxxxxxxxx	102	xxxxxxxxxxxxxxxxxxx	89	xxxxxxxxxxxxxxxxx
(4)	79	xxxxxxxxxxxxxxx	21	xxxx	14	xxx
OAT	85	xxxxxxxxxxxxxxxx	78	xxxxxxxxxxxxxxx	39	xxxxxxxx
(5)	71	xxxxxxxxxxxxxx	14	xxx	14	xxx
PER RYGR	82	xxxxxxxxxxxxxxxx	19	xxxx	0	
(6)	71	xxxxxxxxxxxxxx	7	x	0	
ONION	0		0		0	
(8)	0		0		0	
DWF BEAN	78	xxxxxxxxxxxxxxx	104	xxxxxxxxxxxxxxxxxxx +	91	xxxxxxxxxxxxxxxxx
(9)	79	xxxxxxxxxxxxxxx	86	xxxxxxxxxxxxxxxxx	43	xxxxxxxxx
FLD BEAN	95	xxxxxxxxxxxxxxxxxx	82	xxxxxxxxxxxxxxx	95	xxxxxxxxxxxxxxxxxx
(10)	86	xxxxxxxxxxxxxxxxx	43	xxxxxxxxx	29	xxxxxx
PEA	82	xxxxxxxxxxxxxxx	82	xxxxxxxxxxxxxxxx	82	xxxxxxxxxxxxxxxx
(11)	93	xxxxxxxxxxxxxxxxxx	64	xxxxxxxxxxxx	29	xxxxxx
W CLOVER	7	x	0		0	
(12)	14	xxx	0		0	

PRE-EMERGENCE SELECTIVITY TEST

SPECIES		NC 20484 0.25 kg/ha		NC 20484 1.0 kg/ha		NC 20484 4.0 kg/ha
RAPE	90	xxxxxxxxxxxxxxxxxx	63	xxxxxxxxxxxxx	3	x
(14)	43	xxxxxxxxx	43	xxxxxxxxx	14	xxx
KALE	109	xxxxxxxxxxxxxxxxxxxx +	64	xxxxxxxxxxxxx	5	x
(15)	93	xxxxxxxxxxxxxxxxxxx	50	xxxxxxxxxx	14	xxx
SWEDE	88	xxxxxxxxxxxxxxxxx	14	xxx	0	
(17)	36	xxxxxxx	14	xxx	0	
CARROT	75	xxxxxxxxxxxxxxx	75	xxxxxxxxxxxxxxx	7	x
(18)	100	xxxxxxxxxxxxxxxxxxx	64	xxxxxxxxxxxxx	21	xxxx
LETTUCE	7	x	0		0 R	
(20)	21	xxxx	0		0	
FENUGREK	100	xxxxxxxxxxxxxxxxxxx	100	xxxxxxxxxxxxxxxxxxx	94	xxxxxxxxxxxxxxxxxx
(21)	71	xxxxxxxxxxxxxx	50	xxxxxxxxxx	29	xxxxxx
SUG BEET	107	xxxxxxxxxxxxxxxxxxx +	116	xxxxxxxxxxxxxxxxxxx +	94	xxxxxxxxxxxxxxxxxx
(22)	100	xxxxxxxxxxxxxxxxxxx	71	xxxxxxxxxxxxxx	50	xxxxxxxxxx
BETA VUL	74	xxxxxxxxxxxxxxx	136	xxxxxxxxxxxxxxxxxxx +	53	xxxxxxxxxxx
(23)	93	xxxxxxxxxxxxxxxxxx	57	xxxxxxxxxxx	43	xxxxxxxxx
BROM STE	50	xxxxxxxxxx	15	xxx	0	
(24)	43	xxxxxxxxx	7	x	0	
FEST RUB	2	x	0		0	
(25)	7	x	0		0	
AVE FATU	69 R	xxxxxxxxxxxxxx	137	xxxxxxxxxxxxxxxxxx +	17	xxx
(26)	43	xxxxxxxxx	29	xxxxxx	7	x

PRE-EMERGENCE SELECTIVITY TEST

SPECIES		NC 20484 0.25 kg/ha		NC 20484 1.0 kg/ha		NC 20484 4.0 kg/ha
ALO MYOS	37	xxxxxxx	18	xxxx	0	
(27)	14	xxx	7	x	0	
POA ANN	0		0		0	
(28)	0		0		0	
POA TRIV	0		0		0	
(29)	0		0		0	
SIN ARV	75	xxxxxxxxxxxxxx	48	xxxxxxxxxx	16	xxx
(30)	50	xxxxxxxxxx	36	xxxxxxx	14	xxx
RAPH RAP	103	xxxxxxxxxxxxxxxxxxx +	93	xxxxxxxxxxxxxxxxxx	74	xxxxxxxxxxxxxx
(31)	57	xxxxxxxxxxx	43	xxxxxxxxx	43	xxxxxxxxx
CHRY SEG	125	xxxxxxxxxxxxxxxxxxx +	75	xxxxxxxxxxxxxx	0	
(32)	57	xxxxxxxxxxx	43	xxxxxxxxx	0	
TRIP MAR	67	xxxxxxxxxxxxx	31	xxxxxx	4	x
(33)	36	xxxxxxx	21	xxxx	7	x
SEN VULG	94	xxxxxxxxxxxxxxxxx	49	xxxxxxxxxx	17	xxx
(34)	86	xxxxxxxxxxxxxxxx	79	xxxxxxxxxxxxxxx	50	xxxxxxxxxx
GAL APAR	0		12	xx	0	
(38)	0		14	xxx	0	
CHEN ALB	62	xxxxxxxxxxx	0		0	
(39)	50	xxxxxxxxxx	0		0	
STEL MED	0		0		0	
(40)	0		0		0	

PRE-EMERGENCE SELECTIVITY TEST

SPECIES		NC 20484 0.25 kg/ha		NC 20484 1.0 kg/ha		NC 20484 4.0 kg/ha
VER PERS	7	x	0		7	x
(42)	14	xxx	0		14	xxx
RUM OBTU	177	xxxxxxxxxxxxxxxxxxxx +	38	xxxxxxxx	0	
(44)	64	xxxxxxxxxxxxx	29	xxxxxx	0	
HOLC LAN	0		0		0	
(45)	0		0		0	
AG REPEN	86	xxxxxxxxxxxxxxxxx	0		0	
(47)	29	xxxxxx	0		0	
ALL VIN	83	xxxxxxxxxxxxxxxxx	51	xxxxxxxxxx	37	xxxxxxx
(49)	86	xxxxxxxxxxxxxxxxx	43	xxxxxxxxx	14	xxx
CIRS ARV	112	xxxxxxxxxxxxxxxxxxx +	56	xxxxxxxxxxx	19	xxxx
(50)	71	xxxxxxxxxxxxxx	29	xxxxxx	7	x
TUS FARF	109	xxxxxxxxxxxxxxxxxxx +	95	xxxxxxxxxxxxxxxxxx	109	xxxxxxxxxxxxxxxxxxx +
(51)	100	xxxxxxxxxxxxxxxxxx	86	xxxxxxxxxxxxxxxx	43	xxxxxxxxx
MILLET	0		0		0	
(55)	0		0		0	
MAIZE + S	104	xxxxxxxxxxxxxxxxxxx +	13	xxx	0	
(56)	93	xxxxxxxxxxxxxxxxxx	21	xxxx	0	
MAIZE	25	xxxxx	0		0	
(57)	43	xxxxxxxxx	0		0	
SORG + S	85	xxxxxxxxxxxxxxxx	0		0	
(58)	50	xxxxxxxxxx	0		0	

PRE-EMERGENCE SELECTIVITY TEST

SPECIES		NC 20484 0.25 kg/ha		NC 20484 1.0 kg/ha		NC 20484 4.0 kg/ha	
SORGHUM (59)	6	x	0			0	
	14	xxx	0			0	
RICE (60)	29	xxxxxx	0			0	
	64	xxxxxxxxxxxxx	0			0	
PIGEON P (61)	0		0			0	
	0		0			0	
COWPEA (62)	108	xxxxxxxxxxxxxxxxxxxx +	96	xxxxxxxxxxxxxxxxxxx		36	xxxxxxx
	93	xxxxxxxxxxxxxxxxxxx	86	xxxxxxxxxxxxxxxxx		21	xxxx
CHICKPEA (63)	103	xxxxxxxxxxxxxxxxxxxx +	31	xxxxxx		0	
	50	xxxxxxxxxx	21	xxxx		0	
GRNDNUT (64)	75	xxxxxxxxxxxxxxx	112	xxxxxxxxxxxxxxxxxxx +		94	xxxxxxxxxxxxxxxxxx
	86	xxxxxxxxxxxxxxxxx	71	xxxxxxxxxxxxxx		29	xxxxxx
SOYABEAN (65)	105	xxxxxxxxxxxxxxxxxxx +	105	xxxxxxxxxxxxxxxxxxx +		45	xxxxxxxxx
	71	xxxxxxxxxxxxxx	50	xxxxxxxxxx		29	xxxxxx
COTTON (66)	100	xxxxxxxxxxxxxxxxxxx	67	xxxxxxxxxxxxx	R	44	xxxxxxxxx
	86	xxxxxxxxxxxxxxxxx	71	xxxxxxxxxxxxxx		29	xxxxxx
JUTE (67)	100	xxxxxxxxxxxxxxxxxxx	0			0	
	86	xxxxxxxxxxxxxxxxx	0			0	
KENAF (68)	73	xxxxxxxxxxxxxxx	53	xxxxxxxxxxx		0	
	64	xxxxxxxxxxxxx	43	xxxxxxxxx		0	
SESAMUM (70)	7	x	0			0	
	14	xxx	0			0	

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