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THE ACTIVITY AND PRE-EMERGENCE SELECTIVITY OF SOME RECENTLY DEVELOPED HERBICIDES: AC 213087 AND AC 222293

NB: AC 213087 is confidential (Cyanamid), AC 222293 is imazamethabenz-methyl

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THE ACTIVITY AND PRE-EMERGENCE SELECTIVITY OF SOME RECENTLY DEVELOPED HERBICIDES: AC 213087 AND AC 222293

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SUMMARY

In a series of pot experiments in the glasshouse, two 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. Persistence of the herbicides in the soil was examined over a period of 52 weeks.

AC 213087 and AC 222293 were notable for their control of Avena fatua and Alopecurus myosuroides and for their relative safety on wheat, barley and maize. The level of tolerance by these crops was increased by seed dressings of the safener 1,8-naphthalic anhydride (NA). Useful control of certain other important weeds such as Veronica persica and Galium aparine was indicated, but Compositae were generally resistant. Lettuce was tolerant to AC 222293. Persistence in the soil was as long for AC 213087 and AC 222293, as for simazine.

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.

This report gives pre-emergence selectivity data on AC 213087 and AC 222293. Results of activity experiments which provide information on levels of phytotoxicity, type and route of action have been published previously (Richardson et al, 1981).

METHODS AND MATERIALS

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.

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* Herbicide Group
** ODA Tropical Weeds Group

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 six 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. Fenugreek was 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 $^{-1}$) and/or dithane (1 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), - (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. 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 25). Average temperature during this period was 16°C (minimum 3°C, maximum 33°C) and relative humidity 60% (minimum 22%, maximum 90%).

NB: AC 213087 is confidential (Cyanamid), AC 222293 is imazamethabenz-methyl

Table 1. Soil and environment conditions

Experiment type and herbicide(s) included	Pre-emergence selectivity test AC 213087 AC 222293	
Date of spraying	12.11.80	
Main assessment completed	12.1.81	
Organic matter (%)	4.1	
Clay content (%)	15.0	
pH (water; 1:2 soil/water)	7.0	
Ammonium sulphate (g/kg)	0.7	
Superphosphate (g/kg)	1.7	
Potassium sulphate (g/kg)	0.7	
Vitax QS3 (g/kg) fertilizer	-	
DDT (5% dust) (g/kg)	0.4	
Hydrated Mg SO_4 (g/kg)	0.9	
Temperature (°C)	Temperate	Tropical
Mean	14	21
Maximum	20	32
Minimum	7	10
Relative humidity (%)		
Mean	68	63
Maximum	94	88
Minimum	30	42

NB: AC 213087 is confidential (Cyanamid), AC 222293 is imazamethabenz-methyl

AC 213087

Code number AC 213087

Common name -

Chemical name Confidential

Structure Confidential

Source

Cyanamid International Ltd
Fareham Road
Gosport
Hants PO13 0AS
UK

Information available and suggested uses

Control of Alopecurus myosuroides in cereals, pre-emergence at 0.5-1.0 kg a.i./ha. The manufacturers have indicated that this herbicide is unlikely to be developed.

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

Spray volume for activity experiment 370 l/ha
for pre-emergence selectivity experiment 367 l/ha

RESULTS

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

RATE (kg a.i./ha)	CROPS: vigour reduced by less than 15%	WEEDS: number or vigour reduced by 70% or more
2.5	None	None listed as no crops tolerant
0.5	wheat + safener (NA) barley ± safener (NA) maize + safener (NA)	Avena fatua Alopecurus myosuroides Sinapis arvensis Raphanus raphanistrum Veronica persica Agropyron repens Allium vineale Amaranthus retroflexus Phalaris minor + species below

(continued overleaf)

NB: AC 213087 is confidential (Cyanamid), AC 222293 is imazamethabenz-methyl

RATE (kg a.i./ha)	CROPS: vigour reduced by less than 15%	WEEDS: number or vigour reduced by 70% or more
0.1	species above + wheat perennial ryegrass field bean pea rape carrot fenugreek millet maize sorghum + safener groundnut sesamum	Beta vulgaris Poa trivialis Holcus lanatus

Comments on results

Activity experiment results, together with symptoms caused on susceptible species and post-emergence selectivity were reported earlier (Richardson et al, 1981). Pre-emergence treatments were the most effective of all four methods of application. Differences between surface and incorporated treatments were not very big. This should be borne in mind when considering results of the present test where the herbicide was surface applied.

Persistence in the soil

Using sugar beet as the sensitive test species, severe effects of surface and incorporated treatments of AC 213087 were found 52 weeks after spraying.

Pre-emergence selectivity among temperate species

At 0.1 kg/ha, two annual grasses (Poa trivialis and Holcus lanatus) and annual beet (Beta vulgaris) were controlled. Both Avena fatua and Alopecurus myosuroides were susceptible at 0.5 kg/ha as were Veronica persica, two crucifers (Sinapis arvensis and Raphanus raphanistrum) while the two perennials Agropyron repens and Allium vineale were eventually killed. Several other species were well suppressed though not adequately controlled at this dose eg Galium aparine, but Stellaria media and two of the Compositae (Senecio vulgaris and Tripleurospermum maritimum) showed considerable resistance to this dose, as did Bromus sterilis.

Barley was the only crop to tolerate 0.5 kg/ha. The NA seed dressing caused a slight safening effect on this species and wheat, such that the latter species also tolerated 0.5 kg/ha. Perennial ryegrass, rape, carrot and some leguminous crops (pea, field bean and fenugreek) were the only other crops tolerant at 0.1 kg/ha. Oat, onion, white clover and sugar beet were sensitive.

The most interesting feature of AC 213087 is its control of both A. fatua and A. myosuroides in wheat and barley. Control of certain other important broad-leaved and grass weeds is possible, eg V. persica. These findings are broadly similar to the selectivities found post-emergence though lower doses are adequate pre-emergence. A rather flat dose response on many weeds and crops is apparent as was the case post-emergence; certain species eg Galium aparine being usefully suppressed though not controlled. The slight safening effect of NA seed dressing is also of interest, again corresponding to post-emergence results.

Selectivity among tropical species

Very little selectivity was demonstrated, most crops being damaged at 0.5 kg/ha and only Amaranthus and Phalaris being controlled at this dose. The latter could perhaps be selectively controlled in wheat but otherwise no practical selectivity is indicated in annual crops. Cyperus species were greatly retarded by 0.5 kg/ha for over three months and totally suppressed even longer by 2.5 kg/ha. After five months, however, the tubers were still sound and probably capable of eventual recovery.

There was a modest protection of maize by the safener NA but very little protection of sorghum by cyometrinil.

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PRE-EMERGENCE SELECTIVITY TEST

SPECIES		AC 213087 0.1 kg/ha		AC 213087 0.5 kg/ha		AC 213087 2.5 kg/ha
WHEAT	105	xxxxxxxxxxxxxxxxxxxx +	112	xxxxxxxxxxxxxxxxxxxx +	75	xxxxxxxxxxxxxxx
(1)	93	xxxxxxxxxxxxxxxxxx	71	xxxxxxxxxxxxxx	29	xxxxxx
WHEAT + S	89	xxxxxxxxxxxxxxxxxx	102	xxxxxxxxxxxxxxxxxxx	83	xxxxxxxxxxxxxxxxx
(2)	93	xxxxxxxxxxxxxxxxxxx	93	xxxxxxxxxxxxxxxxxx	50	xxxxxxxxxx
BARLEY	100	xxxxxxxxxxxxxxxxxxx	94	xxxxxxxxxxxxxxxxxxx	100	xxxxxxxxxxxxxxxxxxx
(3)	100	xxxxxxxxxxxxxxxxxxx	86	xxxxxxxxxxxxxxxxx	64	xxxxxxxxxxxx
BARLEY + S	102	xxxxxxxxxxxxxxxxxxx	96	xxxxxxxxxxxxxxxxxxx	96	xxxxxxxxxxxxxxxxxxx
(4)	100	xxxxxxxxxxxxxxxxxxx	93	xxxxxxxxxxxxxxxxxxx	79	xxxxxxxxxxxxxxxx
OAT	98	xxxxxxxxxxxxxxxxxxx	91	xxxxxxxxxxxxxxxxxx	85	xxxxxxxxxxxxxxxxx
(5)	57	xxxxxxxxxxx	14	xxx	14	xxx
PER RYGR	117	xxxxxxxxxxxxxxxxxxx +	86	xxxxxxxxxxxxxxxxx	70	xxxxxxxxxxxxxx
(6)	100	xxxxxxxxxxxxxxxxxxx	79	xxxxxxxxxxxxxxx	29	xxxxxx
ONION	60	xxxxxxxxxxxx	27	xxxxx	0	
(8)	43	xxxxxxxxx	21	xxxx	0	
DWF BEAN	104	xxxxxxxxxxxxxxxxxxx +	91	xxxxxxxxxxxxxxxxx	104	xxxxxxxxxxxxxxxxxxx +
(9)	71	xxxxxxxxxxxxxx	50	xxxxxxxxxx	21	xxxx
FLD BEAN	109	xxxxxxxxxxxxxxxxxxx +	109	xxxxxxxxxxxxxxxxxxx +	82	xxxxxxxxxxxxxxxx
(10)	86	xxxxxxxxxxxxxxxx	50	xxxxxxxxxx	36	xxxxxxx
PEA	95	xxxxxxxxxxxxxxxxxx	68	xxxxxxxxxxxxxx	14	xxx
(11)	86	xxxxxxxxxxxxxxxx	29	xxxxxx	7	x
W CLOVER	61	xxxxxxxxxxxx	33	xxxxxxx	0	
(12)	36	xxxxxxx	29	xxxxxx	0	

PRE-EMERGENCE SELECTIVITY TEST

SPECIES		AC 213087 0.1 kg/ha		AC 213087 0.5 kg/ha		AC 213087 2.5 kg/ha
RAPE	102	xxxxxxxxxxxxxxxxxxxx	87	xxxxxxxxxxxxxxxxx	90	xxxxxxxxxxxxxxxxxx
(14)	86	xxxxxxxxxxxxxxxxx	29	xxxxxx	29	xxxxxx
KALE	109	xxxxxxxxxxxxxxxxxxxx +	100	xxxxxxxxxxxxxxxxxxxx	91	xxxxxxxxxxxxxxxxxx
(15)	79	xxxxxxxxxxxxxxxx	43	xxxxxxxxx	29	xxxxxx
SWEDE	102	xxxxxxxxxxxxxxxxxxxx	92	xxxxxxxxxxxxxxxxxx	78	xxxxxxxxxxxxxxxx
(17)	71	xxxxxxxxxxxxxx	29	xxxxxx	29	xxxxxx
CARROT	135	xxxxxxxxxxxxxxxxxxxx +	120	xxxxxxxxxxxxxxxxxxxx +	60	xxxxxxxxxxx
(18)	93	xxxxxxxxxxxxxxxxxx	57	xxxxxxxxxx	29	xxxxxx
LETTUCE	67	xxxxxxxxxxxxxx	120	xxxxxxxxxxxxxxxxxxx +	73	xxxxxxxxxxxxxx
(20)	64	xxxxxxxxxxxxx	50	xxxxxxxxx	29	xxxxxx
FENUGREK	100	xxxxxxxxxxxxxxxxxxxx	100	xxxxxxxxxxxxxxxxxxxx	87	xxxxxxxxxxxxxxxx
(21)	93	xxxxxxxxxxxxxxxxxxx	64	xxxxxxxxxxxxx	36	xxxxxxx
SUG BEET	17	xxx	13	xxx	0	
(22)	21	xxxx	21	xxxx	0	
BETA VUL	49	xxxxxxxxxx	25	xxxxx	4	x
(23)	29	xxxxxx	14	xxx	14	xxx
BROM STE	90	xxxxxxxxxxxxxxxxxx	90	xxxxxxxxxxxxxxxxxx	40	xxxxxxxx
(24)	93	xxxxxxxxxxxxxxxxxxx	79	xxxxxxxxxxxxxxxx	36	xxxxxxx
FEST RUB	81	xxxxxxxxxxxxxxxx	32	xxxxxx	16	xxx
(25)	93	xxxxxxxxxxxxxxxxxxx	43	xxxxxxxxx	14	xxx
AVE FATU	120	xxxxxxxxxxxxxxxxxxxx +	146	xxxxxxxxxxxxxxxxxxxx +	103	xxxxxxxxxxxxxxxxxxxx +
(26)	64	xxxxxxxxxxxxx	29	xxxxxx	29	xxxxxx

SPECIES		AC 213087 0.1 kg/ha		AC 213087 0.5 kg/ha		AC 213087 2.5 kg/ha
ALO MYOS	92	xxxxxxxxxxxxxxxxxx	18	xxxx	0	
(27)	43	xxxxxxxxx	14	xxx	0	
POA ANN	116	xxxxxxxxxxxxxxxxxxxx +	110	xxxxxxxxxxxxxxxxxxxx +	45	xxxxxxxxx
(28)	86	xxxxxxxxxxxxxxxxx	50	xxxxxxxxxx	29	xxxxxx
POA TRIV	67	xxxxxxxxxxxxx	28	xxxxxx	7	x
(29)	29	xxxxxx	14	xxx	21	xxxx
SIN ARV	123	xxxxxxxxxxxxxxxxxxx +	86	xxxxxxxxxxxxxxxx	75	xxxxxxxxxxxxxxx
(30)	43	xxxxxxxxx	29	xxxxxx	29	xxxxxx
RAPH RAP	93	xxxxxxxxxxxxxxxxxx	103	xxxxxxxxxxxxxxxxxxx +	74	xxxxxxxxxxxxxx
(31)	43	xxxxxxxxx	29	xxxxxx	29	xxxxxx
CHRY SEG	75	xxxxxxxxxxxxxxx	75	xxxxxxxxxxxxxx	25	xxxxx
(32)	79	xxxxxxxxxxxxxxxx	36	xxxxxxx	7	x
TRIP MAR	61	xxxxxxxxxxxx	44	xxxxxxxxx	80	xxxxxxxxxxxxxxx
(33)	79	xxxxxxxxxxxxxxx	71	xxxxxxxxxxxxxx	29	xxxxxx
SEN VULG	87	xxxxxxxxxxxxxxxx	101	xxxxxxxxxxxxxxxxxxx	63	xxxxxxxxxxxx
(34)	79	xxxxxxxxxxxxxxx	86	xxxxxxxxxxxxxxxx	43	xxxxxxxxx
GAL APAR	119	xxxxxxxxxxxxxxxxxxx +	75	xxxxxxxxxxxxxx	75	xxxxxxxxxxxxxx
(38)	86	xxxxxxxxxxxxxxxx	36	xxxxxxx	29	xxxxxx
CHEN ALB	89	xxxxxxxxxxxxxxxxx	98	xxxxxxxxxxxxxxxxxx	53	xxxxxxxxxx
(39)	79	xxxxxxxxxxxxxxx	36	xxxxxxx	29	xxxxxx
STEL MED	81	xxxxxxxxxxxxxxx	66	xxxxxxxxxxxx	0	
(40)	100	xxxxxxxxxxxxxxxxxx	86	xxxxxxxxxxxxxxxx	0	

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PRE-EMERGENCE SELECTIVITY TEST

SPECIES		AC 213087 0.1 kg/ha		AC 213087 0.5 kg/ha		AC 213087 2.5 kg/ha
VER PERS	61	xxxxxxxxxxx	27	xxxxx	20	xxxx
(42)	43	xxxxxxxxx	21	xxxx	21	xxxx
RUM OBTU	123	xxxxxxxxxxxxxxxxxxxx +	146	xxxxxxxxxxxxxxxxxxxx +	85	xxxxxxxxxxxxxxxxx
(44)	64	xxxxxxxxxxxxx	36	xxxxxxx	29	xxxxxx
HOLC LAN	94	xxxxxxxxxxxxxxxxxx	103	xxxxxxxxxxxxxxxxxxx +	0	
(45)	14.	xxx	14	xxx	0	
AG REPEN	94	xxxxxxxxxxxxxxxxxx	26	xxxxx	0	
(47)	71	xxxxxxxxxxxxxx	21	xxxx	0	
ALL VIN	46	xxxxxxxxx	28	xxxxxx	18	xxxx
(49)	50	xxxxxxxxxx	29	xxxxxx	29	xxxxxx
CIRS ARV	131	xxxxxxxxxxxxxxxxxxx +	131	xxxxxxxxxxxxxxxxxxx +	56	xxxxxxxxxx
(50)	93	xxxxxxxxxxxxxxxxx	57	xxxxxxxxxx	21	xxxx
TUS FARF	109	xxxxxxxxxxxxxxxxxx +	68	xxxxxxxxxxxxx	68	xxxxxxxxxxxxx
(51)	79	xxxxxxxxxxxxxx	36	xxxxxx	14	xxx
MILLET	99	xxxxxxxxxxxxxxxxx	80	xxxxxxxxxxxxxx	27	xxxxx
(55)	100	xxxxxxxxxxxxxxxxxx	79	xxxxxxxxxxxxxx	29	xxxxxx
MAIZE + S	104	xxxxxxxxxxxxxxxxxx +	104	xxxxxxxxxxxxxxxxxx +	91	xxxxxxxxxxxxxxxxx
(56)	93	xxxxxxxxxxxxxxxxx	86	xxxxxxxxxxxxxxxx	43	xxxxxxxxx
MAIZE	87	xxxxxxxxxxxxxxx	87	xxxxxxxxxxxxxxx	62	xxxxxxxxxx
(57)	86	xxxxxxxxxxxxxxx	57	xxxxxxxxxx	29	xxxxxx
SORG + S	104	xxxxxxxxxxxxxxxxxx +	98	xxxxxxxxxxxxxxxxx	78	xxxxxxxxxxxxxx
(58)	93	xxxxxxxxxxxxxxxxx	71	xxxxxxxxxxxxx	36	xxxxxxx

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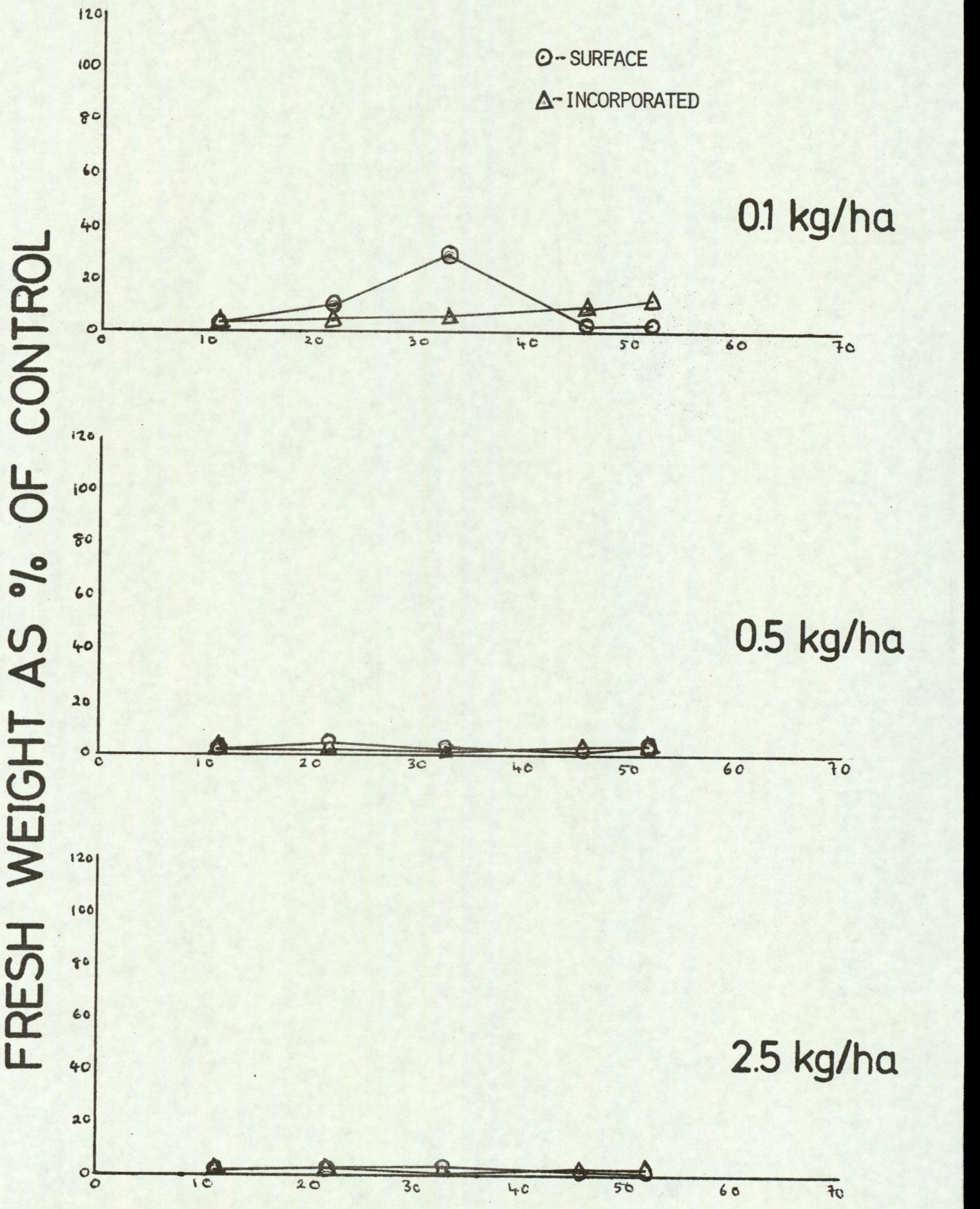
SPECIES	AC 213087 0.1 kg/ha			AC 213087 0.5 kg/ha			AC 213087 2.5 kg/ha	
SORGHUM	102		xxxxxxxxxxxxxxxxxxx	96		xxxxxxxxxxxxxxxxxxx	32	xxxxxx
(59)	79		xxxxxxxxxxxxxxxx	64		xxxxxxxxxxxxx	29	xxxxxx
RICE	104		xxxxxxxxxxxxxxxxxxx +	104		xxxxxxxxxxxxxxxxxxx +	12	xx
(60)	71		xxxxxxxxxxxxxx	36		xxxxxxx	14	xxx
PIGEON P	171	MP	xxxxxxxxxxxxxxxxxxx +	129		xxxxxxxxxxxxxxxxxxx +	21	xxxx
(61)	71		xxxxxxxxxxxxxx	43		xxxxxxxxx	7	x
COWPEA	60		xxxxxxxxxxx	120		xxxxxxxxxxxxxxxxxxx +	108	xxxxxxxxxxxxxxxxxxx +
(62)	64		xxxxxxxxxxxxx	43		xxxxxxxxx	29	xxxxxx
CHICKPEA	93		xxxxxxxxxxxxxxxxxx	83		xxxxxxxxxxxxxxxxx	21	xxxx
(63)	64		xxxxxxxxxxxxx	43		xxxxxxxxx	29	xxxxxx
GRNDNUT	75		xxxxxxxxxxxxxx	112	MP	xxxxxxxxxxxxxxxxxx +	75	xxxxxxxxxxxxxx
(64)	86		xxxxxxxxxxxxxxxx	57		xxxxxxxxxx	43	xxxxxxxxx
SOYABEAN	165		xxxxxxxxxxxxxxxxxx +	75		xxxxxxxxxxxxxx	105	xxxxxxxxxxxxxxxxxx +
(65)	57		xxxxxxxxxx	29		xxxxxx	29	xxxxxx
COTTON	111		xxxxxxxxxxxxxxxxxx +	56		xxxxxxxxxx	111	xxxxxxxxxxxxxxxxxx +
(66)	79		xxxxxxxxxxxxxxx	43		xxxxxxxxx	36	xxxxxxx
JUTE	0			0			0	
(67)	0			0			0	
KENAF	100		xxxxxxxxxxxxxxxxxx	87		xxxxxxxxxxxxxxxx	120	xxxxxxxxxxxxxxxxxx +
(68)	57		xxxxxxxxxx	50		xxxxxxxxx	36	xxxxxxx
SESAMUM	95		xxxxxxxxxxxxxxxxx	27		xxxxx	20	xxxx
(70)	86		xxxxxxxxxxxxxxxx	29		xxxxxx	14	xxx

SPECIES		AC 213087 0.1 kg/ha		AC 213087 0.5 kg/ha		AC 213087 2.5 kg/ha
TOMATO	58	xxxxxxxxxxxx	25	xxxxx	0	
(71)	29	xxxxxx	29	xxxxxx	0	
OR BART	97	xxxxxxxxxxxxxxxxxx	102	xxxxxxxxxxxxxxxxxx	36	xxxxxxx
(73)	71	xxxxxxxxxxxxx	57	xxxxxxxxxx	21	xxxx
ECH CRUS	90	xxxxxxxxxxxxxxxxx	76	xxxxxxxxxxxxxxx	10	xx
(75)	64	xxxxxxxxxxxxx	50	xxxxxxxxxx	14	xxx
ROTT EXA	103	xxxxxxxxxxxxxxxxxxx +	113	xxxxxxxxxxxxxxxxxxx +	93	xxxxxxxxxxxxxxxxxx
(76)	93	xxxxxxxxxxxxxxxxxx	64	xxxxxxxxxxxxx	50	xxxxxxxxxx
DIG SANG	74	xxxxxxxxxxxxxxx	40	xxxxxxxx	0	
(77)	86	xxxxxxxxxxxxxxxxx	64	xxxxxxxxxxxxx	0	
AMAR RET	74	xxxxxxxxxxxxxxx	39	xxxxxxxx	4	x
(78)	50	xxxxxxxxxx	14	xxx	14	xxx
BROM PEC	115	xxxxxxxxxxxxxxxxxx +	93	xxxxxxxxxxxxxxxxxx	22	xxxx
(82)	100	xxxxxxxxxxxxxxxxxxx	64	xxxxxxxxxxxxx	43	xxxxxxxxx
SNO POL	62	xxxxxxxxxxxx	38	xxxxxxxx	8	xx
(83)	57	xxxxxxxxxxx	43	xxxxxxxxx	14	xxx
PHAL MIN	88	xxxxxxxxxxxxxxxxx	9	xx	9	xx
(84)	64	xxxxxxxxxxxxx	14	xxx	14	xxx
CYP ESCU	67	xxxxxxxxxxxxx	50	xxxxxxxxxx	0	
(85)	57	xxxxxxxxxxx	43	xxxxxxxxx	0	
CYP ROTU	72	xxxxxxxxxxxxxx	62	xxxxxxxxxxxx	0	
(86)	57	xxxxxxxxxxx	50	xxxxxxxxxx	0	

NB: AC 213087 is confidential (Cyanamid), AC 222293 is imazamethabenz-methyl

PERSISTENCE OF AC 213087
species: sugar beet

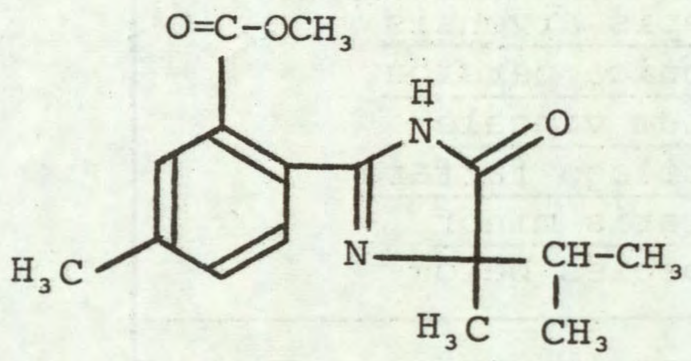


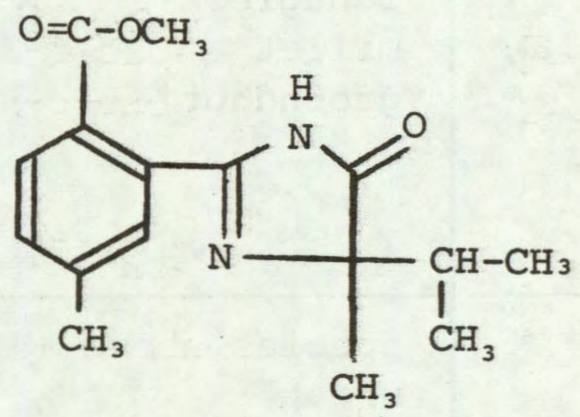
AC 222293

Code number AC 222293

Chemical name methyl 6-(4-isopropyl-4-methyl-5-oxo-2-imidazolin-2-yl)-m-toluate
and methyl 2-(4-isopropyl-4-methyl-5-oxo-2-imidazolin-2-yl)-p-toluate

Structure





Source

Cyanamid International Ltd
Fareham Road
Gosport
Hants PO13 0AS
UK

Information available and suggested uses

Control of Avena fatua and Alopecurus myosuroides in cereals, pre-emergence at 0.5-0.75 kg a.i./ha.

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

Spray volume for activity experiment 370 l/ha
for pre-emergence selectivity experiment 367 l/ha

RESULTS

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

RATE (kg a.i./ha)	CROPS: vigour reduced by 15% or less	WEEDS: number or vigour reduced by 70% or more
2.5	wheat + safener (NA) barley + safener (NA) maize + safener (NA)	Avena fatua Poa trivialis Raphanus raphanistrum Chrysanthemum segetum Chenopodium album Stellaria media Rumex obtusifolius Agropyron repens Oryza barthii Echinochloa crus-galli Bromus pectinatus Snowdenia polystachya Cyperus esculentus Cyperus rotundus + species below

(continued overleaf)

NB: AC 213087 is confidential (Cyanamid), AC 222293 is imazamethabenz-methyl

RATE (kg a.i./ha)	CROPS: vigour reduced by 15% or less	WEEDS: number or vigour reduced by 70% or more
0.5	species above + barley lettuce fenugreek millet groundnut*	Beta vulgaris Festuca rubra Alopecurus myosuroides Sinapis arvensis Veronica persica Allium vineale Tussilago farfara Phalaris minor + species below
0.1	species above + wheat perennial ryegrass dwarf bean pea rape kale swede carrot maize pigeon pea* cowpea chickpea soyabean cotton* sesamum	Holcus lanatus

* Note reductions in plant number but not due to herbicide

Comments on results

Activity test data, symptoms and post-emergence selectivity were reported earlier (Richardson et al, 1981). As with AC 213087, pre-emergence treatments were the most effective of the four application methods and again although differences between surface and incorporated treatments were not very large certain species differed in their response to these two methods of application.

Persistence in the soil

Sugar beet was used as the sensitive test species to monitor persistence in the soil. Plants were still seriously affected by surface and incorporated treatments at all doses, 52 weeks after spraying.

Pre-emergence selectivity among temperate species

Holcus lanatus was the only weed controlled at 0.1 kg/ha. At 0.5 kg/ha a further seven weeds were controlled including Alopecurus myosuroides, Allium vineale and Veronica persica, the two former eventually being killed at this dose. At 2.5 kg/ha, Avena fatua and Agropyron repens were among the eight weeds controlled. Certain composite weeds such as T. maritimum, S. vulgaris and C. arvense were resistant.

Barley, lettuce and fenugreek were the only crops to tolerate 0.5 kg/ha. At the lowest dose of 0.1 kg/ha, wheat, perennial ryegrass, carrot, certain brassicas (rape, kale, swede) and legumes (dwarf bean and pea) were tolerant. However, the most interesting feature with regard to crop tolerance was

NB: AC 213087 is confidential (Cyanamid), AC 222293 is imazamethabenz-methyl

the distinct safening effect of NA seed dressing on barley and in particular wheat, rendering both of these species tolerant even to the highest dose of 2.5 kg/ha, a dose which no other crop tolerated. Onion, sugar beet and radish were rather sensitive.

The weed control and crop tolerance spectrum is broadly similar to that of AC 213087. The latter is perhaps marginally more active on weeds and crops. One difference between the two herbicides, however, is the tolerance shown by lettuce to AC 222293. Unfortunately composite weeds, the main problems in lettuce, were resistant. Of major interest, however, is the selective control of A. fatua and A. myosuroides in barley and wheat and the possibility that the margin of selectivity can be extended by use of NA safener as a seed dressing. This safening effect was found in the earlier post-emergence test (Richardson et al, 1981). A follow-up pot study has confirmed this safening effect in both wheat and barley. A possible advantage of AC 222293 over triallate, one of the very few pre-emergence treatments for wild oats and blackgrass, is that incorporation would not appear to be necessary. This would be a distinct advantage in minimal cultivations and direct-drilled cereal situations. The lack of effect on certain weeds such as composites may mean that consideration will have to be given to mixtures with other herbicides. It is perhaps worth noting that the deficiency on Compositae may well be rectified in mixture with the urea herbicides while the control of V. persica and the suppression of G. aparine by AC 222293 would rectify this defect common to the ureas. The possible control of Allium vineale in cereals may also be of interest.

Selectivity among tropical species

This compound showed slightly more selectivity than AC 213087 and there was a more pronounced protection of maize by safener such that a wide range of weeds could perhaps be controlled selectively at 2.5 kg/ha in maize protected by NA. Sorghum, however, was only slightly protected by cyometrinil. Again Phalaris appears likely to be selectively controlled in wheat. Control of Cyperus species was almost total and prolonged at 2.5 kg/ha but more transient than by AC 213087, at 0.5 kg/ha.

SPECIES		AC 222293 0.1 kg/ha		AC 222293 0.5 kg/ha		AC 222293 2.5 kg/ha
WHEAT	90	xxxxxxxxxxxxxxxxxx	105	xxxxxxxxxxxxxxxxxxxx +	120	xxxxxxxxxxxxxxxxxxxx +
(1)	93	xxxxxxxxxxxxxxxxxx	79	xxxxxxxxxxxxxxx	50	xxxxxxxxxx
WHEAT + S	102	xxxxxxxxxxxxxxxxxxx	96	xxxxxxxxxxxxxxxxxx	102	xxxxxxxxxxxxxxxxxxx
(2)	100	xxxxxxxxxxxxxxxxxxx	100	xxxxxxxxxxxxxxxxxxx	100	xxxxxxxxxxxxxxxxxxx
BARLEY	100	xxxxxxxxxxxxxxxxxxx	100	xxxxxxxxxxxxxxxxxxx	100	xxxxxxxxxxxxxxxxxxx
(3)	100	xxxxxxxxxxxxxxxxxxx	100	xxxxxxxxxxxxxxxxxxx	79	xxxxxxxxxxxxxxx
BARLEY + S	96	xxxxxxxxxxxxxxxxxx	102	xxxxxxxxxxxxxxxxxxx	102	xxxxxxxxxxxxxxxxxxx
(4)	100	xxxxxxxxxxxxxxxxxxx	100	xxxxxxxxxxxxxxxxxxx	93	xxxxxxxxxxxxxxxxxx
OAT	98	xxxxxxxxxxxxxxxxxxx	91	xxxxxxxxxxxxxxxxx	85	xxxxxxxxxxxxxxxxx
(5)	57	xxxxxxxxxxx	21	xxxx	14	xxx
PER RYGR	113	xxxxxxxxxxxxxxxxxxx +	82	xxxxxxxxxxxxxxxx	35	xxxxxxx
(6)	93	xxxxxxxxxxxxxxxxxx	64	xxxxxxxxxxxxx	29	xxxxxx
ONION	80	xxxxxxxxxxxxxxxx	0		0	
(8)	64	xxxxxxxxxxxxx	0		0	
DWF BEAN	104	xxxxxxxxxxxxxxxxxxx +	104	xxxxxxxxxxxxxxxxxxx +	91	xxxxxxxxxxxxxxxxxx
(9)	86	xxxxxxxxxxxxxxxxx	50	xxxxxxxxxx	36	xxxxxxx
FLD BEAN	109	xxxxxxxxxxxxxxxxxxx +	109	xxxxxxxxxxxxxxxxxxx +	68	xxxxxxxxxxxxx
(10)	79	xxxxxxxxxxxxxxxx	71	xxxxxxxxxxxxxx	36	xxxxxxx
PEA	95	xxxxxxxxxxxxxxxxxx	95	xxxxxxxxxxxxxxxxxx	27	xxxxx
(11)	86	xxxxxxxxxxxxxxxxx	50	xxxxxxxxxx	29	xxxxxx
W CLOVER	87	xxxxxxxxxxxxxxxx	43	MP xxxxxxxxx	7	x
(12)	64	xxxxxxxxxxxxx	29	xxxxxx	7	x

PRE-EMERGENCE SELECTIVITY TEST

SPECIES		AC 222293 0.1 kg/ha		AC 222293 0.5 kg/ha		AC 222293 2.5 kg/ha
RAPE	105	xxxxxxxxxxxxxxxxxxxx +	93	xxxxxxxxxxxxxxxxxxxx	93	xxxxxxxxxxxxxxxxxxxx
(14)	86	xxxxxxxxxxxxxxxxx	36	xxxxxxx	29	xxxxxx
KALE	123	xxxxxxxxxxxxxxxxxxxx +	105	xxxxxxxxxxxxxxxxxxxx +	105	xxxxxxxxxxxxxxxxxxxx +
(15)	86	xxxxxxxxxxxxxxxxx	36	xxxxxxx	29	xxxxxx
SWEDE	97	xxxxxxxxxxxxxxxxxx	102	xxxxxxxxxxxxxxxxxxxx	92	xxxxxxxxxxxxxxxxxx
(17)	86	xxxxxxxxxxxxxxxxx	43	xxxxxxxxx	14	xxx
CARROT	105	xxxxxxxxxxxxxxxxxxxx +	60	xxxxxxxxxxxx	90	xxxxxxxxxxxxxxxxx
(18)	86	xxxxxxxxxxxxxxxxx	64	xxxxxxxxxxxxx	36	xxxxxxx
LETTUCE	113	xxxxxxxxxxxxxxxxxxxx +	100	xxxxxxxxxxxxxxxxxxxx	73	xxxxxxxxxxxxxx
(20)	93	xxxxxxxxxxxxxxxxxx	100	xxxxxxxxxxxxxxxxxxxx	50	xxxxxxxxxx
FENUGREK	100	xxxxxxxxxxxxxxxxxxxx	94	xxxxxxxxxxxxxxxxxxxx	100	xxxxxxxxxxxxxxxxxxx
(21)	100	xxxxxxxxxxxxxxxxxxxx	93	xxxxxxxxxxxxxxxxxxxx	64	xxxxxxxxxxxx
SUG BEET	64	xxxxxxxxxxxx	9	xx	9	xx
(22)	43	xxxxxxxxx	14	xxx	14	xxx
BETA VUL	33	xxxxxxx	16	xxx	0	
(23)	36	xxxxxxx	14	xxx	0	
BROM STE	95	xxxxxxxxxxxxxxxxxx	105	xxxxxxxxxxxxxxxxxxx +	75	xxxxxxxxxxxxxx
(24)	100	xxxxxxxxxxxxxxxxxxx	100	xxxxxxxxxxxxxxxxxxx	43	xxxxxxxxx
FEST RUB	67	xxxxxxxxxxxxx	25	xxxxx	12	xx
(25)	71	xxxxxxxxxxxxxx	36	xxxxxxx	21	xxxx
AVE FATU	111	xxxxxxxxxxxxxxxxxx +	86	xxxxxxxxxxxxxxxx	129	xxxxxxxxxxxxxxxxxx +
(26)	64	xxxxxxxxxxxxx	36	xxxxxxx	29	xxxxxx

PRE-EMERGENCE SELECTIVITY TEST

SPECIES		AC 222293 0.1 kg/ha		AC 222293 0.5 kg/ha		AC 222293 2.5 kg/ha
ALO MYOS	61	xxxxxxxxxxxx	55	xxxxxxxxxxx	6	x
(27)	43	xxxxxxxxx	21	xxxx	14	xxx
POA ANN	130	xxxxxxxxxxxxxxxxxxxx +	99	xxxxxxxxxxxxxxxxxxxx	54	xxxxxxxxxx
(28)	100	xxxxxxxxxxxxxxxxxxxx	71	xxxxxxxxxxxxxx	36	xxxxxxx
POA TRIV	56	xxxxxxxxxxx	46	xxxxxxxxx	21	xxxx
(29)	43	xxxxxxxxx	43	xxxxxxxxx	29	xxxxxx
SIN ARV	112	xxxxxxxxxxxxxxxxxxx +	102	xxxxxxxxxxxxxxxxxxx	64	xxxxxxxxxxxx
(30)	50	xxxxxxxxxx	29	xxxxxx	29	xxxxxx
RAPH RAP	89	xxxxxxxxxxxxxxxxx	89	xxxxxxxxxxxxxxxxx	79	xxxxxxxxxxxxxxx
(31)	57	xxxxxxxxxxx	43	xxxxxxxxx	29	xxxxxx
CHRY SEG	100	xxxxxxxxxxxxxxxxxxx	150	xxxxxxxxxxxxxxxxxxx +	125	xxxxxxxxxxxxxxxxxxx +
(32)	79	xxxxxxxxxxxxxxx	64	xxxxxxxxxxxx	29	xxxxxx
TRIP MAR	107	xxxxxxxxxxxxxxxxxx +	71	xxxxxxxxxxxxx	59	xxxxxxxxxxx
(33)	86	xxxxxxxxxxxxxxxx	79	xxxxxxxxxxxxxxx	50	xxxxxxxxxx
SEN VULG	115	xxxxxxxxxxxxxxxxxx +	87	xxxxxxxxxxxxxxxx	129	xxxxxxxxxxxxxxxxxx +
(34)	93	xxxxxxxxxxxxxxxxxx	71	xxxxxxxxxxxxxx	64	xxxxxxxxxxxx
GAL APAR	106	xxxxxxxxxxxxxxxxxx +	100	xxxxxxxxxxxxxxxxxx	87	xxxxxxxxxxxxxxxx
(38)	93	xxxxxxxxxxxxxxxxxx	57	xxxxxxxxxx	36	xxxxxx
CHEN ALB	80	xxxxxxxxxxxxxxx	71	xxxxxxxxxxxxx	77	xxxxxxxxxxxxx
(39)	86	xxxxxxxxxxxxxxxx	43	xxxxxxxxx	29	xxxxxx
STEL MED	90	xxxxxxxxxxxxxxxxx	88	xxxxxxxxxxxxxxxxx	26	xxxxx
(40)	100	xxxxxxxxxxxxxxxxxxx	93	xxxxxxxxxxxxxxxxxx	43	xxxxxxxxx

PRE-EMERGENCE SELECTIVITY TEST

SPECIES		AC 222293 0.1 kg/ha		AC 222293 0.5 kg/ha		AC 222293 2.5 kg/ha
VER PERS	75	xxxxxxxxxxxxxxx	48	xxxxxxxxxx	20	xxxx
(42)	57	xxxxxxxxxxx	21	xxxx	14	xxx
RUM OBTU	146	xxxxxxxxxxxxxxxxxxxx +	85	xxxxxxxxxxxxxxxxx	246	xxxxxxxxxxxxxxxxxxxx +
(44)	93	xxxxxxxxxxxxxxxxxx	50	xxxxxxxxxx	29	xxxxxx
HOLC LAN	43	xxxxxxxxx	43	xxxxxxxxx	26	xxxxx
(45)	14	xxx	14	xxx	7	x
AG REPEN	103	xxxxxxxxxxxxxxxxxxx +	69	xxxxxxxxxxxxxx	0	
(47)	100	xxxxxxxxxxxxxxxxxxx	50	xxxxxxxxxx	0	
ALL VIN	65	xxxxxxxxxxxxx	28	xxxxxx	23	xxxxx
(49)	36	xxxxxxx	29	xxxxxx	14	xxx
CIRS ARV	94	xxxxxxxxxxxxxxxxx	150	xxxxxxxxxxxxxxxxxx +	75	xxxxxxxxxxxxxx
(50)	100	xxxxxxxxxxxxxxxxxx	71	xxxxxxxxxxxxxx	36	xxxxxxx
TUS FARF	95	xxxxxxxxxxxxxxxxx	68	xxxxxxxxxxxxx	0	
(51)	64	xxxxxxxxxxxx	29	xxxxxx	0	
MILLET	110	xxxxxxxxxxxxxxxxxx +	103	xxxxxxxxxxxxxxxxxx +	65	xxxxxxxxxxxx
(55)	100	xxxxxxxxxxxxxxxxxx	93	xxxxxxxxxxxxxxxxx	50	xxxxxxxxx
MAIZE + S	91	xxxxxxxxxxxxxxxxx	104	xxxxxxxxxxxxxxxxxx +	104	xxxxxxxxxxxxxxxxxxx +
(56)	100	xxxxxxxxxxxxxxxxxx	93	xxxxxxxxxxxxxxxxx	79	xxxxxxxxxxxxxxx
MAIZE	100	xxxxxxxxxxxxxxxxxx	100	xxxxxxxxxxxxxxxxxx	75	xxxxxxxxxxxxxx
(57)	93	xxxxxxxxxxxxxxxxx	79	xxxxxxxxxxxxxxx	43	xxxxxxxxx
SORG + S	111	xxxxxxxxxxxxxxxxxx +	98	xxxxxxxxxxxxxxxxxx	85	xxxxxxxxxxxxxxxx
(58)	79	xxxxxxxxxxxxxxx	64	xxxxxxxxxxxx	43	xxxxxxxxx

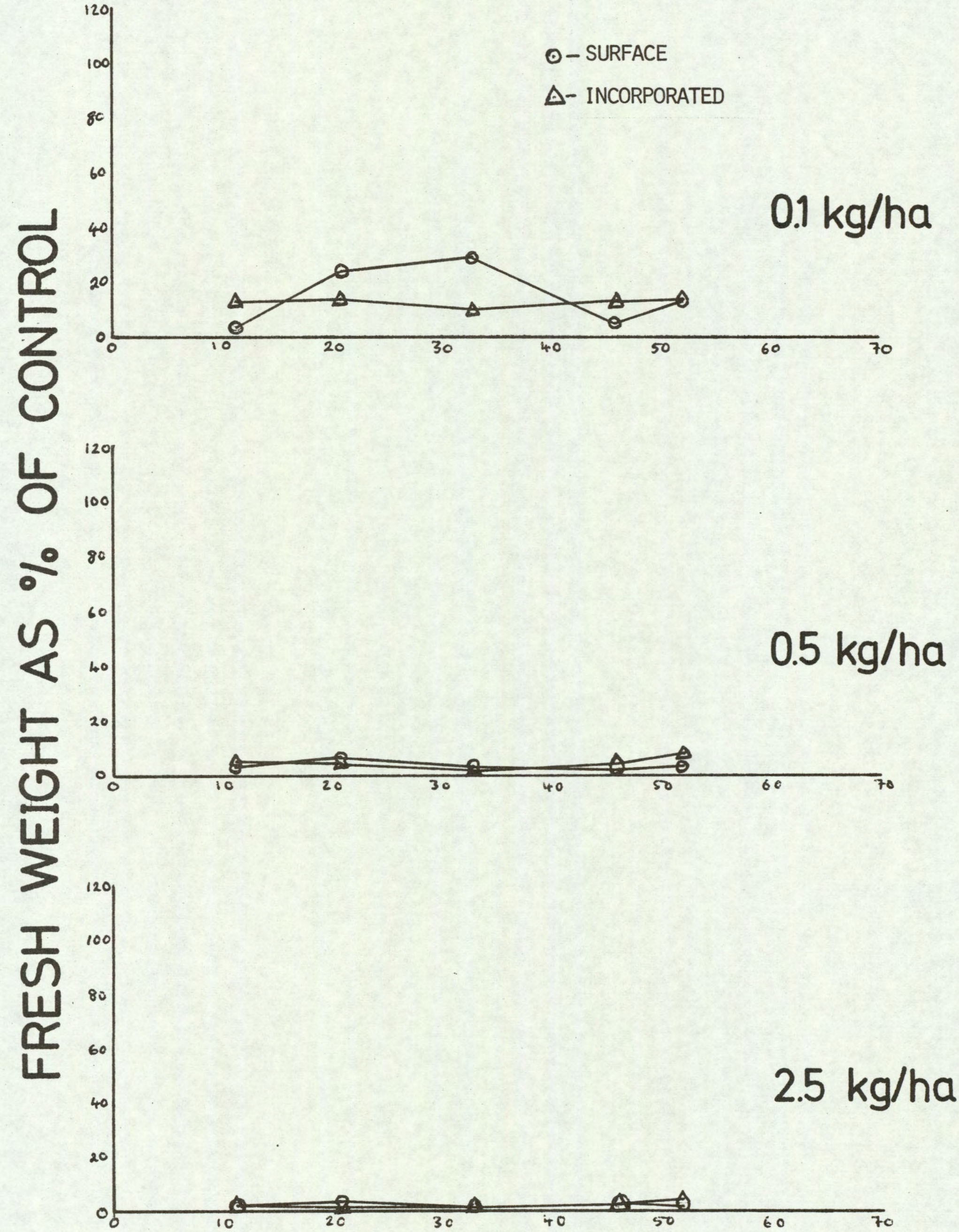
PRE-EMERGENCE SELECTIVITY TEST

SPECIES		AC 222293 0.1 kg/ha		AC 222293 0.5 kg/ha		AC 222293 2.5 kg/ha
SORGHUM	102	xxxxxxxxxxxxxxxxxxxx	102	xxxxxxxxxxxxxxxxxxxx	32	xxxxxx
(59)	64	xxxxxxxxxxxxx	57	xxxxxxxxxxx	29	xxxxxx
RICE	104	xxxxxxxxxxxxxxxxxxx +	115	xxxxxxxxxxxxxxxxxxx +	12	xx
(60)	71	xxxxxxxxxxxxxx	50	xxxxxxxxxx	14	xxx
PIGEON P	43	xxxxxxxxx	171	xxxxxxxxxxxxxxxxxxx +	129	xxxxxxxxxxxxxxxxxxx +
(61)	86	xxxxxxxxxxxxxxxxx	71	xxxxxxxxxxxxxx	43	xxxxxxxxx
COWPEA	108	xxxxxxxxxxxxxxxxxxx +	108	xxxxxxxxxxxxxxxxxxx +	60	xxxxxxxxxxxx
(62)	86	xxxxxxxxxxxxxxxxx	57	xxxxxxxxxxx	43	xxxxxxxxx
CHICKPEA	103	xxxxxxxxxxxxxxxxxxx +	93	xxxxxxxxxxxxxxxxxx	31	xxxxxx
(63)	86	xxxxxxxxxxxxxxxxx	57	xxxxxxxxxxx	36	xxxxxxx
GRNDNUT	75	xxxxxxxxxxxxxxx	75	xxxxxxxxxxxxxxx	56	xxxxxxxxxxx
(64)	100	xxxxxxxxxxxxxxxxxxx	86	xxxxxxxxxxxxxxxxx	64	xxxxxxxxxxxxx
SOYABEAN	120	xxxxxxxxxxxxxxxxxxx +	90	xxxxxxxxxxxxxxxxxx	60	xxxxxxxxxxxx
(65)	86	xxxxxxxxxxxxxxxxx	57	xxxxxxxxxxx	43	xxxxxxxxx
COTTON	78	xxxxxxxxxxxxxxxx	44	xxxxxxxxx	111	xxxxxxxxxxxxxxxxxxx +
(66)	93	xxxxxxxxxxxxxxxxxx	71	xxxxxxxxxxxxxx	64	xxxxxxxxxxxx
JUTE	0		0		0	
(67)	0		0		0	
KENAF	147	xxxxxxxxxxxxxxxxxxx +	133	xxxxxxxxxxxxxxxxxxx +	113	xxxxxxxxxxxxxxxxxxx +
(68)	79	xxxxxxxxxxxxxxxx	64	xxxxxxxxxxxxx	57	xxxxxxxxxxx
SESAMUM	109	xxxxxxxxxxxxxxxxxxx +	61	xxxxxxxxxxxx	7	x
(70)	86	xxxxxxxxxxxxxxxxx	36	xxxxxxx	14	xxx

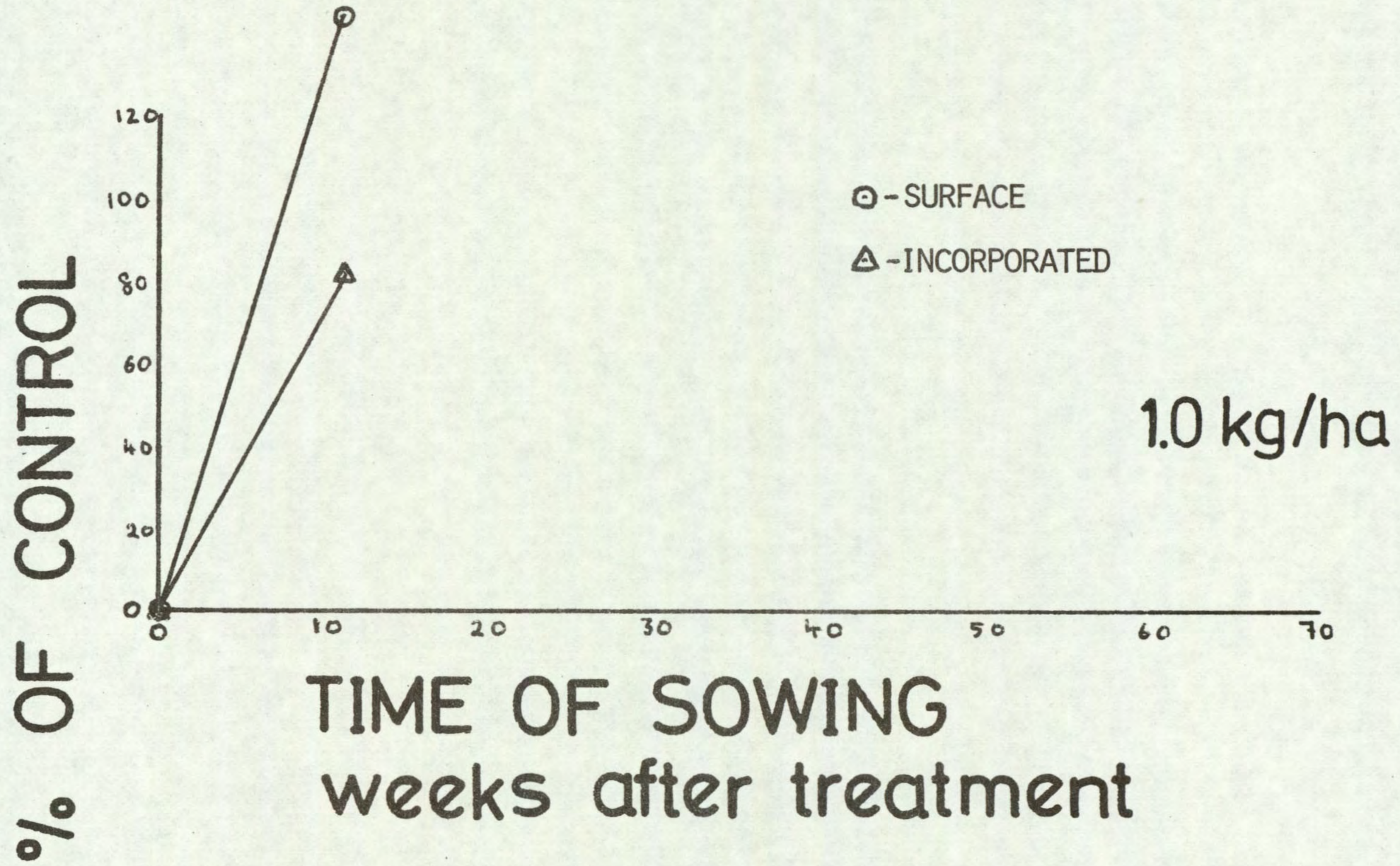
PRE-EMERGENCE SELECTIVITY TEST

SPECIES		AC 222293 0.1 kg/ha		AC 222293 0.5 kg/ha		AC 222293 2.5 kg/ha
TOMATO	117	xxxxxxxxxxxxxxxxxxxx +	58	xxxxxxxxxxxx	0	
(71)	43	xxxxxxxxx	29	xxxxxx	0	
OR BART	97	xxxxxxxxxxxxxxxxxx	102	xxxxxxxxxxxxxxxxxxxx	0	
(73)	64	xxxxxxxxxxxxx	50	xxxxxxxxxx	0	
ECH CRUS	97	xxxxxxxxxxxxxxxxxx	76	xxxxxxxxxxxxxxx	17	xxx
(75)	79	xxxxxxxxxxxxxxx	43	xxxxxxxxx	14	xxx
ROTT EXA	89	xxxxxxxxxxxxxxxxx	108	xxxxxxxxxxxxxxxxxxxx +	103	xxxxxxxxxxxxxxxxxxx +
(76)	100	xxxxxxxxxxxxxxxxxxx	79	xxxxxxxxxxxxxxxx	50	xxxxxxxxxx
DIG SANG	85	xxxxxxxxxxxxxxxxx	28	xxxxxx	45	xxxxxxxxx
(77)	86	xxxxxxxxxxxxxxxxx	71	xxxxxxxxxxxxxx	36	xxxxxxx
AMAR RET	65	xxxxxxxxxxxxx	67	xxxxxxxxxxxxx	54	xxxxxxxxxxx
(78)	100	xxxxxxxxxxxxxxxxxxx	50	xxxxxxxxxx	36	xxxxxxx
BROM PEC	104	xxxxxxxxxxxxxxxxxxx +	82	xxxxxxxxxxxxxxxx	27	xxxxx
(82)	86	xxxxxxxxxxxxxxxxx	79	xxxxxxxxxxxxxxxx	43	xxxxxxxxx
SNO POL	100	xxxxxxxxxxxxxxxxxxx	31	xxxxxx	0	
(83)	64	xxxxxxxxxxxxx	36	xxxxxxx	0	
PHAL MIN	102	xxxxxxxxxxxxxxxxxxx	14	xxx	9	xx
(84)	71	xxxxxxxxxxxxxx	29	xxxxxx	14	xxx
CYP ESCU	83	xxxxxxxxxxxxxxxx	67	xxxxxxxxxxxx	8	xx
(85)	79	xxxxxxxxxxxxxxxx	43	xxxxxxxxx	14	xxx
CYP ROTU	98	xxxxxxxxxxxxxxxxxxx	88	xxxxxxxxxxxxxxxxx	5	x
(86)	64	xxxxxxxxxxxxx	50	xxxxxxxxxx	14	xxx

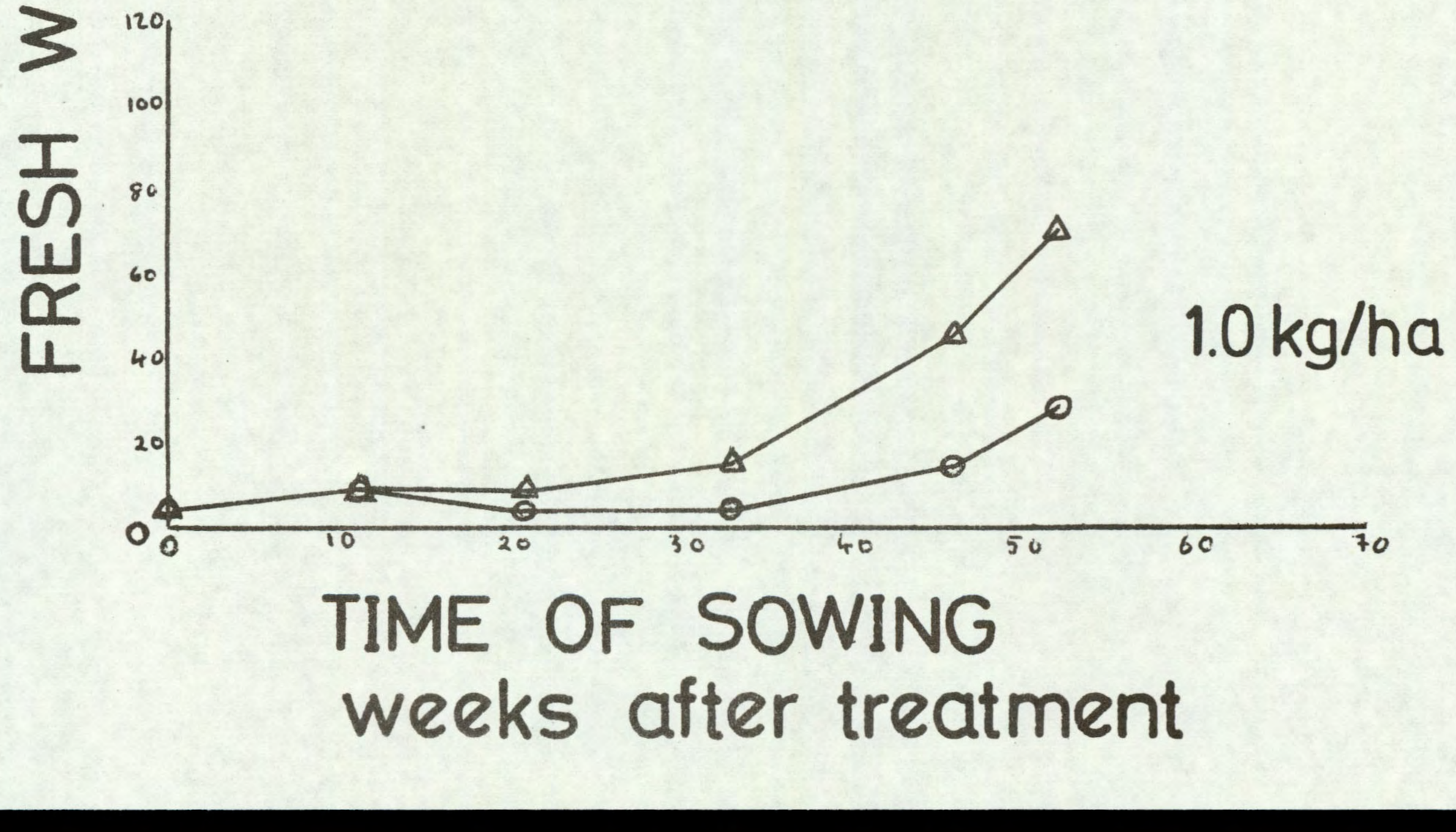
PERSISTENCE OF AC 222293
species: sugar beet



PERSISTENCE OF CYANAZINE
species: perennial ryegrass



PERSISTENCE OF SIMAZINE
species: perennial ryegrass



NB: AC 213087 is confidential (Cyanamid), AC 222293 is imazamethabenz-methyl

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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)
Temperate species					
Wheat (Triticum aestivum)	WHEAT (1)	Maris Huntsman	8	1.0	$7\frac{1}{2}$-$9\frac{1}{2}$ leaves, tillering
Wheat + safener (Triticum aestivum)	WHEAT + S (2)	Maris Huntsman	8	1.0	$7\frac{1}{2}$-$9\frac{1}{2}$ leaves, tillering
Barley (Hordeum vulgare)	BARLEY (3)	Sonja	8	1.0	6-8 leaves, tillering
Barley + safener (Hordeum vulgare)	BARLEY + S (4)	Sonja	8	1.0	6-8 leaves, tillering
Oat (Avena sativa)	OAT (5)	Pennal	8	1.0	8-10 leaves, tillering
Perennial ryegrass (Lolium perenne)	PER RYGR (6)	S 23	15	0.5	7-$11\frac{1}{2}$ leaves, tillering
Onion (Allium cepa)	ONION (8)	Hygro	15	0.5	2-$2\frac{1}{2}$ leaves
Dwarf bean* (Phaseolus vulgaris)	DWF BEAN (9)	Masterpiece	4	2.0	2 trifoliate leaves
Field bean (Vicia faba)	FLD BEAN (10)	Maris Blaze	4	2.0	5-6 leaves
Pea (Pisum sativum)	PEA (11)	Dark Skinned Perfection	4	1.5	8-9 leaves
White Clover (Trifolium repens)	W CLOVER (12)	Milkanova	20	0.5	$2\frac{1}{2}$ trifoliate leaves
Rape (Brassica napus oleifera	RAPE (14)	Rapora	15	0.5	4 leaves
Kale (Brassica oleracea acephala)	KALE (15)	Marrowstem	15	0.5	4-5 leaves
Swede (Brassica napus)	SWEDE (17)	Acme	12	0.5	3-4 leaves

* raised with tropical species until emergence, then transferred to lower temperature regime.

	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)
Carrot (Daucus carota)	CARROT (18)	Chantenay Red Core	10	0.5	3-4½ leaves
Lettuce (Lactuca sativa)	LETTUCE (20)	Reskia	15	0.5	8 leaves
Fenugreek (Trigonella foenumgraecum)	FENUGREK (21)	Paul	10	0.5	5 trifoliate leaves
Sugar beet (Beta vulgaris)	SUG BEET (22)	Nomo	15	1.0	3½ leaves
Beta vulgaris	BETA VUL (23)	WRO 1979	20	0.5	3½ leaves
Bromus sterilis	BROM STE (24)	WRO 1979	12	0.5	7-8 leaves, tillering
Festuca rubra	FEST RUB (25)	Boreal CDN 86-0192	25	0.25	4½-7 leaves, tillering
Avena fatua	AVE FATU (26)	WRO 1978	10	1.0	6-9 leaves, tillering
Alopecurus myosuroides	ALO MYOS (27)	B and S Supplies 1979	25	0.25	3-6½ leaves, several tillering
Poa annua	POA ANN (28)	B and S Supplies 1978	25	0.5	4-6 leaves, some tillering
Poa trivialis	POA TRIV (29)	WRO 1978	25	0.25	5½-7½ leaves, tillering
Sinapis arvensis	SIN ARV (30)	WRO 1978	15	0.5	6 leaves
Raphanus raphanistrum	RAPH RAP (31)	Long Black Spanish	12	0.5	4 leaves
Chrysanthemum segetum	CHRY SEG (32)	WRO 1979	25	surface	6-8 leaves
Tripleurospermum maritium	TRIP MAR (33)	WRO 1978	35	surface	8 leaves

	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)
Senecio vulgaris	SEN VULG (34)	WRO 1979	15	surface	5 leaves
Polygonum lapathifolium	POL LAPA (35)	WRO 1978	15	0.5	nil germination
Polygonum aviculare	POL AVIC (36)	B and S Supplies 1976	50	0.5	nil germination
Galium aparine	GAL APAR (38)	WRO 1978	12	1.0	Up to 16 whorls
Chenopodium album	CHEN ALB (39)	B and S Supplies 1977	30	0.5	6-7 leaves
Stellaria media	STEL MED (40)	B and S Supplies 1979	25	0.5	14 leaves
Veronica persica	VER PERS (42)	WRO 1977	15	0.5	8 leaves
Rumex obtusifolius	RUM OBTU (44)	B and S Supplies 1978	25	0.25	5 leaves
Holcus lanatus	HOLC LAN (45)	B and S Supplies 1977	20	0.5	5-13 leaves, tillering
Agropyron repens	AG REPEN (47)	WRO Clone 31	6/	1.5	8-9 leaves, tillering
Allium vineale	ALL VIN (49)	WRO 1979	12+	1.0	3 leaves
Cirsium arvense	CIRS ARV (50)	WRO Clone 1	4//	1.5	7 leaves
Tussilago farfara	TUS FARF (51)	WRO Clone 1	4/	2.0	4-5 leaves
Tropical species (grown under higher temperature regime)					
Millet (Pennisetum typhoideum)	MILLET (55)	ICRISAT 1977	15	0.5	$5\frac{1}{2}$-6 leaves

	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)
Maize + safener (Zea mays)	MAIZE + S (56)	Julia	4	2.0	5½-6½ leaves
Maize (Zea mays)	MAIZE (57)	Julia	4	2.0	5½-6½ leaves
Sorghum + safener (Sorghum vulgare)	SORG + S (58)	Funk G 268	8	1.0	5½-6 leaves
Sorghum (Sorghum vulgare)	SORGHUM (59)	Funk G 268	8	1.0	5½-6 leaves
Rice (Oryza sativa)	RICE (60)	IR 298	10	1.0	3-3½ leaves
Pigeon pea (Cajanus cajan)	PIGEON P (61)	ICRISAT 1 G 1977	6	1.0	2-4 trifoliate leaves
Cowpea (Vigna unguiculata)	COWPEA (62)	ICRISAT 88-63 1977	5	1.0	3-4 trifoliate leaves
Chickpea (Cicer arietinum)	CHICKPEA (63)	ICRISAT G 62404 1977	6	1.0	½-15 pinnate leaves
Groundnut (Arachis hypogaea)	GRNDNUT (64)	Valencia 1980	5	2.0	Up to 6 pinnate leaves
Soyabean (Glycine max)	SOYABEAN (65)	Fiskby V.	6	1.0	3-4 trifoliate leaves
Cotton (Gossypium hirsutum)	COTTON (66)	Nigeria 26 J	6	2.0	2-4 leaves
Jute (Corchorus olitorius)	JUTE (67)	UAR 1971	15	0.5	3-6 leaves
Kenaf (Hibiscus cannabinus)	KENAF (68)	Ghana A63-440, 1978	12	0.5	4-6 leaves
Sesamum (Sesamum indicum)	SESAMUM (70)	Uganda 1972	20	0.5	4-6 leaves
Tomato (Lycopersicum esculentum)	TOMATO (71)	Ailsa Craig	8	0.5	4-5 leaves
Oryza barthii	OR BART (73)	Upper Volta 1977	10	1.0	4 leaves
Eleusine indica	ELEU IND (74)	WRO 1977	12	0.5	Nil germination

	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)
Echinochloa crus-galli	ECH CRUS (75)	WRO 1976	15	0.5	4-6 leaves
Rottboellia exaltata	ROTT EXA (76)	Zambia 1978	15	0.5	$4\frac{1}{2}$-$5\frac{1}{2}$ leaves
Digitaria sanguinalis	DIG SANG (77)	WRO 1973	15	0.25	4-6 leaves
Amaranthus retroflexus	AMAR RET (78)	WRO 1970	100	0.25	4-6 leaves
Solanum nigrum	SOL NIG (81)	WRO 1977	50	0.25	Nil germination
Bromus pectinatus	BROM PEC (82)	Tanzania 1978	10	0.5	$3\frac{1}{2}$-4 leaves
Snowdenia polystachya	SNO POL (83)	Ethiopia 1978	20	0.5	5-7 leaves
Phalaris minor*	PHAL MIN (84)	India 1977	15	0.25	$3\frac{1}{2}$-4 leaves
Cyperus esculentus	CYP ESCU (85)	WRO Clone 2 (ex South Africa)	8**	2.0	Up to 6 leaves
Cyperus rotundus	CYP ROTU (86)	WRO Clone 1 (Zimbabwe)	6**	2.0	Up to 10 leaves
Oxalis latifolia	OXAL LAT (87)	WRO Clone 2 (Cornwall)	15 bulbs	2.0	Nil germination

* = raised with temperate species until emergence, then transferred to higher temperature regime
** = tubers
/ = one node rhizome fragments
// = 4 cm root fragments
+ = aerial bulbils

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.
cubic centimetre*	cm^3	kilogramme	kg
cubic foot*	ft^3	kilo ($x10^3$)	k
cubic inch*	in^3	less than	<
cubic metre*	m^3	litre	l.
cubic yard*	yd^3	low volume	LV
cultivar(s)	cv.	maximum	max.
curie*	Ci	median lethal dose	LD50
degree Celsius*	^oC	medium volume	MV
degree centigrade	^oC	melting point	m.p.
degree Fahrenheit*	^oF	metre	m
diameter	diam.	micro ($x10^{-6}$)	μ
diameter at breast height	d.b.h.	microgramme*	μg
divided by*	÷ or /	micromicro (pico: $x10^{-12}$)*	μμ
dry matter	d.m.	micrometre (micron)*	μm (or μ)
emulsifiable concentrate	e.c.	micron (micrometre)*†	μm (or μ)
equal to*	=	miles per hour*	mile/h
fluid	fl.	milli ($x10^{-3}$)	m
foot	ft	milliequivalent*	m.equiv.
		milligramme	mg
		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.

WEED RESEARCH ORGANIZATION

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