Project Title:	**The use of contact herbicides on container grown nursery stock overwinter**	
Report:	**Final Report**	
Project Number:	**HNS 70**	
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Coblands Nursery		
Location:	**HRI Efford (Year 1) and Coblands Nursery (Year 2)**	
Project Co-ordinator:	**Mr T Norris, Coblands Nurseries Ltd**	
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PRACTICAL SECTION FOR GROWERS

Objectives and background

Development of weeds overwinter, in the absence of a herbicide programme, or failure of earlier applications to have sufficient longevity or achieve full control, can become a serious problem, especially in milder autumn/winter periods. Weed free containers for potting-on or sale are important, with hand weeding not only costly, but inevitably leaving some weed inoculum behind as a source of contamination for the next stage of production. In addition, labour can account for as much as 40% of container production costs and it is estimated that hand weeding alone can account for 10% of that cost. Consequently, identification of effective control measures for overwintering weeds could significantly reduce labour input, be more thorough and improve pot appearance. However, the range of herbicides with contact action currently available is limited, with little or no information on their safety of use over container nursery stock species.

The potential of a number of chemicals with contact action was identified in a summer herbicide trial (HNS 35f) and these, together with a number of others with known contact action, were included in this work, with the aim of assessing their efficacy and safety of use on overwintered container grown nursery stock. The project was collaborative between HRI Efford, who looked at a wide range of chemicals for efficacy of control of the most important container weeds, and ADAS, who took the most promising treatments from the Efford results and looked at their safety of use over a wider range of HNS species in a commercial nursery situation.

Results

Efficacy Trials – Efford

Following on from the methodology developed in the outdoor herbicide trial HNS 35f, efficacy of chemicals in controlling weeds was tested in 90 mm pots sown with individual weed species, in the absence of nursery plants. Two sowing dates were included, one in late November 1995, the second in late February 1996, with treatments (see Table 1) applied to two stages of weed growth, either at 3-4 or 8 leaf stages. The 3-4 leaf stage trial was fully replicated, with the 8 leaf stage included as an unreplicated observation. The trial was on outdoor sand beds, with scorching and weed death assessed at fortnightly intervals; over a three month period for the winter sowing and over two months for the faster maturing spring sowing.

Weeds:	*Cardamine hirsuta*	(hairy bitter-cress)	*Sagina procumbens*	(pearlwort)
	Senecio vulgaris	(groundsel)	*Epilobium roseum*	(pedicelled willowherb)
	Poa annua	(annual meadow grass)	*Oxalis corniculata*	(second sowing only)

Limited phytotoxicity observations were made in a separate trial using indicator species, *Prunus lusitanica* and *Chamaecyparis lawsoniana* 'Ellwood's Gold'. These plants, potted in 2 litre containers in the spring 1995, received two applications of the range of herbicide treatments, the first in January 1996, the second in April 1996.

Table 1 Treatments and summary of results – HRI Efford

Chemical	Active Ingredient	Supplier of Product	Rate/m^2	Water/m^2	Active Ingredient/ha
Untreated	-		-	-	-
Basagran	bentazone	BASF	0.3 ml	250 ml	1.4 kg
Croptex Bronze	pentanochlor	Hortichem	0.56 ml	250 ml	2.24 kg
Ronstar Liquid	oxadiazon	RP Agic.	0.3 ml	250 ml	0.75 kg
Croptex Steel	sodium Monochloroacetate	Hortichem	2.0 ml	250 ml	19.0 kg
Atlas CIPC 40	chlorpropham	Atlas	0.5 ml	250 ml	2.0 kg
Betanal E	phenmedipham	AgrEvo	0.5 ml	250 ml	0.57 kg
Fortrol	cyanazine	Cyanamid	0.2 ml	250 ml	1.0 kg
Kerb 50 W	propyzamide	PBI	0.34 ml	250 ml	1.7 kg
Nortron	ethofumesate	AgrEvo	0.5 ml	250 ml	0.68 kg
Sovereign	pendimethalin	CIBA Agric.	0.25 ml	250 ml	0.82 kg
Dow Shield	clopyralid	DowElanco	0.035 ml	250 ml	0.07 kg
Diuron 80 WP	diuron	DuPont	0.05 g	250 ml	0.4 kg
Carbetamex	carbetamide	RP Agric.	0.3 g	250 ml	2.1 kg
Armillatox	cresylic acid	Armillatox	4.5 ml	250 ml	13.5 kg
Skirmish 495 SC	isoxaben + Terbuthylazine	CIBA Agric.	0.1 ml	250 ml	0.075 kg 0.42 kg
Goltix WG	metamitron	Bayer	0.3 g	250 ml	2.1 kg
Gesagard 50 WP	prometryn	CIBA Agric.	0.23 g	250 ml	1.15 kg
Atlas Red	chlorpropham + fenuron + cresylic acid	Atlas	2.2 ml	250 ml	4.4 kg 1.1 kg

Chemical	Overall control achieved *(<30% kill) **(31-54% kill) ***(55 – 59% kill) ****(>70% kill)				Phytotoxicity ✔ nil, * some. ** moderate *** severe	
	Overwinter		Spring			
	3-4 leaves	8 leaves	3-4 leaves	8 leaves	*Prunus*	*C.l.* 'Ellwood's Gold'
Basagran	***	**	***	***	*	✔
Croptex Bronze	***	*	**	***	*	✔
Ronstar Liquid	****	*	**	**	**	*
Croptex Steel	****	**	*	**	**	**
Atlas CIPC 40	****	****	**	*	✔	**
Betanal E	***	**	*	***	✔	✔
Fortrol	***	***	****	*	✔	✔
Kerb 50 W	****	****	**	*	✔	✔
Nortron	****	***	*	****	✔	✔
Sovereign	****	*	*	*	✔	✔
Dow Shield	**	*	**	**	*	✔
Diuron 80 WP	****	**	****	***	*	✔
Carbetamex	****	***	*	**	✔	**
Armillatox	***	*	*	*	✔	✔
Skirmish 495 SC	****	**	****	****	✔	✔
Goltix WG	****	***	*	****	✔	*
Gesagard 50 WP	***	**	***	****	*	✔
Atlas Red	****	****	****	****	**	***

Results: Contact herbicide activity varied with weed species, stage of growth and time of year applied. An overall summary of the effectiveness of the range of herbicides used is shown in Table 1, the score being based on mean control achieved across the range of weed species included. Consequently, a herbicide only controlling one or two weed species of the six in the trial would only achieve a moderate score; while those knocking out 4 or more weed species would receive the higher score. Main conclusions from the first years work are as follows:-

- Some herbicides, while giving good weed control proved too phytotoxic (***Ronstar Liquid, Croptex Steel, Atlas Red***).

- Mode of herbicide action varied from scorch and gradual kill of weeds over time (***Kerb 50W, Nortron***), to a rapid knockdown (***Ronstar Liquid, Croptex Steel, Atlas Red***), and those where weeds recovered after an initial scorch (***Betanal E***).

- While effects of herbicides were slower to show over the winter, a greater degree of control was achieved with the annual meadow grass and pearlwort over this period than from the Spring applied herbicides where weed growth would be faster.

- In general the 3-4 leaf stage of weed growth proved easier to kill than the 8 leaf stage, though there were exceptions, particularly with ***Nortron*** and ***Goltix WG***.

- Control of pearlwort, hairy bitter-cress and willowherb was achieved with ***Basagran, Diuron 80 WP, Skirmish 495 SC*** and ***Gesagard 50 WP***.

- Oxalis was killed out by ***Nortron*** and ***Diuron 80 WP***.

- Groundsel was more difficult to eradicate, with only ***Dow Shield*** giving control at both the 3-4 and 8 leaf stages, though ***Nortron*** killed out the 8 leaf stage and ***Fortrol*** produced good results at the 3-4 leaf stage.

- Annual meadow grass also proved difficult to kill, particularly the faster maturing Spring germination where little control was achieved with any herbicide. ***Kerb 50W*** and ***Carbetamex*** gave good control over the winter period at both 3-4 and 8 leaf stages.

Phytotoxicity Trials – ADAS

Using the most effective but least phytotoxic contact herbicides identified in the Efford work, the second phase of the programme was based on a commercial nursery with an extended range of HNS subjects in order to monitor phytotoxicity more closely. Five herbicide programmes were used, the first application of each programme occurred in November 1996, the second in March 1997. The low natural weed colonisation was 'topped up' with a small amount of weed seed of the six species used at Efford, introduced on two occasions, October 1996 and February 1997.

Herbicide treatments:	November 1996	March 1997
1.	Untreated control	Untreated control
2.	Skirmish (0.1 ml/m^2)	Skirmish (0.1 ml/m^2)
3.	Atlas CIPC 40 (0.5 ml/m^2)	Basagran (0.3 ml/m^2)
4.	Carbetamex (0.3 g/m^2)	Diuron Flowable (0.08 ml/m^2)
5.	Kerb 50 W (0.34 g/m^2)	Gesagard 50 WP (0.23 g/m^2)
6.	Nortron (0.5 ml/m^2)	Nortron (0.5 ml/m^2)

HNS species	Stage of Growth	
	1st herbicide application (Nov)	2nd herbicide application (Mar)
Azalea 'Strawberry Ice'	Dormant	Buds swelling
Bergenia cordifolia	Mostly dormant	New leaf and first flower
Buddleia davidii 'Pixie Red'	Some shoot activity	New shoot growth (2-3 cm)
Chamaecyparis lawsoniana 'Ellwoodii'	Growth still 'soft'	Dormant
Cornus alba	Dormant	New shoots starting growth
Euonymus fortunei	Reddish winter colour	Few plants with new shoots
Forsythia 'Lynwood'	Leaves still present	In flower, starting shoot growth
Mahonia 'Charity'	Flower bud development	In flower
Prunus laurocerasus 'Otto Luyken'	Plant growth slow	Shoot growth starting
Thuya plicata	Dormant	Dormant
Viburnum tinus	Close to flower	In flower, start of shoot growth
Weigela 'Bristol Ruby'	Dormant	New shoot growth starting

Results: None of the herbicide programmes eradicated the weed population as effectively as in the Efford programme, possibly due in part to difficulties in achieving good spray cover over the pot surface as a result of obstruction from the plant canopy, (even though the spray was directed), and weed development which ranged from newly emerged seedlings to developed flowering weeds. Nevertheless the potential of a number of treatments was demonstrated (Table 2).

Table 2

Treatment	Short Term Weed Eradication	Long Term Weed Suppression	Moss/ Liverwort Control	Phytotoxic Damage	Growth Reduction
	*poor **moderate ***good			*Transient chlorosis **Chlorosis sustained ***Tip die back	
Skirmish	*	**	**	-	-
Atlas CIPC 40	*	**	*	-	-
Basagran	**	**	**/***	***	-
Carbetamex	*	**	*/**	-	-
Diuron Flowable	**	**	***	*	-
Kerb 50W	*	*/**	*/**	-	-
Gesagard 50 WP	**	*	**/***	*	-
Nortron	**	**	*/**	-	-

- Few phytotoxicity symptoms were seen over the period of the trial. By April, when *Buddleia* broke dormancy, a transient leaf tip/edge chlorosis was seen in the ***Atlas CIPC 40/Basagran***, ***Carbetamex/Diuron Flowable*** and ***Kerb 50 W/Gesagard 50 W*** treatments. By June/July, chlorosis of leaf tips of *Chamaecyparis lawsoniana* 'Ellwoodii' and shoot tip dieback of *Thuja plicata* was observed in the ***Atlas CIPC 40/Basagran*** programme.

- Although weed pressure was relatively light, there was a steady increase in weeds in the untreated control plots compared with those receiving the herbicide programmes.

- The winter application of ***Skirmish 495 SC, Atlas CIPC 40, Carbetamex, Kerb 50W*** and ***Nortron*** only produced a small initial reduction in weed growth, but appeared to limit further germination such that weed pressure had not increased by March 1997.

- The most effective herbicides were the March applied ***Basagran*** (following Atlas CIPC 40) and ***Gesagard 50 WP*** (following Kerb 50 W), closely followed by ***Diuron Flowable*** (after Carbetamex) and then ***Nortron*** (following Nortron), where a noticeable reduction in weed number occurred during April/May. Weed numbers were again increasing by June/July, though they were still far less than in the untreated control. The ***Skirmish*** programme also appeared to have a residual influence, limiting weed germination compared to the control

- ***Diuron Flowable***, applied in the Spring, eradicated existing moss and liverwort, and provided long term control. ***Gesagard 50 WP*** and ***Basagran*** provided reasonable short term control.

Results from the two years work has identified a number of herbicides as having potential for contact action and suppression of further weed germination, with relatively low phytotoxicity over the majority of the limited number of species screened. The contact action achieved in the commercial trial was disappointing, especially under low weed pressure, and a number of factors were identified which may help account for this, including herbicide distribution and a wide range of weed growth stages present. In addition, many of the herbicides were applied at reduced or lowest rate 'recommended' in order to maximise crop safety, which may have reduced their contact activity. It is also recognised that high organic matter levels can reduce the effectiveness and persistence of some herbicides. The relatively low phytotoxicity observed could therefore warrant further trialling at increased rates of herbicides.

Action points for growers

Results from the two years are of sufficient promise to consider further ***SMALL SCALE*** trialling on nurseries. The following points provide some guidelines to obtaining the most effective results from use of contact herbicides, particularly overwinter.

- Maintain an effective weed control programme over the full growing season which will carry over into the late autumn/early winter.

- Apply a 'contact' herbicide programme once weed regrowth starts. The earlier the stage of weed growth treated, the more effective the programme is likely to be. The herbicide should also have a residual effect in reducing further weed germination.

- Ensure an adequate herbicide distribution over the weeds, using a directed spray. This may require an increase in volume of water used over a given area. (e.g. from 1200 l/ha to 2500 l/ha), and is a subject for further work.

- A number of herbicides appear to have promise, depending on time of year, and weed species to be controlled.

Winter	Annual meadow grass	Kerb 50 W, *Atlas CIPC 40, Carbetamex
	Pearlwort	*Basagran, Kerb 50 W, *Atlas CIPC 40, Diuron, Skirmish, Fortrol
Spring	Annual meadow grass	Kerb 50 W
	Pearlwort, Bitter-Cress, Willowherb	*Basagran, Diuron, Skirmish, Gesagard 50 WP
	Groundsel	Fortrol, Dow Shield
	Oxalis (*corniculata*)	Fortrol, Kerb 50 W, Diuron, Skirmish
	Moss/Liverwort	Diuron (*Basagran and Gesagard gave short term control)

*Potential phytotoxicity with conifers, further investigation required.

Trial initially with rates used in the HDC work, but extend range of HNS species to monitor for phytotoxicity. Based on results obtained, a more effective programme might then be developed from trialling somewhat higher rates of certain herbicides for specific problems.

Practical and financial benefits from study

Weeds which establish overwinter in container HNS are a major problem, and the only recourse until now has been hand weeding, since pots are required clean at point of sale. Hand weeding is an expensive option, and it is estimated to be 30-40 times more costly than herbicide spray programmes. In addition, weed inoculum can be left behind following hand weeding, acting as the source for the next flush of weeds. Consequently, a contact herbicide programme would have distinct financial benefits over hand weeding prior to sale, both in eradication of existing weed and reducing further germination.

This work has not yet reached a stage for specific guidelines to be produced, since, while efficacy work in year 1 demonstrated the potential of a number of herbicides with contact action, extrapolation of the best treatments to a commercial nursery in year 2 did not achieve as good a result. Nevertheless, results taken overall were considered to be of sufficient interest for further small scale nursery trialling to be undertaken over a wider range of HNS species to monitor for phytotoxicity and contact activity.

INTRODUCTION

Development of weeds over winter, in the absence of a herbicide programme, or failure of earlier applications to have sufficient longevity or achieve full control, can become a serious problem, especially in milder autumn/winter periods, with hand weeding usually the only option. Late season weed build up may also occur, despite a routine herbicide programme over the growing season, if resistant weed strains occur, weed pressure is too great, the herbicide programme adopted does not control a specific weed species, or is less effective due to extreme weather conditions following application.

Weed free pots are essential for potting on or at point of sale, and hand weeding is not only a costly and time consuming operation, but inevitably leaves some inoculum behind as a source of contamination for the next stage of production, as well as removing relatively large quantities of media if left too late.

It is estimated that labour costs can be 40% of container production costs and that hand weeding alone can account for 10% of that cost. Consequently, identification of effective control measures for over-wintering weeds could significantly reduce labour input, improve pot appearance and be more thorough.

The potential of a number of chemicals with contact action was identified in a summer herbicide trial (HNS 35f). These, together with a number of others with known contact action, were included in this project, with the aim of assessing their efficacy and safety of use on overwintered container grown hardy nursery stock.

The project was collaborative between HRI Efford and ADAS. HRI Efford looked at a wide range of chemicals for efficacy of control of the more important container weeds in the first year (1995/96). ADAS then took the most promising treatments and, in collaboration with HRI, developed five weed control programmes to assess their safety and effectiveness over a wider range of HNS species on a commercial nursery (Coblands Nurseries Ltd), in the second year (1996/97).

Project Objective: To identify effective, safe, chemical control measures for overwintering weeds in container grown hardy nursery stock by comparing a number of herbicides with known contact action.

SECTION A

YEAR 1

HRI EFFORD

MATERIALS AND METHODS

Production System

Following on from the methodology developed in the outdoor herbicide trial HNS 35f, efficacy of chemicals in controlling weeds was tested on pots sown with individual weed species, in the absence of nursery plants. The phytotoxicity observations were a separate assessment using a limited number of HNS species, potted in the spring of 1995, in 2 litre containers.

The weed pots and container nursery stock were grown on outdoor sand beds, with overhead irrigation for the limited periods required.

Weed Species

Cardamine hirsuta (hairy bitter-cress)
Epilobium roseum (pedicelled willowherb)
Poa annua (annual meadow grass)
Sagina procumbens (pearlwort)
Senecio vulgaris (groundsel)
Oxalis corniculata (in second sowing only)

Container Nursery Stock Species

Prunus lusitanica
Chamaecyparis lawsoniana 'Ellwood's Gold'

Start Material

The weed seeds were bought from Herbiseed, (The Nurseries, Billingbear Park, Wokingham, RG11 5RY). The container nursery stock species were bought in from Hillier Nurseries Ltd.

Pot Size

The weed seeds were sown into 90 mm pots.

The nursery stock species were bought in in 2 litre containers.

Growing Medium: 100% Irish sphagnum peat (medium baled)
5.0 kg/m^3 Osmocote Plus 8-9 months
1.5 kg/m^3 Magnesian Limestone

Treatments

Chemical	Active Ingredient	Supplier of Product	Rate/m^2	Water/m^2	Active Ingredient/ha
Untreated	-		-	-	-
Basagran	bentazone	BASF	0.3 ml	250 ml	1.4 kg
Croptex Bronze	pentanochlor	Hortichem	0.56 ml	250 ml	2.24 kg
Ronstar Liquid	oxadiazon	RP Agric.	0.3 ml	250 ml	0.75 kg
Croptex Steel	sodium monochloroacetate	Hortichem	2.0 ml	250 ml	19.0 kg
Atlas CIPC 40	chlorpropham	Atlas	0.5 ml	250 ml	2.0 kg
Betanal E	phenmedipham	AgrEvo	0.5 ml	250 ml	0.57 kg
Fortrol	cyanazine	Cyanamid	0.2 ml	250 ml	1.0 kg
Kerb 50 W	propyzamide	PBI	0.34 ml	250 ml	1.7 kg
Nortron	ethofumesate	AgrEvo	0.5 ml	250 ml	0.68 kg
Sovereign	pendimethalin	CIBA Agric.	0.25 ml	250 ml	0.82 kg
Dow Shield	clopyralid	DowElanco	0.035 ml	250 ml	0.07 kg
Diuron 80 WP	diuron	DuPont	0.05 g	250 ml	0.4 kg
Carbetamex	carbetamide	RP Agric.	0.3 g	250 ml	2.1 kg
Armillatox	cresylic acid	Armillatox	4.5 ml	250 ml	13.5 kg
Skirmish 495 SC	isoxaben + terbuthylazine	CIBA Agric.	0.1 ml	250 ml	0.075 kg 0.42 kg
Goltix WG	metamitron	Bayer	0.3 g	250 ml	2.1 kg
Gesagard 50 WP	prometryn	CIBA Agric.	0.23 g	250 ml	1.15kg
Atlas Red	chlorpropham + fenuron + cresylic acid	Atlas	2.2 ml	250 ml	4.4 kg 1.1 kg

Chemical Suppliers

AgroEvo UK Crop Protection Ltd	East Winch Hall, East Winch, Kings Lynn, Norfolk PE32 1HN Tel: (01553) 841581
Armillatox Ltd	121 Main Road, Morton, Alfreton, Derbyshire DE55 6HL Tel: (01773) 590566
Atlas Crop Protection Ltd	PO Box 38, Low Moor, Bradford, West Yorks BD12 0JZ Tel: (01274) 693707
BASF plc	Agriculture Division, PO Box 4, Earl Road, Cheadle Hulme, Cheadle, Cheshire SK8 6OG Tel: (0161) 485 6222
Bayer plc	Crop Protecton Business Group, Eastern Way, Bury St Edmunds, Suffolk IP32 7AH Tel: (01284) 763200
Ciba Agriculture	Whittlesford, Cambridge CB2 4QT Tel: (01223) 833621
Cyanamid of Great Britain Ltd	Crop Protection Division, Cyanamid House, Fareham Road, PO Box 7, Gosport, Hants PO13 0AS Tel: (01329) 224000
DowElanco Ltd	Latchmore Court, Brand Street, Hitchin, Herts SG5 1HZ Tel: (01462) 457272
DuPont (UK) Ltd	Agriculture Products Division, Wedgwood Way, Stevenage, Herts SG1 4QN Tel: (01438) 734000
Hortichem Ltd	16 Mills Way, Boscombe Down Business Park, Amesbury, Wilts SP4 7RX Tel: (01980 676500)
PBI	Pan Britannica Industries Ltd, Britannica House, Waltham Cross, Herts EN8 7DY Tel: (01992) 623691
RP Agric.	Rhone-Poulenc Agriculture Ltd, Fyfield Road, Ongar, Essex CM5 0HW Tel: (01277) 301301

Start Date

There were two sowings for the trial:

Sowing 1 - Weed seeds were sown under glass into 90 mm pots in carrier trays on 29 November 1995. Double the number of pots required were sown to enable selection for uniformity and weed number. Once germinated, they were moved on 20 December 1995 to a sand bed in a net-sided polytunnel to develop to the 3-4 leaf stage. The required number of pots for each species were selected and laid out on the outdoor sand bed on 25 January 1996. Treatments were applied on 26 January 1996. The remaining pots of weeds were left to develop to the 8 leaf stage before being selected for the observation section of the trial. These were laid out and sprayed on 6 March 1996.

Sowing 2 - Methodology was the same as for the first sowing. Seeds were sown on 29 February 1996 (*Oxalis* on 8 March 1996) and moved to the polytunnel on 4 March 1996. Pots were moved outdoors and treatments applied to the 3-4 leaf stage on 10 April 1996 and the 8 leaf stage on 26 April 1996.

Phytotoxicity observation on container nursery stock - Plants bought-in in late October 1995 and held outdoors, received the first spray application on 30 January 1996, the second on 17 April 1996.

Design

The 3-4 leaf stage weed trial was laid out in four replicate blocks with 3 pots/treatment fully randomised within each weed species.

The 8 leaf stage weed trial and the nursery stock phytotoxicity trial were both unreplicated observations.

Plans for all three trials are given in Appendix I, pages 49 to 55.

Records

1.	3-4 leaf and 8 leaf stage weed trials:	Count of weeds germinated in pots prior to treatment application. Weed growth, scorch and death monitored at 2-3 week intervals throughout trial.
2.	HNS phytotoxicity:	Phytotoxicity symptoms recorded both over the winter and as the spring flush of growth appeared.
3.	Photographs as appropriate.	

Statistical Analysis

Results of the 3-4 leaf stage weed trial were analysed using Standard Analysis of Variance (ANOVA). The degrees of freedom (d.f.), standard error (SED) and least significant difference at 5% (LSD), on which the significance tests were based, are presented in the tables to aid interpretation of the results.

RESULTS

The level of weed control achieved varied not only with chemical used but also with season, weed species and stage of growth of the weed. On occasion, the results tables indicate a decrease in the number of dead weeds compared to the previous record. In reality, this reflected the difficulty of determining whether a weed seedling was actually dead or merely severely scorched, a condition from which species such as annual meadow grass regularly recovered.

First Sowing

3-4 leaf stage (Replicated Trial) *Treatment Application Date: 26 January 1996*

Severe frosts in January, together with heavy snow in February, killed the hairy bitter-cress, willowherb and groundsel just after the first weed count was taken. Annual meadow grass and pearlwort were also affected by the weather, but here sufficient seedlings survived to enable an assessment of the effectiveness of the chemical treatments to be made.

Poa annua (annual meadow grass) (Table 15 in Appendix II, pp 56-57)

By the first record, 18 days after treatment, ***Ronstar Liquid***, ***Armillatox*** and ***Atlas Red*** plots had significantly more scorching than the untreated control, with significantly more seedling deaths also occurring where ***Armillatox*** and ***Atlas Red*** had been used.

By the second record, one month after treatment application, the severe weather had to some extent masked effects of the chemicals, all plots now showing a marked degree of scorching. Nevertheless, seedling deaths continued to increase in the ***Ronstar Liquid***, ***Armillatox*** and ***Atlas Red*** plots, and were showing a significant increase in ***Croptex Steel*** and ***Goltix WG*** plots as well.

Annual meadow grass seedling deaths had increased further by the third record, taken 8 weeks after treatments were applied, with ***Croptex Steel*** the most effective at this stage having given over 98% control, followed by ***Ronstar Liquid*** and ***Atlas Red*** with over 75% control, and ***Armillatox*** and ***Goltix WG*** achieving over 50% control. Significant foliage scorching was also recorded in plots treated with ***Atlas CIPC 40***, ***Kerb 50 W***, ***Norton***, ***Sovereign*** and ***Carbetamex***.

Records taken 3 and 4 months after treatments were applied showed that 5 chemicals had given complete, or almost complete control of young annual meadow grass seedlings, namely ***Croptex Steel***, ***Atlas CIPC 40***, ***Kerb 50 W***, ***Carbetamex*** and ***Atlas Red***. Around 80% control was achieved with ***Ronstar Liquid***, ***Norton*** and ***Goltix WG***. ***Sovereign*** and ***Skirmish 495 SC*** also gave a significant reduction in seedling survival, but only around the 60% level.

Sagina procumbens (pearlwort) (Table 16 in Appendix II, pp 58-59)

Evidence of scorching/death of seedling pearlwort was seen at the first record, 18 days after spraying, in the ***Croptex Steel*** and ***Armillatox*** treatments. Two weeks later, at the second record, control in ***Croptex Steel*** treated plots was significantly ahead of other treatments with 98% of the seedlings dead. Good control was also being achieved in ***Fortrol***, ***Gesagard 50 WP*** and ***Atlas Red*** where 80% of the seedlings had been killed. ***Betanal E***, ***Diuron 80 WP***, ***Armillatox***, ***Skirmish 495 SC*** and ***Goltix WG*** also demonstrated some control of this weed species with a 60-70% kill being achieved.

Three weeks later, the third record showed that ***Skirmish 495 SC*** was now controlling the pearlwort as effectively as ***Croptex Steel***, both giving almost complete control. These were followed by ***Fortrol***, ***Diuron 80 WP***, ***Gesagard 50 WP*** and ***Atlas Red*** where good control was achieved (>80%), although significantly less than with ***Croptex Steel*** or ***Skirmish 495 SC***. A reasonable kill was also achieved by use of ***Basagran***, ***Croptex Bronze***, ***Betanal E*** and ***Armillatox***, but only in the order of 60-70%, significantly behind the other chemicals identified.

By the fourth record, 3 months after treatments were applied, 4 chemicals had given in excess of 95% control of the pearlwort seedlings, namely ***Croptex Steel***, and ***Atlas CIPC 40*** (where over 45% of the seedlings had died since the third record a month earlier), ***Kerb 50 W*** and ***Skirmish 495 SC***, closely followed, as at the third record, by ***Fortrol***, ***Gesagard 50 WP*** and ***Atlas Red*** with over 80% control, but joined by ***Croptex Bronze*** and ***Nortron***, where over 40% of the seedlings had died since the previous record. ***Armillatox*** was still only giving around 75% control, a similar figure to that recorded two months earlier.

The final record in May 1996, 4 months after treatments were applied, showed that complete control of pearlwort was achieved with ***Atlas CIPC 40***, ***Skirmish 495 SC*** and ***Atlas Red***, closely followed by ***Croptex Steel***, ***Kerb 50 W*** and ***Nortron*** where the kill was in excess of 95%. Reasonable control was also given by ***Basagran***, ***Fortrol***, ***Sovereign***, ***Diuron 80 WP*** (>80% kill), closely followed by ***Croptex Bronze*** and ***Gesagard 50*** (>75% kill).

8 leaf stage (Observation Trial) *Treatment Application Date: 6 March 1996*

Poa annua (annual meadow grass) (Table 17 in Appendix II, p 60)

Three weeks after treatment application ***Croptex Steel*** and ***Betanal E*** had caused high levels of scorching of annual meadow grass seedlings. However, where ***Betanal E*** had been applied seedlings had made a good recovery by the next record, with very few actually dying. The high scorch levels with ***Croptex Steel*** did not always translate into control, with only 30% of the seedlings dead by the end of the trial. ***Goltix WG*** and ***Armillatox*** also caused increased scorching of the annual meadow grass foliage, but as with ***Croptex Steel***, only around 25-30% of the seedlings died. With ***Ronstar Liquid*** seedlings appeared to recover from an initial scorch and very few deaths were recorded over the period of the trial.

The most effective chemicals in this observation were ***Kerb 50 W*** and ***Carbetamex*** where foliage scorch gradually increased followed by 100% seedling death by the final assessment. ***Atlas Red*** also gave excellent control (98%), and effects of treatment were more rapid with this chemical, seedling control having been achieved by the second record, 7 weeks after application.

Leaf scorch increased over time in response to ***Atlas CIPC 40*** application, and by the end of the trial, 11 weeks after treatments were applied, over 70% of the seedlings had been killed out.

Nortron had a limited effect in controlling growth of seedlings at this 8 leaf stage, with around a 50% kill by the end of the trial.

Sagina procumbens (pearlwort) (Table 18 in Appendix II, p 61)

The first assessment, three weeks after treatments were applied, showed 70% control of pearlwort seedlings by ***Fortrol***, ***Skirmish 495 SC***, ***Goltix WG*** and ***Atlas Red***, closely followed by ***Diuron 80 WP*** and ***Gesagard 50 WP*** (>60% kill), then ***Betanal E*** (50% kill).

Eight weeks post application complete, or in excess of 98% control, was shown by ***Skirmish 495 SC***, ***Atlas Red*** and ***Fortrol***, followed by ***Goltix WG***, ***Basagran***, ***Diuron 80 WP*** and ***Gesagard 50 WP*** (>80% kill). ***Betanal E*** continued to show some activity against pearlwort seedlings along with ***Atlas CIPC 40*** and ***Kerb 50 W*** with >60% control at this stage.

By the final assessment almost 50% of the untreated seedlings had died in the control plots, probably the result of the frost and snow experienced in the earlier part of the year as discussed earlier. Nevertheless, some of the treatment effects appeared striking, even when taking the plant loss in the control plots into account. As at the second assessment, complete or almost complete control was achieved with ***Skirmish 495 SC***, ***Atlas Red*** and ***Fortrol***, closely followed by ***Goltix WG*** (>90% kill). Similarly ***Basagran***, ***Diuron 80 WP*** and ***Gesagard 50 WP*** finished with over an 80% kill of the seedlings, and ***Kerb 50 W*** continued to improve over time, achieving 85% control by the end of the trial. Around a 70% kill of the seedlings had also been achieved by ***Atlas CIPC 40***, ***Betanal*** and ***Nortron*** where a response to treatment was late to show.

Second Sowing

3-4 leaf stage (Replicated Trial) *Treatment Application Date: 10 April 1996*

Cardamine hirsuta (hairy bitter-cress) (Table 19 in Appendix III, p 62)

Seven weeks after the application of the treatments several chemicals showed potential for control of this weed species, with severe foliage scorch and the start of seedling deaths occurring in ***Basagran***, ***Croptex Bronze***, ***Ronstar Liquid***, ***Fortrol***, ***Diuron 80 WP***, ***Skirmish 495 SC***, ***Gesagard 50 WP*** and ***Atlas Red*** plots.

By the second record complete eradication had been achieved by ***Basagran***, ***Fortrol***, ***Diuron 80 WP***, ***Skirmish 495 SC*** and ***Atlas Red***, closely followed by ***Gesagard 40 WP*** and ***Croptex Bronze***.

The final record confirmed the result, ***Diuron 80 WP***, ***Skirmish 495 SC*** and ***Atlas Red*** having eradicated the hairy bitter-cress, with ***Basagran***, ***Croptex Bronze***, ***Fortrol*** and ***Gesagard 50 WP*** also giving excellent control, only leaving a couple of seedlings alive. The early promise of ***Ronstar Liquid*** did not translate into complete seedling eradication, only a 50% control being achieved by the end of the trial.

Epilobium roseum (pedicelled willowherb) (Table 20 in Appendix III, p 63)

Promising control of this troublesome weed was shown by ***Ronstar Liquid*** as early as 15 days after treatment application.

Seven weeks after application, ***Basagran***, ***Dow Shield*** and ***Diuron 80 WP*** had completely controlled this willowherb seedlings. ***Croptex Bronze***, ***Ronstar Liquid***, ***Skirmish 495 SC***, ***Gesagard 50 WP*** and ***Atlas Red*** were all giving good control at this stage (>90% kill), with ***Fortrol*** and ***Sovereign*** also giving over 80% control. This pattern of results was maintained through to the third and final record.

This weed species showed some sensitivity to ***Atlas CIPC 40***, ***Betanal E***, ***Fortrol***, and ***Kerb 50 W***, but only to the extent of around 60% control.

Although ***Nortron*** had shown promise at the second record by scorching virtually all the seedlings present, the majority had recovered by the final assessment.

Poa annua (annual meadow grass) (Table 21 in Appendix III, p 64)

While ***Ronstar Liquid*** had scorched 100% of the annual meadow grass seedlings by the first assessment, at the third record, six weeks later, all the seedlings had recovered.

Significant foliage scorching had also occurred at the first assessment where ***Atlas Red***, ***Carbetamex***, ***Fortrol***, ***Croptex Steel*** and ***Skirmish 495 SC*** had been applied, but this only resulted in significant seedling deaths at the second assessment with ***Skirmish 495 SC***, ***Atlas Red*** and ***Fortrol***. A relatively small but significant number of seedling deaths was also occurring where ***Kerb 50 W*** had been used.

The effects of ***Kerb 50 W*** again improved over time and by the final assessment this herbicide had eradicated over 80% of the seedlings present, significantly ahead of ***Skirmish 495 SC,*** where only 62% of the seedlings had died, or ***Atlas Red*** which achieved a 50% control. ***Fortrol*** had not improved on its performance at the second assessment only giving around 30% control.

Sagina procumbens (pearlwort) (Table 22 in Appendix III, p 65)

The pattern and degree of control of this weed species by the different herbicides was established by the second record and remained unchanged in the third and final record. Complete control was given by ***Skirmish 495 SC*** and ***Gesagard 50 WP***, with ***Basagran***, ***Fortrol***, ***Diuron 80 WP*** and ***Atlas Red*** giving 99% control. All other treatments gave no better than a 50% control.

Senecio vulgaris (groundsel) (Table 23 in Appendix III, p 66)

Ronstar Liquid and ***Sovereign*** scorched a high percentage of groundsel seedlings initially but most of these recovered and ultimately less than 40% were killed by these two treatments. ***Dow Shield*** also caused severe scorch of seedlings by the first record, but here complete control was achieved by the second, eight weeks after application. ***Fortrol*** also appeared effective against groundsel seedlings, killing out the majority by the second assessment.

Other treatments were significantly poorer, with ***Basagran*** only giving 60% control and ***Betanal E***, ***Gesagard 50 WP*** and ***Atlas Red*** only around a 50% kill.

Oxalis corniculata (Table 24 in Appendix III, p 67)

By the third and final record, two months after the chemicals had been applied, only ***Kerb 50 W*** had managed to control this *Oxalis* completely, although ***Diuron 80 WP*** and ***Atlas Red*** came a very close second, killing 99% and 97% of the seedlings respectively. Control of 90% or over was also achieved with ***Skirmish 495 SC*** and ***Fortrol***. ***Ronstar Liquid*** appeared to have given total eradication by the first assessment, but a few seedlings subsequently grew back, giving this treatment an 87% control overall. Control achieved with ***Dow Shield*** had increased to 70% by the end of the trial, with ***Betanal E*** only just behind.

Despite ***Goltix WG*** initially scorching 100% of the *Oxalis* seedlings by the first record, most had recovered by the second assessment and only 7% were dead at the end of the trial. Early scorching in ***Nortron*** treated plots had also disappeared by the end of the trial. Similarly, scorch following application of ***Basagran***, ***Croptex Bronze***, ***Croptex Steel*** and ***Gesagard 50 WP*** did not produce more than 40% control of the seedlings.

8 Leaf Stage (Observation Trial)*Treatment Application Date: 26 April 1996*

Cardamine hirsuta (hairy bitter-cress) (Table 25 in Appendix III, p 68)

A number of chemicals gave a high percentage of scorch by the first record, which was taken less than a week after treatment application. Although the seedlings in some treatments recovered subsequently, by the final record, seven weeks after application, several had given complete control, including ***Basagran***, ***Ronstar Liquid***, ***Nortron***, ***Diuron 80 WP***, ***Skirmish 495 SC***, ***Goltix WG***, ***Gesagard 50 WP*** and ***Atlas Red***. ***Croptex Steel*** and ***Carbetamex*** were only slightly behind with

>90% control. ***Ronstar Liquid***, ***Betanal E*** and ***Armillatox*** demonstrated some activity against this weed species, but only achieved around 65% control overall.

Epilobium roseum (pedicelled willowherb) (Table 26 in Appendix III, p 69)

By the second record, just over a month post treatment application, complete control of young willowherb plants had been achieved with ***Basagran***, ***Diuron 80 WP***, ***Skirmish 495 SC***, ***Goltix WG***, ***Gesagard 50 WP*** and ***Atlas Red***. Good control was also given by ***Ronstar Liquid***, ***Atlas CIPC 40*** and ***Nortron*** (>90%), with ***Croptex Bronze***, ***Betanal E*** and ***Dow Shield*** also giving good control at this point (>80%). Some way behind, ***Carbetamex*** and ***Armillatox*** gave >70% control, while ***Kerb 50 W*** only achieved just over 60%.

The pattern of results was essentially the same at the third and final record, but with ***Dow Shield*** also having given complete control of the willowherb by these assessments.

Poa annua (annual meadow grass) (Table 27 in Appendix III, p 70)

Within a week of applying the treatments, annual meadow grass treated with ***Ronstar Liquid***, ***Croptex Steel*** and ***Armillatox*** were severely scorched. This scorching was still evident at the 4 week record with ***Ronstar Liquid*** and ***Croptex Steel***, as well as ***Atlas Red***, ***Atlas CIPC 40***, ***Kerb 50 W***, ***Sovereign*** and ***Nortron***, whereas those in ***Armillatox*** treatments had begun to recover.

The final record, taken seven weeks after treatment showed that most, and in some cases all, of the seedlings treated with ***Ronstar Liquid***, ***Croptex Steel***, ***Atlas CIPC 40***, ***Kerb 50 W***, ***Nortron***, ***Sovereign***, ***Carbetamex*** and ***Atlas Red*** were still severely scorched. However, none of the chemicals had managed to kill more than around 20% of the seedlings.

Sagina procumbens (pearlwort) (Table 28 in Appendix III, p 71)

It was not until just over a month after the treatments had been applied to this weed species that chemicals with potential for control could be identified. These included complete control by ***Nortron***, ***Diuron 80 WP***, ***Skirmish 495 SC***, ***Gesagard 50 WP*** and ***Atlas Red*** and good control by ***Basagran***, ***Croptex Bronze***, ***Betanal E*** and ***Goltix WG*** (>85%). The same pattern was evident by the final record on 14 June 1996.

Senecio vulgaris (groundsel) (Table 29 in Appendix III, p 72)

The second record, taken a month after spraying, showed ***Nortron*** as the only chemical achieving complete control of groundsel at this time, though in excess of 70% control was achieved by ***Ronstar Liquid***, ***Betanal E***, and ***Gesagard 50 WP***.

At the final record, ***Dow Shield*** had also given complete control of this weed species as well as ***Nortron***. Over 80% control was achieved with ***Croptex Steel*** and ***Betanal E***, closely followed by ***Gesagard 50 WP*** (78%) and then ***Atlas Red*** (68%).

Oxalis corniculata (Table 30 in Appendix III, p 73)

Ronstar Liquid gave good control of this weed in under a week and had eradicated it completely by the second record, just over a month after treatment application. Complete control was also achieved at this time by ***Nortron***, ***Diuron 80 WP*** and ***Skirmish 495 SC***. At the final record ***Atlas Red*** had also given good control of *Oxalis* (90%).

Over half the seedlings were also killed by ***Gesagard 50 WP*** and ***Diuron 80 WP*** (73%), ***Goltix WG*** (62%) and ***Kerb 50 W*** (57%). Despite early scorch as a result of applying ***Basagran***, ***Croptex Bronze***, ***Croptex Steel*** and ***Armillatox***, final seedling kill was only 38%, 45%, 17%, 0% respectively.

Phytotoxicity Observations (Tables 31-35 in Appendix IV, pp 74-76)

Prunus lusitanica

The first application of ***Ronstar Liquid*** (January 1996) caused a degree of leaf necrosis, some of which was still evident at the end of the trial on the older foliage. This chemical also caused some reduction in growth. ***Croptex Bronze*** appeared to cause some check to growth following application, whereas treatment with ***Croptex Steel*** resulted in moderate leaf necrosis and leaf drop, from which the plants did not recover within the time scale of the trial. Slight, transient leaf necrosis was also seen from use of ***Dow Shield***. The second application of ***Basagran*** (April 1996) to the *Prunus* resulted in a check to growth, and some chlorosis and necrosis of the lower leaves was recorded at the final assessment. By the end of the trial reduced growth had been recorded in this species by the use of ***Diuron 80 WP***, ***Gesagard 50 WP*** and ***Atlas Red***. The ***Atlas Red*** treatment also appeared to have delayed new growth in the spring.

Chamaecyparis lawsoniana **'Ellwood's Gold'**

This species suffered tip necrosis at the start of the trial after treatment with ***Atlas CIPC 40***, which had extended to necrotic patches on the lower foliage by the end of the trial, accompanied by reduced and late growth. ***Croptex Steel*** also caused slight tip necrosis by mid April 1996, later resulting in some necrotic patches, together with a delay in new growth getting away. Reduced growth was observed in ***Carbetamex*** treated plots after the second application (April 1996). ***Atlas Red*** proved the most phytotoxic of the chemicals used with this species, causing necrosis, severely reducing overall plant size and delaying new growth.

SUMMARY

Contact herbicide activity varied with weed species, stage of growth and time of year applied. An overall summary of the effectiveness and safety of the range of herbicides used is shown in Tables 3, 4 and 5.

- Some herbicides, while giving good weed control proved too phytotoxic (***Ronstar Liquid, Croptex Steel, Atlas Red***).

- Mode of herbicide action varied from scorch and gradual kill of weeds over time (***Kerb 50W, Nortron***), to a rapid knockdown (***Ronstar Liquid, Croptex Steel, Atlas Red***), and those where weeds recovered after an initial scorch.

- While effects of herbicides were slower to show over the winter, a greater degree of control was achieved with the annual meadow grass and pearlwort over this period than from the Spring applied herbicides where weed growth would be faster.

- In general the 3-4 leaf stage of weed growth proved easier to kill than the 8 leaf stage, though there were exceptions, particularly with ***Nortron*** and ***Goltix WG***.

- Control of pearlwort, hairy bitter-cress and willowherb was achieved with ***Basagran, Diuron 80 WP, Skirmish 495 SC*** and ***Gesagard 50 WP***.

- Oxalis was killed out by ***Nortron*** and ***Diuron 80 WP***.

- Groundsel was more difficult to eradicate, with only ***Dow Shield*** giving control at both the 3-4 and 8 leaf stages, though ***Nortron*** killed out the 8 leaf stage and ***Fortrol*** produced good results at the 3-4 leaf stage.

- Annual meadow grass also proved difficult to kill, particularly the faster maturing Spring germination where little control was achieved with any herbicide. ***Kerb 50W*** and ***Carbetamex*** gave good control over the winter period at both 3-4 and 8 leaf stages.

Eight of the most promising contact herbicides identified above were then taken on into the second part of the trial on the commercial nursery (see Section B). Those chosen were:-

Winter application: ***Skirmish, Atlas CIPC 40, Carbetamex, Kerb 50W, Nortron***
Spring application: ***Skirmish, Basagran, Diuron, Gesagard 50 and Nortron***

Table 3

Overall summary of effectiveness of a range of chemicals as *CONTACT* herbicides – HRI Efford

3-4 leaf application stage

Treatment	Percentage Weed Control									
	1st sowing (trt. appl. 26 Jan 96)			2nd sowing (trt. appl. 10 April 96)						
	Poa	*Sagina*	*Mean*	*Poa*	*Sagina*	*Cardamine*	*Epilobium*	*Senecio*	*Oxalis*	*Mean*
Untreated	40	58	*49*	2	0	0	18	5	0	*8*
Basagran	23	**86**	*55*	1	**99**	**98**	**100**	64	45	*68*
Croptex Bronze	42	76	*59*	4	44	***92***	**90**	27	29	*48*
Ronstar Liquid	**82**	66	*74*	0	1	53	**90**	39	***87***	*45*
Croptex Steel	**99**	**97**	***98***	7	50	8	21	16	7	*18*
Atlas CIPC 40	**100**	**100**	***100***	1	69	31	60	18	67	*41*
Betanal E	42	69	*56*	0	9	1	63	54	0	*21*
Fortrol	47	**90**	*69*	29	**99**	**99**	**84**	**93**	**82**	**81**
Kerb 50 W	**100**	96	***98***	83	39	4	62	1	**100**	*48*
Nortron	**87**	***96***	***92***	0	46	0	8	10	3	*11*
Sovereign	59	***81***	*70*	0	20	23	**85**	38	3	*25*
Dow Shield	42	57	*50*	1	1	10	**100**	**100**	70	*47*
Diuron 80 WP	51	**90**	*71*	4	**99**	**100**	**100**	19	**99**	*70*
Carbetamex	**99**	69	***84***	6	0	***82***	7	16	48	*27*
Armillatox	58	78	*68*	0	0	5	7	3	0	*3*
Skirmish 495 SC	64	**100**	***82***	62	**100**	**100**	**99**	15	**90**	78
Goltix WG	79	62	*71*	0	16	45	38	34	7	*23*
Gesagard 50 WP	41	79	*60*	4	**100**	**99**	**99**	55	34	*65*
Atlas Red	**100**	**100**	***100***	50	**99**	**100**	**96**	48	**97**	**82**

Table 4

Overall summary of effectiveness of a range of chemicals as *CONTACT* herbicides – HRI Efford

8 leaf application stage

Treatment	Percentage Weed Control									
	1st sowing (trt. appl. 6 Mar 96)			2nd sowing (trt. appl. 26 April 96)						
	Poa	*Sagina*	*Mean*	*Poa*	*Sagina*	*Cardamine*	*Epilobium*	*Senecio*	*Oxalis*	*Mean*
Untreated	5	44	*25*	0	27	1	6	8	0	*7*
Basagran	9	**87**	*48*	0	**92**	**100**	**100**	57	39	*65*
Croptex Bronze	0	44	*22*	0	**86**	**94**	**87**	0	45	*52*
Ronstar Liquid	7	29	*18*	0	0	70	**94**	14	**100**	*46*
Croptex Steel	30	62	*46*	0	6	22	**90**	**80**	17	*36*
Atlas CIPC 40	74	78	*76*	11	2	27	24	8	45	*20*
Betanal E	2	73	*38*	0	**91**	65	**87**	**87**	28	*60*
Fortrol	13	**98**	*56*	0	2	21	58	27	0	*18*
Kerb 50 W	**100**	**86**	***93***	22	0	1	70	15	57	*28*
Nortron	52	67	*60*	24	**100**	**100**	**95**	**100**	**100**	***87***
Sovereign	2	26	*14*	1	22	17	**91**	0	0	*22*
Dow Shield	6	31	*19*	0	1	19	**100**	**100**	18	*40*
Diuron 80 WP	2	**87**	*45*	0	**100**	**100**	**100**	31	73	*67*
Carbetamex	**100**	25	*63*	0	7	***90***	79	0	47	*37*
Armillatox	25	29	*27*	1	0	65	75	0	0	*24*
Skirmish 495 SC	5	**100**	*53*	23	**100**	**100**	**100**	47	**100**	*78*
Goltix WG	32	**94**	*63*	1	**93**	**100**	**100**	69	62	*71*
Gesagard 50 WP	2	**82**	*42*	1	**100**	**100**	**100**	78	73	*75*
Atlas Red	**98**	**100**	***99***	0	**100**	**100**	**100**	69	**91**	*77*

Table 5

Overall summary of *PHYTOTOXICITY* as a result of contact herbicide applications – HRI Efford

Treatment	Phytotoxicity (✓ nil, * some, ** moderate, *** severe)	
	Prunus lusitanica	*Cham. Law.* 'Ellwood's Gold'
Basagran	*	✓
Croptex Bronze	*	✓
Ronstar Liquid	**	*
Croptex Steel	**	**
Atlas CIPC 40	✓	**
Betanal 40	✓	✓
Fortrol	✓	✓
Kerb 50 W	✓	✓
Nortron	✓†	✓
Sovereign	✓†	✓
Dow Shield	*	✓
Diuron 80 WP	*	✓
Carbetamex	✓	**
Armillatox	✓	✓
Skirmish 495 SC	✓	✓
Goltix WG	✓	*
Gesagard 50 WP	*	✓
Atlas Red	**	***

† Small delay in new growth coming away in the spring.

SECTION B

YEAR 2

ADAS: COBLANDS NURSERIES

MATERIALS AND METHODS

All the following plant subjects were potted into 2 or 3 litre pots during spring/early summer 1996 using a peat based growing medium with controlled release fertiliser;

Azalea 'Strawberry Ice', *Bergenia cordifolia*, *Buddleia davidii* 'Pixie Red', *Chamaecyparis lawsoniana* 'Ellwoodii', *Cornus alba*, *Euonymus fortunei*, *Forsythia* 'Lynwood', *Mahonia* 'Charity', *Prunus laurocerasus* 'Otto Luyken', *Thuja plicata*, *Viburnum tinus* and *Weigela* 'Bristol Ruby'.

A standard ***Ronstar 2G*** application (200kg/ha) was made to all the subjects during June and July 1996. At the end of August 1996, 54 plants of each species were laid out according to the plan presented in Figure 1, p. 27. Any tall or uneven plants were pruned to ensure a relatively standard plant height within each species across all treatments. As natural weed colonisation of the pots was slow, 300 seeds of each of the following weed species were mixed with sand and distributed over the plants on 15 October 1996;

Cardamine hirsuta (hairy bitter-cress), *Epilobium roseum* (pedicelled willowherb), *Poa annua* (annual meadow grass), *Polygonum persicaria* (redshank), *Sagina procumbens* (pearlwort), *Senecio vulgaris* (groundsel) and *Sonchus arvensis* (sowthistle).

On 29 November 1996 all the plants in the trial were assessed. The height of each plant was measured and a score attributed. A scoring system of 0-5 was used to assess overall growth rather than just height (0 represented a very poor stunted plant with no vigour, through to 5 which represented an overall vigorous plant of good marketable quality). The number of each weed species present was also recorded (Appendix 7, Tables 41 and 42).

After recording, the first herbicide treatment of each programme was applied in a directed spray over the trial plants (to try and ensure the weeds and growing media surfaces were treated) using a knapsack applicator;

Trt	Herbicide product	Active Ingredient	Rate per m^2
1	Untreated control	-	-
2	***Skirmish***	Isoxaben+terbuthylazine	0.1 ml
3	***Atlas CIPC 40***	Chlorpropham	0.5 ml
4	***Carbetamex***	Carbetamide	0.3 g
5	***Kerb 50W***	Propyzamide	0.34 g
6	***Nortron***	Ethofumesate	0.5 ml

The choice of herbicide was based on the results of the trials carried out at HRI Efford, the details of which are outlined in Section A.

To ensure adequate herbicide coverage, all the treatments were applied in the equivalent of 1,200 litres of water per hectare. The treatments were not irrigated in as it rained immediately after application.

Figure 1

Trial and Individual Plot Layout

1	2	6
4	1	5
6	5	4
3	4	2
2	3	3
5	6	1
Plots 13-18	7-12	1-6

Plots numbered from top to bottom.

Individual plot layout

Mahonia 'Charity'	*Azalea* 'Strawberry Ice'	*Thuja plicata*	*Viburnum tinus*
Bergenia cordifolia	*Buddleia davidii* 'Pixie Red'	*Forsythia* 'Lynwood'	*Euonymus fortunei*
Weigela 'Bristol Ruby'	*Cham. Laws.* 'Ellwoodii'	*Cornus alba*	*Prunus l.* 'Otto Luyken'

Each sub-plot contained three plants of each species (36 plants per plot).

Treatment programme (November application followed by a second treatment in March).

1. Untreated control
2. ***Skirmish*** (0.1ml/m^2) followed by ***Skirmish*** (0.1ml/m^2).
3. ***Atlas CIPC 40*** (0.5ml/m^2) followed by ***Basagran*** (0.3ml/m^2).
4. ***Carbetamex*** (0.3g/m^2) followed by ***Diuron Flowable*** (0.08ml/m^2).
5. ***Kerb 50W*** (0.34g/m^2) followed by ***Gesagard 50WP*** (0.23g/m^2).
6. ***Nortron*** (0.5ml/m^2) followed by ***Nortron*** (0.5ml/m^2).

The stage of growth for each plant at the time of herbicide application is summarised as follows;

Plant subject	Growth stage at first application
Azalea 'Strawberry Ice'	Dormant, full leaf drop.
Bergenia cordifolia	Mainly dormant, some plants with new growth.
Buddleia davidii 'Pixie Red'	Shoots still active, a number of leaves still retained.
Cham. laws. 'Ellwoodii'	New growth still 'soft' in appearance.
Cornus alba	Dormant, full leaf drop.
Euonymus fortunei	Reddish winter colouration to plants.
Forsythia 'Lynwood'	Leaves still present on most plants.
Mahonia 'Charity'	Flower buds developing.
Prunus l. 'Otto Luyken'	New growth still developing.
Thuja plicata	Dormant.
Viburnum tinus	Many plants in bud and close to flower.
Weigela 'Bristol Ruby'	Dormant, only a few leaves remaining near shoot tips.

Weed development at the time of herbicide application was variable, weeds varied in size from recently emerged seedlings to a small number (approximately 2-3 per plot) of established weeds in flower. Pearlwort was the most numerous and established of all the weeds present (Appendix VII, Table 41).

On 13 January 1997 the second assessment was carried out; weed numbers and species were again recorded.

The third weed record was carried out carried out on 18 February 1997. Another 300 weed seeds of each of the previously listed weed species were applied over the plants mixed with sand.

The fourth weed record was done on 11 March 1997. After this the second herbicide treatment of each programme (outlined below) was applied to the trial plants; again as a directed spray using a knapsack applicator.

Trt	Herbicide product	Active Ingredient	Rate per m^2
1	Untreated control	-	-
2	***Skirmish***	Isoxaben+terbuthylazine	0.1 ml
3	***Basagran***	Bentazone	0.3 ml
4	***Diuron Flowable***	Diuron	0.08ml
5	***Gesagard 50WP***	Prometryn	0.23 g
6	***Nortron***	Ethofumesate	0.5 ml

The treatments were again applied in 1,200 litres of water per hectare and irrigated in.

The stage of growth for each plant at the time of herbicide application is summarised below:-

Plant subject	Growth stage at second application
Azalea 'Strawberry Ice'	Dormant buds beginning to swell.
Bergenia cordifolia	New leaves opening, first flowers noted.
Buddleia davidii 'Pixie Red'	New shoot growth 2-3cm long.
Cham. laws. 'Ellwoodii'	Dormant, brownish colouration to shoot tips.
Cornus alba	New shoots just opening.
Euonymus fortunei	New shoots noted on a few plants.
Forsythia 'Lynwood'	In flower, new shoots just opening.
Mahonia 'Charity'	In flower.
Prunus l. 'Otto Luyken'	New growth developing.
Thuja plicata	Dormant, brownish colouration to shoot tips.
Viburnum tinus	In flower, new shoots opening.
Weigela 'Bristol Ruby'	New shoots just opening.

Once again weed development was variable, with a whole spectrum of different sized weeds present in the trial (the majority of weeds were between first true leaf and 6-8 leaves). The more developed weeds were pearlwort, chickweed and groundsel. Pearlwort and bitter-cress were the most numerous weeds present (Appendix VII, Table 41 and 43).

Three more weed records were made on 14 April, 16 May and 10 June 1997. On the 22 August 1997 the trial plants were remeasured (to ascertain final height) and assessed (a second growth score allocated to each plant).

RESULTS

The results obtained are presented in the following Tables 6-14, with further recorded data in Appendix VII, Tables 40-47, and statistical analysis in Appendix VIII, Tables 48-53. All the results were analysed using statistical tests to determine significant results.

As can be seen from Table 6, the average weed number was low to moderate at the start of the trial and on average reasonably uniform between treatments (any initial variability in weed levels was accounted for by the use of appropriate statistical tests). Pearlwort was the most numerous weed present, followed by bitter-cress. Willowherb, groundsel, chickweed, sowthistle and annual meadow grass were also present.

Weed numbers built up slowly through the trial (as can be seen from the results for the untreated control), even though weed seeds were artificially introduced into the trial at low levels on two separate occasions.

By the final trial recording the weed spectrum had remained unchanged, however bitter-cress was now the most numerous weed present closely followed by pearlwort. Pearlwort was still the most dominant weed present in terms of the total growing media area covered.

The percentage change in weed number as presented in Table 6 shows the change in weed number month by month per treatment. An indication of relative weed control can be gained by comparing the percentage change for each treatment with the control. By comparing the percentage weed figures recorded at each herbicide application (November and March) with those recorded one month later, an idea of the relative level of short term weed eradication can also be gained.

None of the treatments completely eradicated the weeds present in the pots either in the short or long term. However, the better treatments gave rise to an initial reduction in weed number (as recorded the month after the herbicide treatment) and limited any further weed germination (as recorded throughout the trial).

The treatments which produced some initial eradication of weed seedlings compared to the control included in the March applications of ***Basagran***, ***Gesagard 50 WP***, ***Diuron Flowable*** and ***Nortron*** (however none of these results were statistically significant). When compared to the control, these treatments appeared to achieve weed eradication levels of 28-34%. The weed species most affected (in terms of a reduction in weed seedling numbers) by these treatments included bitter-cress, willowherb and pearlwort.

In the case of longer term weed suppression, the majority of the treatments applied, managed to limit the amount of new weed colonisation relative to the untreated control (as can be seen in Figure 2). ***Diuron Flowable*** (following Carbetamex) ***Nortron*** and ***Skirmish*** achieved good to moderate levels of weed suppression over a number of months.

Table 6

Average Weed Number and Percentage Change in Weed Number per Recording Date

	Recording Date															
	29 Nov 96		13 Jan 97		18 Feb 97		11 Mar 97		14 Apr 97		16 May 97		10 Jun 97		9 Jul 97	
Treatment Programme	Av. weed number per plot	% change in weed number	Av. weed number per plot	% change in weed number	Av. Weed number per plot	% change in weed number	Av. weed number per plot	% change in weed number	Av. weed number per plot	% change in weed number	Av. weed number per plot	% change in weed number	Av. weed number per plot	% change in weed number	Av. weed number per plot	% change in weed number
1. Untreated control	16	-	16	0	21	+31.2	27	+28.6	21	-22.2	25	+19.0	29	+16.0	27	-6.9
2. Skirmish - Skirmish	10	-	9	-10.0	10	+11.1	9	-10.0	7	-22.2	8	+14.3	10	+25.0	7	-30.0
3. Atlas CIPC 40 - Basagran	16	-	13	-18.7	15	+15.4	16	+6.7	7	-56.2	11	+57.1	13	+18.2	14	+7.7
4. Carbetamex - Diuron	21	-	17	-19.0	20	+17.6	22	+10.0	13	-41.0	13	0	16	+23.1	17	+6.2
5. Kerb 50W - Gesagard 50 WP	14	-	13	-7.1	17	+30.8	16	-5.9	7	-56.2	10	+42.9	21	+110.0	18	-14.3
6. Nortron - Nortron	25	-	18	-28.0	21	+16.7	22	+4.8	15	-31.8	10	-33.3	17	+70.0	12	-29.4

Average weed number per plot - average of 3 plots, 36 plants per plot.
Herbicide application dates shaded (first herbicide in programme applied on 29 November 1996, the second on 11 March 1997).

Figure 2

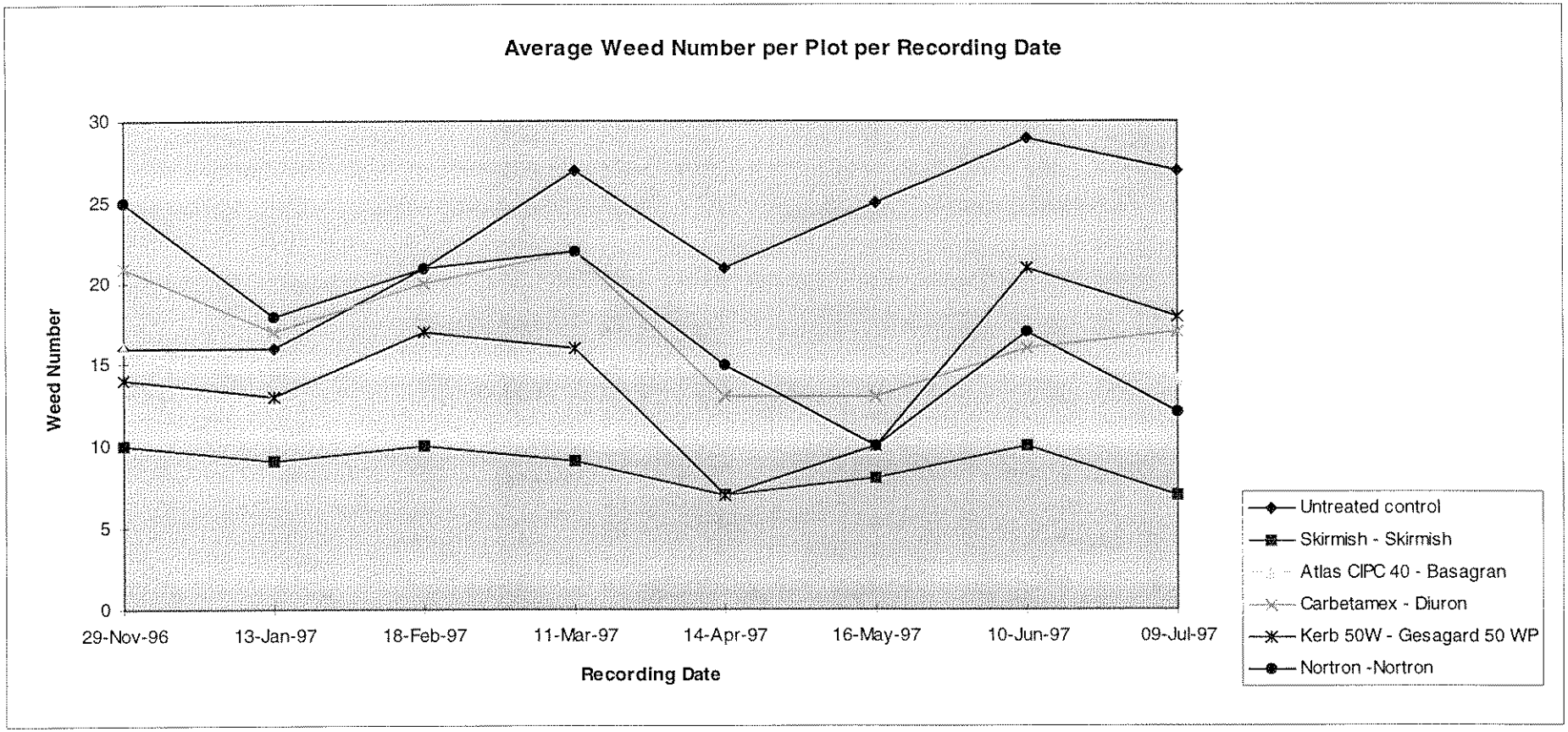


Table 7

Average Number of Pots Containing Moss and or Liverwort per Plot

	Recording Date															
	29 Nov 96		13 Jan 97		18 Feb 97		11 Mar 97		14 Apr 97		16 May 97		10 Jun 97		9 Jul 97	
Treatment Programme	Av. no of pots with moss / liverwort	Av. amount of compost covered	Av. no of pots with moss / liverwort	Av. amount of compost covered	Av. no of pots with moss / liverwort	Av. amount of compost covered	Av. no of pots with moss / liverwort	Av. amount of compost covered	Av. no of pots with moss / liverwort	Av. amount of compost covered	Av. no of pots with moss / liverwort	Av. amount of compost covered	Av. no of pots with moss / liverwort	Av. amount of compost covered	Av. no of pots with moss / liverwort	Av. amount of compost covered
1. Untreated control	5.0	*	4.0	**	5.7	**	7.3	**	3.7	**	4.0	*	2.0	*	5.7	**
2. Skirmish - Skirmish	5.7	**	4.0	**	3.7	**	5.0	***	2.7	**	2.7	*	2.3	*	3.3	*
3. Atlas CIPC 40 - Basagran	5.7	**	7.0	**	4.0	**	4.7	***	0.7	*	1.0	*	1.3	*	2.3	*
4. Carbetamex - Diuron	5.0	*	4.7	*	4.3	**	3.7	**	0.7	*	0	_	0.7	*	0	_
5. Kerb 50W - Gesagard 50 WP	4.0	*	4.7	**	2.7	*	2.3	**	1.0	*	0.7	*	1.3	*	2.0	*
6. Nortron - Nortron	4.0	*	2.3	*	5.7	**	4.0	**	2.0	*	5.7	**	5.3	**	7.3	**

Key

Average amount of compost covered refers to the average total surface area of each pot covered by the moss and or liverwort.

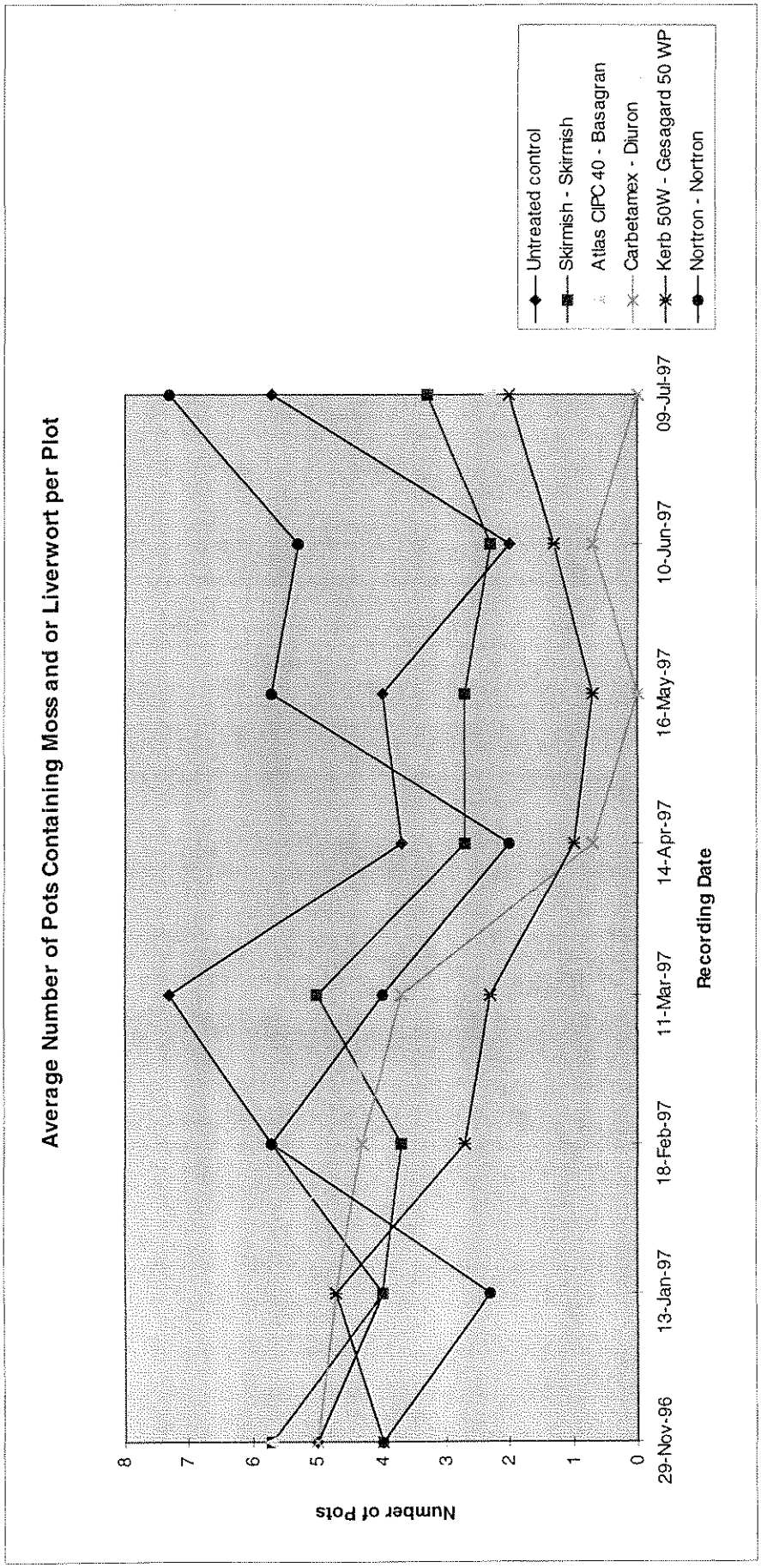
* - An average of 0-30% of compost surface per pot covered.

** - An average of 31-60% of compost surface per pot covered.

*** - An average of 61%+ of compost surface per pot covered.

Herbicide application dates shaded (first herbicide in programme applied on 29 November 1996, the second on 11 March 1997).

Figure 3



The herbicide treatments also had an effect on liverwort and moss levels on the growing media surface. As can be seen from Table 7 and Figure 3, ***Basagran*** and ***Diuron Flowable*** achieved the best eradication compared to the control. A 32-36% reduction in the relative level of moss and liverwort was recorded a month after these treatments were applied. ***Diuron Flowable*** produced the most long lasting control of liverwort and moss.

Table 8

Phytotoxic Symptoms Noted on Crop Plants

Treatment	Date	Symptoms noted
Atlas CIPC 40/Basagran	14/4/97	Transient moderate leaf tip and leaf edge chlorosis on *Buddleia davidii.*
Carbetamex/Diuron Flowable	14/4/97	Transient moderate leaf tip and leaf edge chlorosis on *Buddleia davidii.*
Kerb 50W/Gesagard 50 WP	14/4/97	Slight leaf tip chlorosis on *Buddleia davidii.*
Atlas CIPC 40/Basagran	16/5/97	General intense chlorosis of new growth and tip dieback in *Chamaecyparis lawsoniana* 'Ellwoodii'.
Atlas CIPC 40/Basagran	10/6/97	General chlorosis of new growth and tip dieback in *Chamaecyparis lawsoniana* 'Ellwoodii', death of one plant. Shoot tip dieback in *Thuja plicata.*
Atlas CIPC 40/Basagran	9/7/97	Shoot tip dieback still evident in *Thuja plicata.*

Few phytotoxic symptoms were noted as a result of the treatments. The herbicide treatment which gave rise to most of the phytotoxic symptoms recorded was the ***Atlas CIPC 40*** followed by ***Basagran*** programme. The symptoms noted are described in Table 8 and can be seen in Appendix IX, Plate 11. The only other phytotoxic symptoms noted were as a result of ***Diuron Flowable*** and ***Gesagard 50 WP***; both treatments caused a transient leaf edge chlorosis in *Buddleia davidii.* The effect of ***Diuron Flowable*** on *Buddleia* can be seen in Appendix IX, Plate 10.

Slight differences in plant height and overall growth were noted at the end of the trial. However, with the exception of the differences in height recorded for *Viburnum tinus*, none of the height or growth scores recorded, were statistically significant. In the case of *Viburnum tinus* it was the stressful hot dry weather conditions experienced through the spring and summer in 1997, rather than the herbicide treatments, which had the greatest effect on plant height.

In the case of two of the species used in the trial (*Bergenia* and *Euonymus*), plant height was not the best parameter to record, as the plants tended to grow horizontally rather than upwards. The growth of these plants was recorded more accurately by the growth score given to each plant (Tables 12 and 13).

Table 9

Average Plant Height (cm) per Treatment - 29 November 1996

	Plant Species											
Trt	A	B	C	D	E	F	G	H	I	J	K	L
	42.1	47.0	48.4	48.1	32.6	57.4	52.8	25.8	50.1	24.8	48.0	39.9
2	42.2	47.2	52.2	47.1	35.2	65.1	53.8	22.9	56.7	25.8	50.5	40.9
3	44.8	44.9	53.5	50.0	29.7	61.4	62.3	24.0	55.7	27.1	53.2	40.1
4	37.2	40.5	49.9	45.2	30.3	61.2	57.0	26.0	55.7	23.4	53.1	37.9
5	45.1	40.9	52.0	49.2	33.2	63.8	57.8	23.2	59.1	23.9	47.9	40.0
6	40.2	41.8	50.6	49.0	31.6	59.2	57.8	22.9	57.2	24.4	51.2	41.3

Table 10

Average Plant Height (cm) per Treatment - 22 August 1997

	Plant Species											
Trt	A	B	C	D	E	F	G	H	I	J	K	L
1	51.5	55.5	84.0	47.8	25.0	99.1	73.5	31.5	66.8	39.0	92.2	43.1
2	51.4	58.1	88.1	48.3	26.8	92.0	72.6	30.1	66.0	45.6	85.3	44.6
3	48.8	55.8	85.9	51.7	25.2	90.4	69.6	26.0	69.2	38.8	83.4	44.0
4	45.5	56.3	88.2	49.3	26.1	98.2	71.7	30.2	80.8	34.8	77.9	42.4
5	51.1	55.1	87.2	50.5	24.3	95.1	72.2	28.2	66.6	40.0	87.4	44.2
6	44.8	52.9	85.2	51.8	25.4	92.8	78.2	22.2	56.8	38.9	91.4	44.4

Key

Plant species

A - *Mahonia* 'Charity.' B - *Azalea* 'Strawberry Ice'. C - *Thuja plicata.* D - *Viburnum tinus.*
E - *Bergenia cordifolia.* F - *Buddleia davidii* 'Pixie Red'. G - *Forsythia* 'Lynwood'.
H - *Euonymus* fortunei. I - *Weigela* 'Bristol Ruby'. J - *Chamaecyparis lawsoniana* 'Ellwoodii'.
K - *Cornus alba.* L - *Prunus laurocerasus* 'Otto Luyken'.

Herbicide treatments

1. ***Untreated Control.*** 2. ***Skirmish - Skirmish.*** 3. ***Atlas CIPC 40 - Basagran.***
4. ***Carbetamex - Diuron Flowable.*** 5. ***Kerb 50W - Gesagard 50WP.*** 6. ***Nortron - Nortron.***

Table 11

Percentage Increase in Average Plant Height

	Plant Species											
Trt	A**	B	C	D**	E*	F	G	H	I**	J	K	L
1	22.3	18.1	73.5	-	-	72.6	39.2	22.1	33.3	57.3	92.1	8.0
2	21.8	23.1	68.8	2.5	-	41.3	34.9	31.4	16.4	76.7	68.9	9.0
3	8.9	24.3	60.6	3.4	-	47.2	11.7	8.3	24.2	43.2	56.8	9.7
4	22.3	39.0	76.7	9.1	-	60.5	25.8	16.1	45.1	48.7	46.7	11.9
5	13.3	34.7	67.7	2.6	-	49.1	24.9	21.5	12.7	67.4	82.5	10.5
6	11.4	26.5	68.4	5.7	-	56.7	35.3	-	-	59.4	78.5	7.5

Key

Plant species

A - *Mahonia* 'Charity.' B - *Azalea* 'Strawberry Ice'. C - *Thuja plicata.* D - *Viburnum tinus.*
E - *Bergenia cordifolia.* F - *Buddleia davidii* 'Pixie Red'. G - *Forsythia* 'Lynwood'.
H - *Euonymus* fortunei. I - *Weigela* 'Bristol Ruby'. J - *Chamaecyparis lawsoniana* 'Ellwoodii'.
K - *Cornus alba.* L - *Prunus laurocerasus* 'Otto Luyken'.

Herbicide treatments

1. ***Untreated Control.*** 2. ***Skirmish - Skirmish.*** 3. ***Atlas CIPC 40 - Basagran.***
4. ***Carbetamex - Diuron Flowable.*** 5. ***Kerb 50W - Gesagard 50WP.*** 6. ***Nortron - Nortron.***

* - Plant height was a poor indictor of growth in the case of *Bergenia cordifolia.*
** - Indicates plant species most effected by dry spring/early summer conditions.

Table 12

Average Growth Score per Treatment - 29 November 1996

	Plant Species											
Trt	A	B	C	D	E	F	G	H	I	J	K	L
1	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0
2	4.3	5.0	5.0	5.0	5.0	5.0	5.0	4.7	5.0	4.7	5.0	5.0
3	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0
4	4.7	4.7	5.0	5.0	5.0	5.0	5.0	4.7	5.0	5.0	5.0	5.0
5	5.0	5.0	5.0	5.0	5.0	5.0	5.0	4.7	5.0	5.0	5.0	5.0
6	4.7	5.0	4.7	5.0	4.7	5.0	5.0	5.0	5.0	5.0	4.7	5.0

Table 13

Average Growth Score per Treatment - 22 August 1997

	Plant Species											
Trt	A**	B	C	D**	E	F	G	H	I**	J	K	L
1	3.7	3.7	4.0	3.7	5.0	4.3	4.3	4.3	3.7	3.5	4.7	4.0
2	3.7	3.7	4.3	5.0	4.7	4.0	4.3	4.7	4.0	4.0	4.3	4.3
3	4.0	4.3	4.3	4.0	5.0	4.0	4.7	4.0	3.7	4.0	4.3	4.3
4	3.3	4.0	4.3	4.0	5.0	4.3	4.3	4.0	4.3	3.7	4.7	4.0
5	3.7	4.7	4.7	4.0	5.0	4.3	4.0	4.3	3.7	4.0	4.3	4.0
6	3.3	4.3	4.3	3.7	5.0	4.3	4.7	3.3	3.3	4.7	4.3	4.0

Key

Plant species

A - *Mahonia* 'Charity.' B - *Azalea* 'Strawberry Ice'. C - *Thuja plicata.* D - *Viburnum tinus.*
E - *Bergenia cordifolia.* F - *Buddleia davidii* 'Pixie Red'. G - *Forsythia* 'Lynwood'.
H - *Euonymus* fortunei. I - *Weigela* 'Bristol Ruby'. J - *Chamaecyparis lawsoniana* 'Ellwoodii'.
K - *Cornus alba.* L - *Prunus laurocerasus* 'Otto Luyken'.

Herbicide treatments

1. ***Untreated Control.*** 2. ***Skirmish - Skirmish.*** 3. ***Atlas CIPC 40 - Basagran.***
4. ***Carbetamex - Diuron Flowable.*** 5. ***Kerb 50W - Gesagard 50WP.*** 6. ***Nortron - Nortron.***

** - Indicates plant species most effected by dry spring/early summer conditions.

Table 14

Weed Species Noted in the Trial (in Order of Number Recorded)

Pearlwort	*Sagina procumbens*
Bitter-cress	*Cardamine hirsuta*
Willowherb	*Epilobium roseum*
Groundsel	*Senecio vulgaris*
Chickweed	*Stellaria media*
Sowthistle	*Sonchus arvensis*
Annual meadow grass	*Poa annua*

SUMMARY

None of the herbicide programmes eradicated the weed population as effectively as in the Efford programme, possibly due in part to difficulties in achieving a good spray cover as a result of crop canopy obstruction, even though every effort was made to direct the spray. In addition, the stage of weed development ranged from newly emerged seedlings to established weeds at the point of flowering, which were more difficult to control. Table 15 below summarises the main results of the second year.

Table 15

Treatment	Short term Weed Eradication	Long Term Weed Suppression	Moss/ Liverwort Control	Phytotoxic Damage	Growth Reduction
Skirmish	*	**	**	-	-
Atlas CIPC 40	*	**	*	-	-
Basagran	**	**	**/***	***	-
Carbetamex	*	**	*/**	-	-
Diuron Flowable	**	**	***	*	-
Kerb 50 W	*	*/**	*/**	-	-
Gesagard 50WP	**	*	**/***	*	-
Nortron	**	**	*/**	-	-

Key to the above table

Weed, Moss and Liverwort Control		Phytotoxicity		Growth Reduction	
Total Control	****	Tip and Leaf Death	***	Severe Stunting	***
Good Control	***	Tip Dieback	***	May Reduce Grade	***
Moderate Control	**	Long Term Chlorosis	**	Visible Reduction	**
Poor Control	*	Transient Chlorosis	*	Slight Reduction	*
No Control	-	No Damage Noted	-	No Growth Reduction	-

- Few phytotoxicity symptoms were seen as a result of herbicide treatments. However, ***Atlas CIPC 40*** followed by ***Basagran*** did cause tip die back in both the conifer species used in the trial (*Chamaecyparis lawsoniana* 'Ellwoodii' and *Thuja plicata* (Plate 10)). Other than this, there was only a transient leaf chlorosis of *Buddleia* which occurred in the early spring flush

of growth as a result of this treatment, and also where ***Carbetamex/Diuron Flowable*** and ***Kerb 50W*** programmes were applied.

- While weed pressure was low in this work, despite distributing a mix of weed seed over the trial on two separate occasions, there was a steady increase in weed population in the untreated plots and limited observations on treatment effects were possible.

- The winter application of ***Skirmish, Atlas CIPC 40, Carbetamex, Kerb 50W*** and ***Nortron*** only produced a small reduction in weed growth initially, but appeared to check further germination such that weed pressure had not increased by March 1997.

- The most effective herbicides were the March applied ***Basagran*** (following Atlas CIPC 40) and ***Gesagard 50 WP*** (following Kerb 50W), closely followed by ***Diuron Flowable*** (after Carbetamex) and the second application of ***Nortron***, where some reduction in weed population occurred during April and May. However, weeds were increasing again by June/July, though to a lesser degree than in the untreated controls. The ***Skirmish*** programme appeared to have a residual influence, preventing any increase in weed population, compared with the control, though it seemed to have had little contact action on existing weed at this time of year in this trial.

- ***Diuron Flowable*** applied in the Spring, eradicated existing moss and liverwort and provided control over the period of the trial. ***Gesagard 50 WP*** and ***Basagran*** achieved reasonable short term control.

OVERALL DISCUSSION

The project was designed to test the efficacy and safety of a range of herbicides with contact action for eradication of overwintering weeds in container grown hardy nursery stock. The most promising results from detailed efficacy trials at HRI Efford in Year 1 (1995/96) were taken on by ADAS for further assessment under commercial nursery conditions in Year 2 (1996/97).

Year 1 – Efficacy (1995/96) – HRI Efford

The technique of growing specific pots of weeds for testing the effectiveness of herbicides proved very successful, and batches of weeds at defined growth stages were able to be selected by sowing more pots than required. However, in order to achieve a significant flush of weed growth over the winter period, and reduce the inherent variability in germination and development, pots were sown under protection, and grown on in a polythene roof/netting sided structure until required. This meant that weed growth was initially somewhat softer than that developing outdoors, and may have been more sensitive to the applied herbicides. Nevertheless, this is a recognised technique for preliminary assessments of efficacy of chemicals.

A period of frosty weather during the winter of 1995/96 coincided with the start of the trial and wiped out three of the weed species, bitter-cress, groundsel and willowherb. However, annual meadow grass and pearlwort are perhaps two of the more important 'overwintering' weed problems, and despite suffering a check to growth, recovered and provided useful information on the effectiveness of the different herbicides at this time of year.

Kerb 50W and ***Carbetamex*** gave excellent control of annual meadow grass at both stages of growth, with ***Atlas CIPC 40*** eliminating the 3-4 leaf stage, but only achieving around 75% control at the 8 leaf stage.

Pearlwort can be a particular problem where routine herbicide programmes are based on Ronstar 2G, since the product does not control this weed. It was therefore encouraging to find a number of herbicides with activity against pearlwort including ***Basagran, Fortrol, Kerb 50W, Diuron*** and ***Skirmish***, followed by ***Goltix WG*** and ***Gesagard 50 WP***.

The late autumn herbicide application appeared more effective in eradicating annual meadow grass or pearlwort, than the spring application, where weed growth would be considerably faster. Annual meadow grass proved particularly difficult to control in the early spring with only ***Kerb 50W*** showing any significant activity (>80% kill), and then only at the earlier stage of development.

Pearlwort, bitter-cress and willowherb were controlled in the spring by ***Basagran, Diuron, Skirmish*** and ***Gesagard*** at both stages of development while ***Nortron*** and ***Goltix WG*** appeared more effective at the later stage of growth, though this will need confirming.

Groundsel proved considerably more difficult to kill, only ***Dow Shield*** achieving control at both stages of growth. ***Fortrol*** and ***Nortron*** could also be worth re-examining as they appeared to have some activity at the 3-4 and 8 leaf stages respectively.

The pernicious red leaved Oxalis normally found in containers could not be obtained as seed and was substituted by *Oxalis corniculata*, in the hope that information gained with this species might provide some guide as to the sensitivity of the genus which could be followed up. Four herbicides demonstrated activity against the early stages of growth of this *Oxalis* species, namely ***Kerb 50W, Fortrol, Diuron*** and ***Skirmish***, and now needs testing on a natural infestation of the red leaved *Oxalis*.

In general the more mature the weed the more difficult it was to control, and it was encouraging that a number of herbicides were able to provide control over a range of development stages, since this would be the situation occurring in the nursery.

Herbicide action also varied, with some chemicals providing an immediate 'knockdown' (***Atlas Red, Armillatox***), others checking growth and gradually killing out the weeds over time (***Kerb 50W, Gesagard, Nortron***) or some giving an initial scorch with the weed then recovering (***Betanal E***).

Of the most promising herbicides identified in the first year, the only phytotoxicity symptoms observed were some leaf tip necrosis and a small reduction in growth of *C.l.* 'Ellwood's Gold' where ***Atlas CIPC 40*** and ***Carbetamex*** were applied, and a small reduction in growth in *Prunus lusitanica* from ***Diuron*** and ***Gesagard 50 WP***. Since they had given promising weed control they were taken on for screening over a wider range of HNS species in the second year. Other herbicides, while giving good weed control, appeared more phytotoxic and consequently were not taken forward for further testing (***Ronstar Liquid, Croptex Steel, Atlas Red***).

Year 2 - Commercial Nursery Trial (1996/97)

Eight chemicals were selected from the first years' work and combined to provide five programmes, with different herbicides used for the winter and spring applications, apart for ***Skirmish*** and ***Nortron*** which were repeated at the second application.

Overall weed pressure was low in this trial, making it difficult to fully test the potential of the herbicide programmes, despite sowing additional weed seed on two occasions. The dry, hot weather conditions experienced in the spring of 1997 helped to limit weed germination through the latter part of the trial. Nevertheless, there was a gradual increase in weeds in the untreated control plots enabling observations on the various treatments to be made.

It was disappointing that the contact (eradication) properties of the selected herbicides were poorly exhibited in the second year. A number of factors could help account for this.

- Distribution of the herbicides over small pots of weeds was obviously more even in the Efford work. The crop canopy which developed in the second part of the trial made directing the herbicide sprays more difficult, thus reducing the spray coverage over any weeds present.

- Less water was used for the herbicide application under commercial conditions (1200 l/ha as opposed to the Efford standard of 2500 l/ha). While the reduced volume is considered to be a commercial standard for general herbicide applications, it may well have limited spray coverage over the weeds.

- Weed growth was less uniform in the second part of the trial than in the Efford programme. Weed size varied from newly germinated seedlings to those almost in flower, and the earlier work had demonstrated the greater susceptibility of the younger stages of weed growth, though some success was achieved up to the 8 leaf stage with certain weeds.

- Weed growth, developing under natural conditions, provided a more rigorous test than the softer grown material in the Efford work.

However, the commercial trialling indicated some contact action, particularly after the ***Basagran, Diuron Flowable, Gesagard 50WP*** and ***Nortron*** applications in the spring and also demonstrated some residual influence of most herbicides in limiting further weed build up, at least over the short term.

On a more positive note, few phytotoxic symptoms were seen as a result of the herbicide application. In the case of ***Diuron Flowable*** (following Carbetamex) and ***Gesagard 50 WP*** (following Kerb 50W) it was a simple transient chlorosis on *Buddleia davidii*. ***Basagran*** (following Atlas CIPC 40) also gave rise to transient chlorosis on *Buddleia*, but in addition caused growing point die-back in both conifer species (*C.l.* 'Ellwoodii', *Thuja plicata*). It is unclear

whether the damage was a long term result of ***Atlas CIPC 40*** or the result of the ***Basagran*** application, since damage did not occur until after the latter application. Tip dieback of *C.l.* 'Ellwood's Gold' also occurred in the Efford work after ***Atlas CIPC 40*** was applied.

Many of the herbicide programmes were applied at reduced rates or at the lowest general rate recommended, in order to maximise crop safety. As a result their potential contact action would have been reduced as well as their persistence. In addition, the efficacy of a number of herbicides are known to be reduced in the presence of high levels of organic matter (e.g. ***Atlas CIPC 40, Gesagard 50WP, Nortron).*** Such products would, therefore, be expected to be less effective in peat based mixes, further reducing their residual activity, especially at lower rates. In view of the limited phytotoxicity seen in the work, it might be possible to increase the rate of herbicide used, (apart from ***Atlas CIPC 40/Basagran*** on conifers, where the phytotoxicity, if confirmed, could preclude their use with this group). Further investigation is required to establish optimum safe rates and timing of applications under different conditions.

Diuron, at the low rate of 0.05 ml/m^2, looked particularly promising, both in terms of weed control and especially moss and liverwort control. Its properties for this use have been recognised in previous work in the UK and abroad, but there have always been doubts on its safety of use across a wide range of shrubs and conifers, particularly at standard rates and during the growing season. It may well prove safer to use overwinter, when plants are dormant or semi dormant, and would provide a valuable addition to the herbicides currently used for weed, moss and liverwort control overwinter and into the early spring. Further investigation on its use for this application is required, particularly across a wider range of HNS species.

Thus a number of herbicides have been identified during the course of the work as having some potential for contact/residual action for use on overwintering weeds. The use of such herbicides should eliminate/reduce the weed pressure and the need for the expensive and time consuming operation of hand weeding, which is estimated as being 30 - 40 times more expensive than an effective spray programme. However, it may be necessary to combine a small degree of hand weeding to improve the effectiveness of a herbicide programme, for instance by removal of larger more mature weeds prior to spraying, since they are unlikely to be controlled at that stage, and would become a further source of inoculum. In addition, the earlier the stage of weed growth treated, the more effective the programme is likely to be, with the added benefit of a residual effect reducing further weed germination.

While work in this project has not reached the stage for specific guidelines to be produced, results taken overall, suggest that further small scale nursery trialling could be worthwhile to see whether the eradication results obtained in the first year can be repeated under commercial conditions. How the contact action under these circumstances might be improved needs further investigation and would help develop guidelines for optimising rate and timing of herbicide applications for the future.

CONCLUSIONS

The efficacy and safety of a range of herbicides with contact action was assessed for their eradicant properties for overwintering weeds in container grown nursery stock over two years.

In the first year, detailed efficacy trials at HRI Efford highlighted a number of chemicals with potential for killing out young weed growth. Success on control varied with time of year, weed species and their stage of growth, with a more effective eradication occurring from a winter, rather than spring applied programme, and weeds at an earlier stage of growth (3-4 leaf stage), being generally easier to kill than more mature weeds (8 leaf stage). Herbicides appearing to have promise over a range of weed stages included:

Winter	Annual Meadow Grass	Kerb 50 W, *Atlas CIPC 40, Carbetamex
	Pearlwort	*Basagran, Kerb 50 W, *Atlas CIPC 40, Diuron, Skirmish, Fortrol, Gesagard 50 WP
Spring	Annual Meadow Grass	Kerb 50 W
	Pearlwort, Bitter-cress, Willowherb	*Basagran, Diuron, Skirmish, Gesagard 50 WP
	Groundsel	Fortrol, Dow Shield
	Oxalis (corniculata)	Fortrol, Kerb 50 W, Diuron, Skirmish
	Moss/Liverwort	Diuron (*Basagran and Gesagard gave short term control)

*Potential phytotoxicity with conifers, further investigation required.

The most promising of these herbicides were taken on into the second year by ADAS for commercial trialling at Coblands Nurseries Ltd, where 5 programmes were applied and evaluated over the winter and spring. Low levels of weeds made it difficult to fully assess the value of the herbicides, but contact action was disappointing, though some residual activity in limiting further weed germination was demonstrated. Reasons for the poor contact action of the herbicides are discussed and include difficulties in obtaining adequate spray cover due to crop canopy impedance, and the spectrum of weed development noted, from germinating seedlings to those near flowering.

An encouraging result was the apparent safety of use of the majority of herbicides used over the 10 species in the trial, suggesting increased rates above the reduced/lowest recommended used in the work might be worth considering. However, use of ***Atlas CIPC 40/Basagran*** caused damage to conifers, reflecting similar damage seen in the earlier work, which could limit their use with this group.

Results are discussed in the context of the need for further trialling to see whether the early promise of eradication can be repeated under commercial conditions, and, if so, to establish optimum safe rates and timing of herbicides, together with volume of water required for effective application, in order to develop guidelines for the future.

RECOMMENDATIONS FOR FURTHER WORK

Despite the somewhat inconclusive results from the commercial trialling in the second year, results of the preliminary efficacy testing at HRI Efford demonstrated the potential contact action of a range of herbicides for eradication of overwintering weeds in container grown nursery stock. Because of the financial benefits to be gained by substituting a herbicide spray programme for the expense involved in hand weeding, it is therefore felt that further commercial trialling of the contact herbicide programmes could be worthwhile. Further work for consideration includes:

- Repeating the work on a number of locations around the country to monitor effects of varying climates on the programmes.

- Obtaining further experience of the efficacy of the herbicides under different cultural management techniques. This information could be used to produce guidelines for maximising their use.

- Establishing optimum herbicide application rates and timing under different environmental conditions.

- Investigating spray application methods and volume of water required to obtain more efficient distribution over the weeds.

- Evaluating whether the contact action of the herbicides could be improved by use of an adjuvant or wetter.

- Obtaining further information on safety of use across a wider range of HNS species. This would gradually build into a database showing where the various herbicide programmes have been used successfully (or not as the case may be!). Such information becomes invaluable where herbicides do not have label recommendations for such a use, and can only be used under the 'growers risk' option.

ACKNOWLEDGEMENT

We would like to record our sincere thanks to Coblands Nurseries Ltd., and their staff, for providing the site and help in managing the trial in the second year of the project.

APPENDICES

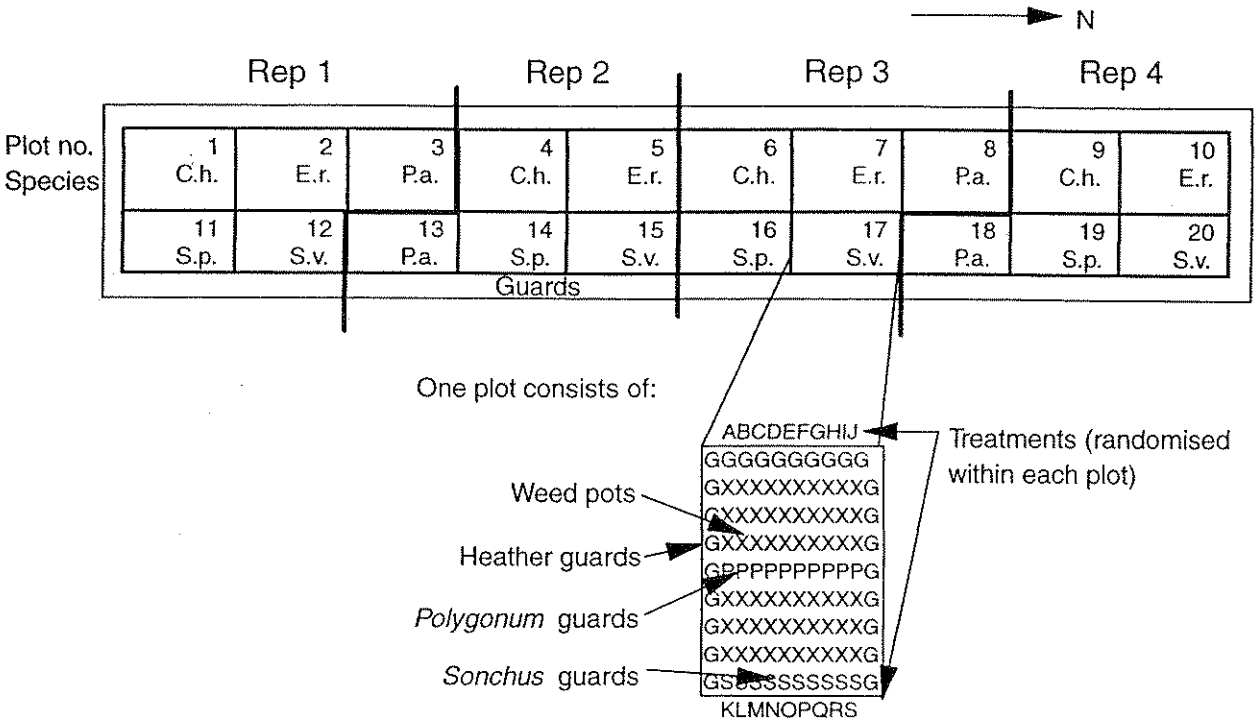
SECTION A

YEAR 1

HRI EFFORD

APPENDIX 1

Sowing 1: 3-4 Leaf Stage Weed Trial Layout



Weed Species

C.h. - *Cardamine hirsuta* (hairy bittercress)
E.r. - *Epilobium roseum* (willow-herb)
P.a. - *Poa annua* (annual meadow grass)
S.a. - *Sagina procumbens* (pearlwort)
S.v. - *Senecio vulgaris* (groundsel)

P - *Polygonum persicaria* (redshank)
S - *Sonchus arvensis* (sowthistle)

APPENDIX 1

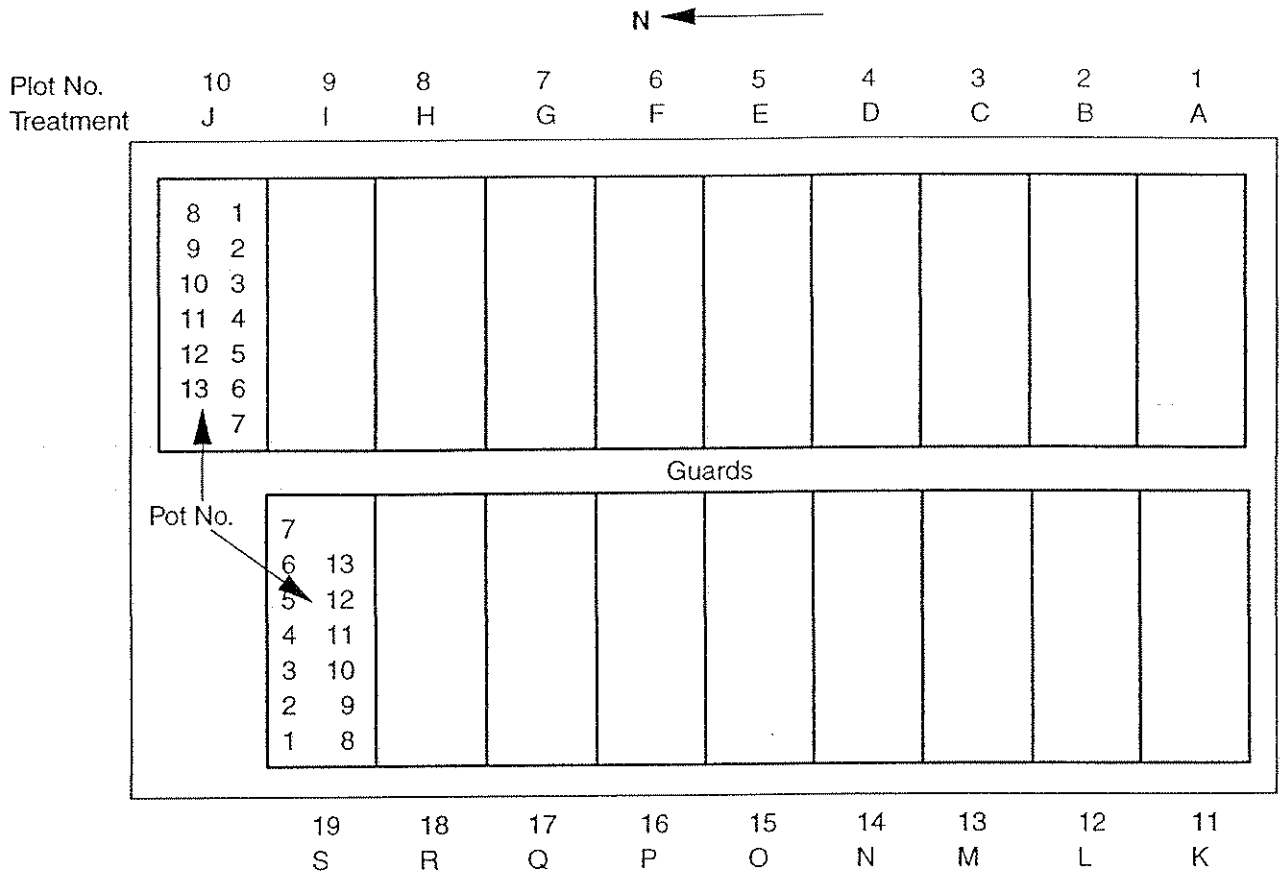
Sowing 1 : 3-4 Leaf Stage Weed Trial Layout

Treatment Randomisation

	Weed species :	Randomisation :	
Replicate 1			
Plot 1	*Cardamine hirsuta*	QKOMACJBDG	NRFPIHLES
Plot 2	*Epilobium roseum*	ERJDMCKALP	GNOHQBFSI
Plot 3	*Poa annua*	SBOPLAHQFR	JGDKCNMIE
Plot 11	*Sagina procumbens*	AKJPFRGLIE	SMOCBQHDN
Plot 12	*Senecio vulgaris*	GJCFIBQNLH	OKMERDSAP
Replicate 2			
Plot 4	*Cardamine hirsuta*	RIPLAQOKHN	CSMJGBDEF
Plot 5	*Epilobium roseum*	EONIJCDSRQ	KAFBHMPGL
Plot 13	*Poa annua*	AHFBPKNLGQ	DIMRCOSEJ
Plot 14	*Sagina procumbens*	LKQHGICOAJ	DRMFBSENP
Plot 15	*Senecio vulgaris*	DJBMSOCPRA	GLEKFQNHI
Replicate 3			
Plot 6	*Cardamine hirsuta*	LBQSRNHJIE	OFKAPDCMG
Plot 7	*Epilobium rosuem*	MQEPSLGHIB	AOFRKNJCD
Plot 8	*Poa annua*	HMGOCPQKRS	DBFILEJNA
Plot 16	*Sagina procumbens*	OHABCDQEMF	LNPJSRGKI
Plot 17	*Senecio vulgaris*	CBPHJEQNRM	KOILGADFS
Replicate 4			
Plot 9	*Cardamine hirsuta*	DSFGBCRAKQ	ONMIEPJLH
Plot 10	*Epilobium roseum*	NJHPGLQMRI	CBDFAEKOS
Plot 18	*Poa annua*	BCKGAFHQSD	IEJRNMOLP
Plot 19	*Sagina procumbens*	EGMPOHSQNB	LRJDIKACF
Plot 20	*Senecio vulgaris*	FNKJPMEHRQ	GIALSBCOD

APPENDIX I

Sowing 1: 8 Leaf Stage Weed Observation Trial Layout

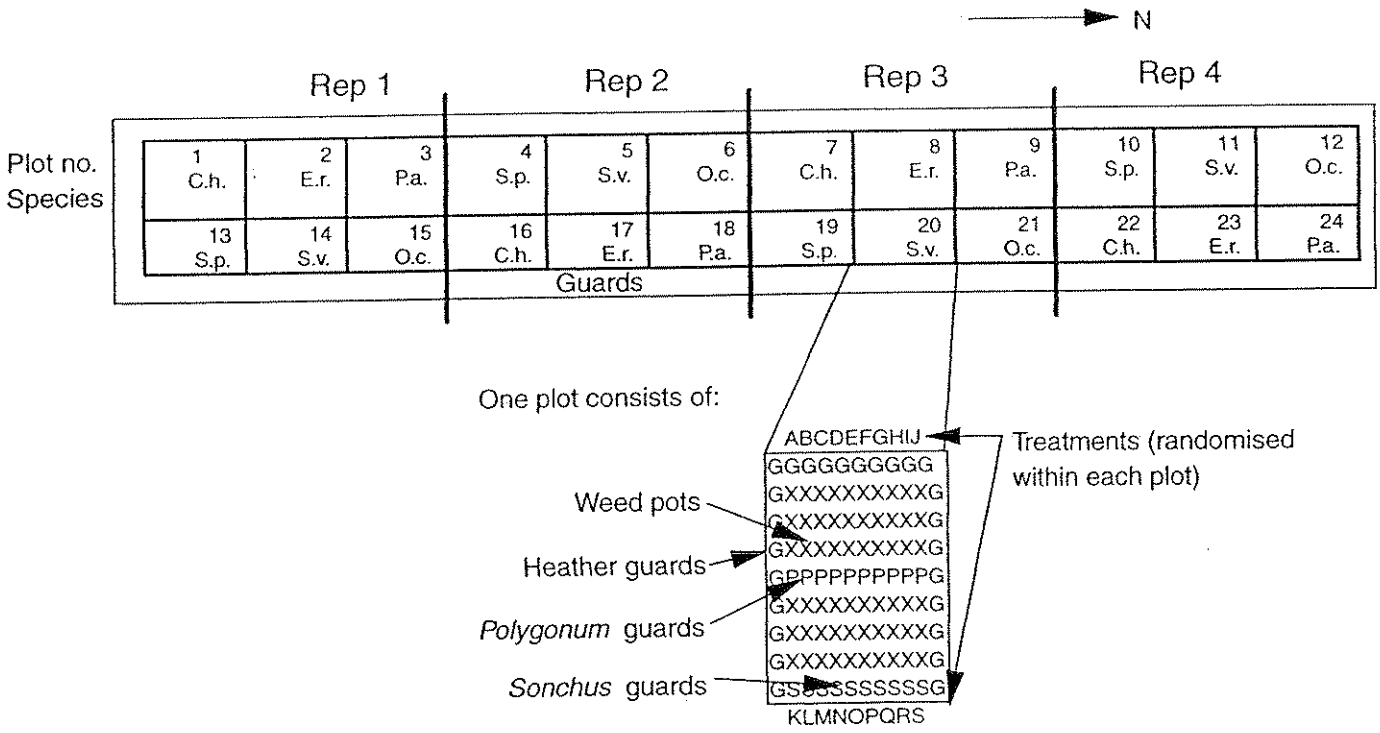


Key

Pot No.: 1-7 = *Sagina procumbens* (pearlwort)
8 - 10 = *Poa annua* (annual meadow grass)
11 - 12 = *Epilobium roseum* (willow-herb)
13 = *Cardamine hirsuta* (hairy bittercress)

APPENDIX I

Sowing 2: 3-4 Leaf Stage Weed Trial Layout



Weed Species

C.h. - *Cardamine hirsuta* (hairy bittercress)
E.r. - *Epilobium roseum* (willow-herb)
O.c. - *Oxalis corniculata*
P.a. - *Poa annua* (annual meadow grass)
S.a. - *Sagina procumbens* (pearlwort)
S.v. - *Senecio vulgaris* (groundsel)

P - *Polygonum persicaria* (redshank)
S - *Sonchus arvensis* (sowthistle)

APPENDIX 1

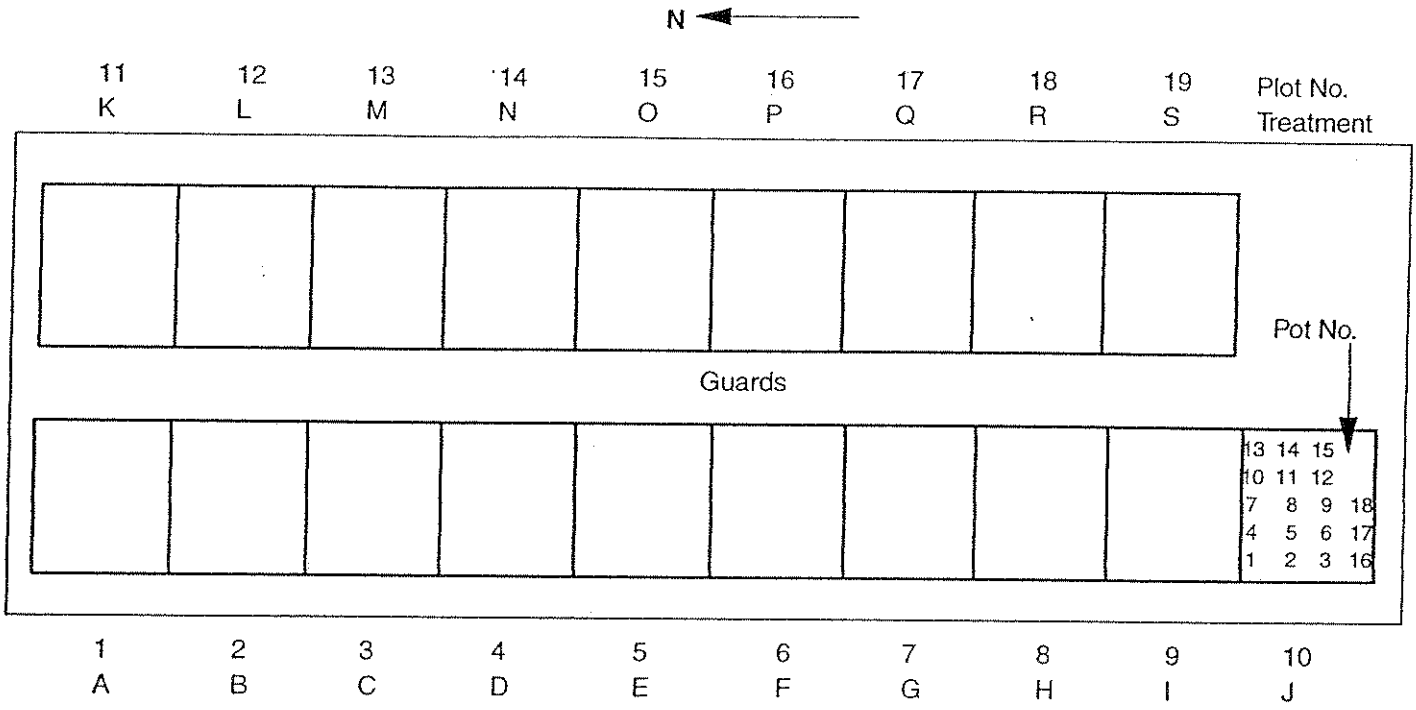
Sowing 2 : 3-4 Leaf Stage Weed Trial Layout

Treatment Randomisation

	Weed species :	Randomisation :	
Replicate 1			
Plot 1	*Cardamine hirsuta*	PQIOJEBCHK	SLARFMDGN
Plot 2	*Epilobium roseum*	MERFGLKIJB	HAQSOCNPD
Plot 3	*Poa annua*	FAJHKEMRSI	OQPGCNDBL
Plot 13	*Sagina procumbens*	HBMDNSOAGQ	JCEFIPKLR
Plot 14	*Senecio vulgaris*	SIHOMEKRQA	JFDCLNGPB
Plot 15	*Oxalis corniculata*	HNREPBDICG	SLOKFJQMA
Replicate 2			
Plot 4	*Sagina procumbens*	HGRIBLSQOP	JNDKEMFAC
Plot 5	*Senecio vulgaris*	CAMHNKPDIR	SLBQJOFGE
Plot 6	*Oxalis corniculata*	LDCKNHBPSQ	RGIEJAOMF
Plot 16	*Cardamine hirsuta*	GDMPENJKAI	QBCHLFORS
Plot 17	*Epilobium roseum*	SMAIGBDQRK	JLHOCNPEF
Plot 18	*Poa annua*	BQGAPJOHCN	EDISRFMKL
Replicate 3			
Plot 7	*Cardamine hirsuta*	HKBSIJLDPR	OEANMCGQF
Plot 8	*Epilobium roseum*	PRFHABDNIO	CSKJGLQME
Plot 9	*Poa annua*	QSMCOGDELA	INBJFHPRK
Plot 19	*Sagina procumbens*	IJMKLNDOSH	GPFRAEQBC
Plot 20	*Senecio vulgaris*	KHAQNDSJRF	OCLPIEBMG
Plot 21	*Oxalis corniculata*	KSMQDJNPFO	BALGRICHE
Replicate 4			
Plot 10	*Sagina procumbens*	KBDEHGSAIF	PCJQNRMOL
Plot 11	*Senecio vulgaris*	OHIEDLKQRN	GMSACBPJF
Plot 12	*Oxalis corniculata*	MSNGHJKFAI	LEDOPQBRC
Plot 22	*Cardamine hirsuta*	MSQNJRPCFO	HGIALDEBK
Plot 23	*Epilobium roseum*	INPROMEBHL	QGFASKJCD
Plot 24	*Poa annua*	LNCEIQDSAG	PMJRBKHOF

APPENDIX I

Sowing 2: 8 Leaf Stage Weed Observation Trial Layout

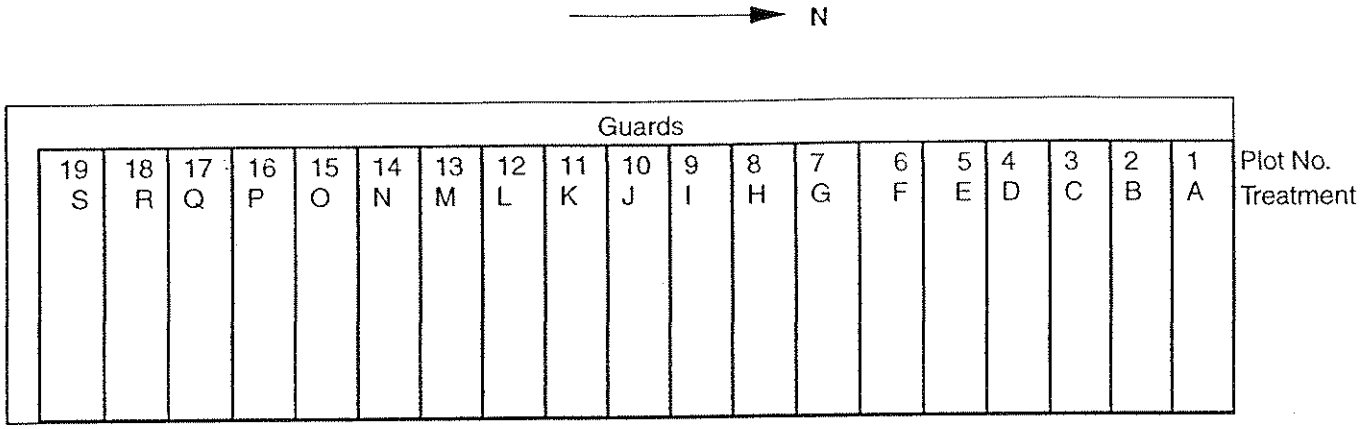


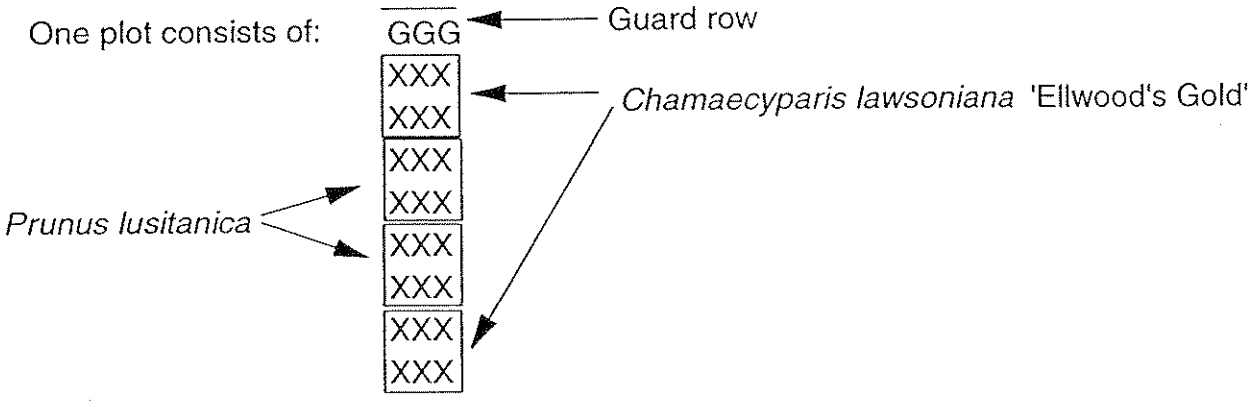
Key

Pot No.: 1- 3 = *Cardamine hirsuta* (hairy bittercress)
4 - 6 = *Epilobium roseum* (willow-herb)
7 - 9 = *Poa annua* (annual meadow grass)
10 - 12 = *Sagina procumbens* (pearlwort)
13 - 15 = *Oxalis corniculata*
16 - 17 = *Senecio vulgaris* (groundsel)
18 = *Sonchus arvensis* (sowthistle)

APPENDIX I

Nursery Stock Phytotoxicity Observation





APPENDIX II

Table 15 **First Sowing: 3-4 True Leaves - *Poa annua* (annual meadow grass)**

(Figures are a mean of 4 replicates, 3 pots/plot)

Treatment Application Date: 26 January 1996

Treatment Code	Chemical	Rate/m²	Pre-spray Count 25/1/96 No. Germinated	First Record 13/2/96 % Scorched		First Record 13/2/96 % Dead		Second Record 27/2/96 % Scorched		Second Record 27/2/96 % Dead		Third Record 19/3/96 % Scorched		Third Record 19/3/96 % Dead	
					(actual %)		(actual %)		(actual %)		(actual %)		(actual %)		(actual %)
A	Untreated	-	36.7	14.3	(8.9)	5.0	(2.9)	27.2	(21.2)	9.0	(8.7)	21.6	(15.0)	15.9	(15.1)
B	Basagran	0.3 ml	32.0	20.1	(12.6)	0.0	(0.0)	27.9	(22.7)	0.0	(0.0)	24.0	(18.5)	10.4	(4.5)
C	Croptex Bronze	0.56 ml	43.0	9.5	(6.8)	0.0	(0.0)	24.1	(16.4)	0.0	(0.0)	26.5	(18.5)	2.8	(1.5)
D	Ronstar Liquid	0.3 ml	45.2	74.9	(87.2)	7.0	(5.4)	38.4	(39.0)	51.4	(60.6)	27.1	(22.5)	62.6	(77.1)
E	Croptex Steel	2.0 g	53.5	19.0	(14.2)	3.4	(1.4)	43.7	(48.0)	46.0	(51.3)	4.7	(1.3)	85.3	(98.7)
F	Atlas CIPC 40	0.5 ml	53.2	12.5	(6.9)	0.0	(0.0)	37.1	(36.9)	5.4	(1.9)	53.8	(65.0)	32.9	(29.9)
G	Betanal E	0.5 ml	49.7	19.2	(10.5)	0.0	(0.0)	28.4	(20.9)	3.2	(2.3)	25.4	(15.7)	9.0	(5.1)
H	Fortrol	0.2 ml	46.5	10.2	(6.2)	2.9	(1.0)	34.2	(32.1)	22.2	(14.5)	30.3	(27.3)	26.4	(20.8)
I	Kerb 50 W	0.34 g	43.7	12.3	(6.3)	0.0	(0.0)	37.8	(37.9)	11.7	(6.1)	51.7	(61.5)	35.9	(34.5)
J	Nortron	0.5 ml	43.0	18.7	(10.4)	0.0	(0.0)	34.8	(33.1)	10.5	(6.5)	58.8	(72.6)	29.7	(25.1)
K	Sovereign	0.25 ml	34.5	19.9	(15.5)	0.0	(0.0)	28.6	(23.5)	11.0	(3.8)	48.5	(55.9)	19.6	(12.5)
L	Dow Shield	0.035 ml	43.5	10.6	(4.7)	2.1	(0.5)	22.1	(14.4)	2.1	(0.5)	23.3	(16.3)	6.9	(3.1)
M	Diuron 80 WP	0.05 g	43.5	11.0	(5.5)	2.7	(0.9)	25.9	(19.3)	10.2	(4.5)	21.6	(14.4)	16.3	(9.2)
N	Carbetamex	0.3 g	43.7	18.8	(10.7)	2.1	(0.5)	35.7	(34.2)	7.2	(3.4)	65.6	(82.6)	22.8	(15.3)
O	Armillatox	4.5 ml	50.7	42.8	(46.4)	37.6	(38.6)	32.8	(30.3)	46.8	(53.4)	29.4	(26.2)	46.2	(52.5)
P	Skirmish 495 SC	0.1 ml	50.0	10.9	(5.2)	0.0	(0.0)	25.0	(19.2)	0.0	(0.0)	32.0	(31.0)	19.7	(12.3)
Q	Goltix WG	0.3 g	41.2	18.5	(13.4)	4.3	(2.1)	40.2	(41.7)	36.0	(34.6)	36.1	(34.8)	46.4	(52.4)
R	Gesagard 50 WP	0.23 g	50.0	15.1	(7.4)	0.0	(0.0)	17.9	(9.6)	4.6	(2.5)	16.0	(7.7)	10.7	(5.0)
S	Atlas Red	2.2 ml	49.7	37.7	(38.2)	18.8	(14.2)	35.5	(33.9)	50.3	(59.0)	26.1	(21.0)	63.9	(79.0)
	d.f. = 52	*SED = ±*		*7.21*		*4.84*		*5.33*		*6.82*		*6.15*		*7.22*	
		LSD (5%) = ±		*14.4*		*9.7*		*10.7*		*13.6*		*12.3*		*14.4*	

Data were arcsine transformed before analysis; actual data are given in parentheses.

APPENDIX II

Table 15 (Continued) **First Sowing: 3-4 True Leaves - *Poa annua* (annual meadow grass)**

(Figures are a mean of 4 replicates, 3 pots/plot)

Treatment Application Date: 26 January 1996

Treatment Code	Chemical	Rate/m²	Fourth Record 22/4/96 % Scorched		Fourth Record 22/4/96 % Dead		Fifth Record 27/5/96 % Scorched		Fifth Record 27/5/96 % Dead	
				(actual %)		(actual %)		(actual %)		(actual %)
A	Untreated	-	0.0	(0.0)	39.3	(40.3)	0.0	(0.0)	39.3	(40.3)
B	Basagran	0.3 ml	0.0	(0.0)	29.1	(24.2)	2.4	(0.7)	28.9	(23.4)
C	Croptex Bronze	0.56 ml	4.3	(2.3)	40.9	(42.4)	4.1	(2.3)	40.7	(42.4)
D	Ronstar Liquid	0.3 ml	2.4	(0.7)	66.8	(83.5)	0.0	(0.0)	66.2	(82.8)
E	Croptex Steel	2.0g	0.0	(0.0)	88.1	(99.6)	0.0	(0.00	88.1	(99.6)
F	Atlas CIPC40	0.5 ml	0.0	(0.0)	90.0	(100.0)	0.0	(0.0)	90.0	(100.0)
G	Betanal E	0.5 ml	0.0	(0.0)	41.0	(42.3)	0.0	(0.0)	40.7	(42.3)
H	Fortrol	0.2 ml	0.0	(0.0)	43.2	(47.0)	0.0	(0.0)	43.2	(47.0)
I	Kerb 50 W	0.34g	0.0	(0.0)	90.0	(100.0)	0.0	(0.0)	90.0	(100.0)
J	Nortron	0.5 ml	12.2	(6.4)	70.3	(87.4)	12.2	(6.4)	70.3	(87.4)
K	Sovereign	0.25 ml	21.8	(17.9)	52.0	(61.9)	18.8	(13.6)	50.5	(59.2)
L	Dow Shield	0.035 ml	0.0	(0.0)	40.3	(42.0)	0.0	(0.0)	40.3	(42.0)
M	Diuron 80 WP	0.05g	0.0	(0.0)	45.7	(51.2)	2.3	(0.7)	45.7	(51.2)
N	Carbetemex	0.3g	4.7	(2.6)	85.3	(97.4)	2.3	(0.6)	87.7	(99.4)
O	Armillatox	4.5 ml	0.0	(0.0)	49.8	(58.2)	3.7	(1.6)	49.8	(58.2)
P	Skirmish 495SC	0.1 ml	5.9	(3.9)	55.7	(66.0)	6.4	(4.6)	54.1	(63.7)
Q	Goltix WG	0.3g	8.6	(5.1)	58.7	(72.7)	8.1	(4.5)	64.2	(78.8)
R	Gesagard 50WP	0.23g	0.0	(0.0)	39.7	(41.1)	0.0	(0.0)	39.7	(41.1)
S	Atlas Red	2.2 ml	2.1	(0.5)	88.0	(99.5)	0.0	(0.0)	90.0	(100.0)
	d.f. = 52 SED = ±		*4.47*		*4.71*		*4.25*		*4.59*	
	LSD(5%) = ±		8.9		9.4		8.5		9.2	

Data were arcsine transformed before analysis; actual data are given in parentheses.

APPENDIX II

Table 16 **First Sowing: 3-4 True Leaves - *Sagina procumbens* (pearlwort)**

(Figures are a mean of 4 replicates, 3 pots/plot)

Treatment Application Date: 26 January 1996

Treatment Code	Chemical	Rate/m²	Pre-spray Count 25/1/96 No. Germinated	First Record 13/2/96 % Scorched	(actual %)	First Record 13/2/96 % Dead	(actual %)	Second Record 27/2/96 % Scorched	(actual %)	Second Record 27/2/96 % Dead	(actual %)	Third Record 19/3/96 % Scorched	(actual %)	Third Record 19/3/96 % Dead	(actual %)
A	Untreated	-	88.8	8.8	(2.4)	7.7	(2.9)	17.8	(10.2)	35.9	(34.7)	30.7	(27.1)	38.4	(38.9)
B	Basagran	0.3 ml	114.0	7.8	(1.9)	13.5	(5.7)	20.9	(13.3)	59.5	(73.8)	27.7	(21.7)	58.9	(72.9)
C	Croptex Bronze	0.56 ml	116.3	5.8	(2.0)	11.9	(4.6)	17.9	(9.4)	54.8	(66.5)	23.0	(15.7)	54.2	(65.7)
D	Ronstar Liquid	0.3 ml	96.3	8.0	(2.8)	13.2	(5.8)	19.7	(11.6)	45.2	(50.3)	31.5	(29.0)	45.8	(51.4)
E	Croptex Steel	2.0 g	101.8	17.8	(9.7)	31.3	(27.8)	4.4	(1.3)	85.1	(98.4)	5.9	(2.1)	83.3	(97.3)
F	Atlas CIPC 40	0.5 ml	81.5	7.7	(1.9)	12.6	(5.6)	19.6	(12.0)	38.8	(39.3)	34.8	(35.1)	46.7	(53.8)
G	Betanal E	0.5 ml	84.5	6.5	(2.5)	8.7	(3.3)	22.4	(15.0)	50.4	(59.2)	23.3	(16.8)	53.0	(63.6)
H	Fortrol	0.2 ml	107.0	4.9	(1.5)	14.2	(6.4)	17.0	(8.6)	64.2	(80.7)	14.5	(6.7)	72.6	(90.9)
I	Kerb 50 W	0.34 g	88.5	7.2	(1.7)	9.9	(3.1)	19.6	(11.5)	40.4	(42.4)	34.5	(32.6)	42.2	(45.3)
J	Nortron	0.5 ml	67.0	7.1	(2.1)	14.1	(8.3)	22.1	(14.5)	45.1	(50.1)	39.3	(40.5)	42.4	(45.9)
K	Sovereign	0.25 ml	104.0	8.6	(2.3)	2.9	(0.5)	18.2	(10.9)	31.1	(28.9)	41.6	(44.9)	37.8	(38.2)
L	Dow Shield	0.035 ml	97.0	9.5	(3.0)	19.4	(11.6)	18.9	(10.6)	44.6	(49.2)	27.3	(22.0)	46.5	(52.6)
M	Diuron 80 WP	0.05 g	98.8	9.9	(3.0)	8.3	(2.8)	19.5	(11.6)	58.8	(73.1)	21.3	(13.8)	66.3	(83.2)
N	Carbetamex	0.3 g	80.5	12.5	(5.0)	19.3	(12.1)	24.0	(16.8)	44.8	(49.6)	31.4	(28.6)	46.3	(52.1)
O	Armillatox	4.5 ml	118.0	19.6	(12.4)	38.5	(39.9)	17.7	(9.8)	58.4	(71.7)	20.5	(13.6)	59.1	(72.4)
P	Skirmish 495 SC	0.1 ml	101.3	2.8	(0.5)	14.7	(6.9)	24.4	(17.3)	54.0	(65.3)	4.7	(1.3)	85.3	(98.7)
Q	Goltix WG	0.3 g	84.0	6.8	(2.0)	9.2	(2.6)	22.0	(14.2)	54.4	(65.0)	31.7	(29.1)	48.3	(55.4)
R	Gesagard 50 WP	0.23 g	71.3	12.5	(4.9)	14.4	(8.8)	20.5	(12.5)	62.5	(78.4)	19.7	(12.5)	66.0	(82.9)
S	Atlas Red	2.2 ml	95.8	6.4	(1.7)	17.2	(9.2)	17.1	(8.8)	67.2	(84.5)	17.8	(9.9)	70.0	(88.1)
	d.f. = 52	*SED = ±*		*3.83*		*4.84*		*3.14*		*5.02*		*5.46*		*5.16*	
		LSD (5%) = ±		*6.7*		*9.7*		*6.3*		*10.0*		*10.9*		*10.3*	

Data were arcsine transformed before analysis; actual data are given in parentheses.

APPENDIX II

Table 16 (continued) **First Sowing: 3-4 True Leaves – *Sagina procumbens* (pearlwort)**

Figures are a mean of 4 replicates, 3 pots/plot)

Treatment Application Date: 26 January 1996

Code	Chemical	Rate/m^2	Fourth Record 22/4/96 % Scorched		Fourth Record 22/4/96 % Dead		Fifth Record 21/5/96 % Scorched		Fifth Record 21/5/96 % Dead	
				(actual %)		(actual %)		(actual %)		(actual %)
A	Untreated	-	15.2	(9.1)	46.5	(52.8)	17.5	(9.7)	49.9	(58.0)
B	Basagran	0.3 ml	14.0	(7.7)	65.0	(81.6)	14.3	(6.3)	68.6	(86.6)
C	Croptex Bronze	0.56 ml	10.2	(4.2)	59.3	(73.9)	12.5	(5.2)	60.9	(76.3)
D	Ronstar Liquid	0.3 ml	17.3	(9.0)	51.0	(60.2)	9.9	(4.1)	54.7	(66.5)
E	Croptex Steel	2.0 g	5.9	(2.1)	83.7	(97.6)	7.5	(2.7)	82.5	(97.3)
F	Atlas CIPC 40	0.5 ml	1.7	(0.3)	88.4	(99.7)	0.0	(0.0)	90.0	(100.00)
G	Betanal E	0.5 ml	11.9	(4.6)	55.5	(67.5)	9.4	(3.0)	56.4	(68.9)
H	Fortrol	0.2 ml	4.0	(1.1)	73.7	(91.7)	11.1	(4.2)	71.5	(89.8)
I	Kerb 50 W	0.34 g	6.6	(1.9)	79.2	(96.1)	9.2	(3.8)	80.5	(95.9)
J	Nortron	0.5 ml	19.9	(12.4)	66.4	(83.8)	8.4	(4.5)	81.6	(95.5)
K	Sovereign	0.25 ml	24.7	(22.8)	57.5	(64.7)	20.9	(15.0)	66.6	(80.8)
L	Dow Shield	0.035 ml	9.4	(5.2)	56.1	(67.3)	10.9	(3.7)	49.6	(57.5)
M	Diuron	0.05 g	4.4	(1.3)	71.0	(88.5)	9.8	(3.8)	71.9	(89.8)
N	Carbetamex	0.3 g	19.8	(12.0)	46.1	(52.0)	15.7	(7.5)	56.9	(69.6)
O	Armillatox	4.5 ml	8.8	(3.5)	61.3	(76.2)	7.1	(2.1)	62.6	(78.2)
P	Skirmish 495 SC	0.1 ml	0.0	(0.0)	87.9	(99.5)	0.0	(0.0)	90.0	(100.0)
Q	Goltix	0.3 g	11.0	(5.5)	52.0	(61.5)	25.3	(20.4)	52.0	(61.8)
R	Gesagard 50 WP	0.23 g	6.2	(2.7)	65.6	(82.0)	14.0	(5.9)	63.2	(79.5)
S	Atlas Red	2.2 ml	4.5	(2.4)	79.4	(88.6)	0.0	(0.0)	90.0	(100.00)
	d.f. = 52	*SED = ±*	*5.41*		*6.87*		*4.40*		*4.97*	
		LSD (5%) = ±	*10.8*		*13.7*		*8.8*		*9.9*	

Data were arcsine transformed before analysis, actual data are given in parentheses.

APPENDIX II

Table 17

First Sowing: 8 Leaves - *Poa annua* (annual meadow grass)

(Figures are a mean of 4 replicates, 3 pots/plot)

Treatment Application Date: 6 March 1996

Treatment Code	Chemical	Rate/m²	Pre-spray count 5/3/96 No. Germinated	First Record 28/3/96 % Scorched	First Record 28/3/96 % Dead	Second Record 30/4/96 % Scorched	Second Record 30/4/96 % Dead	Third Record 28/5/96 % Scorched	Third Record 28/5/96 % Dead
A	Untreated	-	20.0	6.7	0.0	8.3	0.0	8.3	5.0
B	Basagran	0.3 ml	17.3	15.4	3.8	9.6	9.6	17.3	9.6
C	Croptex Bronze	0.56 ml	18.3	12.7	0.0	12.7	0.0	23.6	0.0
D	Ronstar Liquid	0.3 ml	20.0	46.7	3.3	11.7	5.0	15.0	6.7
E	Croptex Steel	2.0 g	21.0	77.8	6.3	28.6	23.8	22.2	30.2
F	Atlas CIPC 40	0.5 ml	23.0	31.9	5.8	78.3	21.7	26.1	73.9
G	Betanal E	0.5ml	18.0	81.5	3.7	9.3	1.9	13.0	1.9
H	Fortrol	0.2 ml	20.3	31.1	3.3	8.2	8.2	44.3	13.1
I	Kerb 50 W	0.34 g	23.0	33.3	10.1	49.3	50.7	0.0	100.0
J	Norton	0.5 ml	26.7	16.3	5.0	26.3	42.5	35.0	52.5
K	Sovereign	0.25 ml	19.3	8.6	0.0	37.9	1.7	98.3	1.7
L	Dow Shield	0.035 ml	21.7	0.0	0.0	7.7	0.0	9.2	6.2
M	Diuron 80 WP	0.05 g	15.3	2.2	0.0	76.1	2.2	21.7	2.2
N	Carbetamex	0.3 g	14.3	16.3	0.0	69.8	30.2	0.0	100.0
O	Armillatox	4.5 ml	24.0	30.6	0.0	30.6	0.0	5.6	25.0
P	Skirmish 495 SC	0.1 ml	18.0	3.7	0.0	5.6	1.9	1.9	5.6
Q	Goltix WG	0.3 g	19.7	32.2	6.8	67.8	32.2	42.4	32.2
R	Gesagard 50 WP	0.23 g	16.7	10.0	0.0	12.0	2.0	16.0	2.0
S	Atlas Red	2.2 ml	24.3	26.0	0.0	1.4	98.6	1.4	98.6

APPENDIX II

Table 18

First Sowing: 8 Leaves (Obervation) - *Sagina procumbens* (pearlwort)

(Figures are a mean of 7 pots/treatment)

Treatment Application Date: 6 March 1996

Treatment Code	Chemical	Rate/m^2	Pre-spray Count 5/3/96 No.Germinated	First Record 28/3/96 % Scorched	First Record 28/3/96 % Dead	Second Record 30/4/96 % Scorched	Second Record 30/4/96 % Dead	Third Record 28/5/96 % Scorched	Third Record 28/5/96 % Dead
A	Untreated	-	36.6	12.9	18.7	9.0	36.7	1.2	44.5
B	Basagran	0.3 ml	30.9	60.2	35.2	18.5	80.1	9.7	87.5
C	Croptex Bronze	0.56 ml	29.9	30.1	7.2	11.5	33.5	0.5	44.0
D	Ronstar Liquid	0.3ml	33.3	8.6	3.0	11.2	18.0	0.0	29.2
E	Croptex Steel	2.0 g	40.7	26.3	31.2	52.3	43.9	7.4	62.1
F	Atlas CIPC 40	0.5 ml	36.9	81.4	11.2	39.1	60.9	19.8	78.3
G	Betanal E	0.5 ml	25.9	41.4	50.8	6.6	68.5	1.7	73.5
H	Fortrol	0.2 ml	31.3	28.8	70.8	1.4	98.6	1.8	98.2
I	Kerb 50 W	0.34 g	33.9	8.0	3.0	35.4	64.6	6.8	85.7
J	Nortron	0.5 ml	38.7	12.9	2.6	66.4	33.6	32.5	67.5
K	Sovereign	0.25 ml	36.9	23.3	5.4	81.0	16.3	73.6	26.0
L	Dow Shield	0.035 ml	28.0	23.0	10.7	30.6	11.7	11.2	31.1
M	Diuron 80 WP	0.05 g	32.7	31.0	62.9	10.5	86.0	0.9	87.3
N	Carbetamex	0.3 g	25.4	16.9	2.2	27.5	11.2	0.6	25.3
O	Armillatox	4.5 ml	41.1	21.5	5.6	21.2	8.0	0.0	29.2
P	Skirmish 495 SC	0.1 ml	24.6	29.1	70.3	0.0	100.0	0.0	100.0
Q	Goltix WG	0.3 g	30.4	22.5	74.6	6.1	93.9	6.1	93.9
R	Gesagard 50 WP	0.23 g	32.0	28.6	64.7	13.4	82.1	0.4	82.1
S	Atlas Red	2.2 ml	25.9	20.4	70.7	0.6	99.4	0.0	100.0

APPENDIX III

Table 19 **Second Sowing: 3-4 True Leaves - *Cardamine hirsuta* (hairy bitter-cress)**

(Figures are a mean of 4 replicates, 3 pots/plot)

Treatment Application Date: 10 April 1996

Treatment Code	Chemical	Rate/m²	Pre-spray Count 10/4/96 No. Germinated	First Record 24/4/96 % Scorched	(actual %)	First Record 24/4/96 % Dead	(actual %)	Second Record 28/5/96 % Scorched	(actual %)	Second Record 28/5/96 % Dead	(actual %)	Third Record 10/6/96 % Scorched	(actual %)	Third Record 10/6/96 % Dead	(actual %)
A	Untreated	-	28.5	3.2	(1.2)	0.0	(0.0)	0.0	(0.0)	0.0	(0.0)	0.0	(0.0)	0.0	(0.0)
B	Basagran	0.3 ml	26.7	56.5	(68.6)	33.5	(31.4)	0.0	(0.0)	90.0	(100.0)	0.0	(0.0)	86.3	(98.3)
C	Croptex Bronze	0.56 ml	34.5	59.8	(73.8)	9.5	(6.7)	3.2	(1.2)	74.6	(90.8)	0.0	(0.0)	75.6	(91.8)
D	Ronstar Liquid	0.3 ml	27.2	66.7	(78.3)	23.3	(21.7)	17.4	(12.2)	44.3	(49.1)	0.0	(0.0)	47.1	(53.4)
E	Croptex Steel	2.0 g	35.0	22.5	(20.0)	0.0	(0.0)	44.0	(42.9)	4.1	(2.0)	9.4	(9.4)	11.7	(7.9)
F	Atlas CIPC 40	0.5 ml	33.7	28.5	(23.9)	4.7	(2.6)	13.6	(7.7)	28.2	(24.0)	0.0	(0.0)	33.5	(30.7)
G	Betanal E	0.5 ml	33.7	33.6	(31.7)	0.0	(0.0)	2.0	(0.5)	0.0	(0.0	0.0	(0.0)	2.0	(0.5)
H	Fortrol	0.2 ml	31.5	63.4	(78.0)	7.5	(2.2)	0.0	(0.0)	90.0	(100.0)	0.0	(0.0)	85.3	(98.6)
I	Kerb 50 W	0.34 g	28.7	2.5	(0.8)	0.0	(0.0)	28.3	(28.9)	0.0	(0.0)	0.0	(0.0)	5.8	(3.9)
J	Nortron	0.5 ml	24.7	4.3	(2.2)	0.0	(0.0)	83.1	(94.6)	0.0	(0.0)	64.7	(74.9)	0.0	(0.0)
K	Sovereign	0.25 ml	29.2	29.5	(25.0)	0.0	(0.0)	25.5	(20.2)	7.0	(5.5)	0.0	(0.0)	28.3	(22.8)
L	Dow Shield	0.035 ml	32.0	3.2	(1.2)	2.2	(0.6)	63.0	(67.3)	0.0	(0.0)	13.2	(15.8)	11.7	(10.1)
M	Diuron 80 WP	0.05 g	33.0	53.4	(64.1)	14.7	(12.1)	0.0	(0.0)	90.0	(100.0)	0.0	(0.0)	90.0	(100.0)
N	Carbetamex	0.3 g	31.8	7.0	(3.0)	0.0	(0.0)	6.7	(5.1)	7.0	(3.0)	0.0	(0.0)	13.8	(8.2)
O	Armillatox	4.5 ml	28.2	13.8	(8.4)	2.4	(0.7)	0.0	(0.0)	8.9	(4.9)	0.0	(0.0)	8.9	(4.9)
P	Skirmish 495 SC	0.1 ml	29.0	78.8	(94.7)	11.2	(5.3)	0.0	(0.0)	90.0	(100.0)	0.0	(0.0)	90.0	(100.0)
Q	Goltix WG	0.3 g	31.0	36.0	(34.8)	2.8	(0.9)	8.0	(4.0)	41.2	(43.5)	0.0	(0.0)	41.9	(44.7)
R	Gesagard 50 WP	0.23 g	27.5	72.3	(89.5)	16.6	(8.9)	0.0	(0.0)	87.1	(99.0)	0.0	(0.0)	87.1	(99.0)
S	Atlas Red	2.2 ml	33.2	65.8	(82.8)	6.5	(2.6)	0.0	(0.0)	90.0	(100.0)	0.0	(0.0)	90.0	(100.0)
	d.f. = 54	*SED = ±*		*7.12*		*5.93*		*11.19*		*5.11*		*6.81*		*6.17*	
		LSD (5%) = ±		*14.2*		*11.9*		*22.4*		*10.2*		*13.6*		*12.3*	

Data were arcsine transformed before analysis; actual data are given in parentheses.

APPENDIX III

Table 20 **Second Sowing: 3-4 True Leaves - *Epilobium roseum* (pedicelled willowherb)**

(Figures are a mean of 4 replicates, 3 pots/plot)

Treatment Application Date: 10 April 1996

Treatment Code	Chemical	Rate/m²	Pre-spray Count 9/4/96 No. Germinated	First Record 25/4/96 % Scorched	(actual %)	First Record 25/4/96 % Dead	(actual %)	Second Record 28/5/96 % Scorched	(actual %)	Second Record 28/5/96 % Dead	(actual %)	Third Record 10/6/96 % Scorched	(actual %)	Third Record 10/6/96 % Dead	(actual %)
A	Untreated	-	69.0	0.0	(0.0)	0.0	(0.0)	4.2	(2.0)	10.6	(6.7)	0.0	(0.0)	21.0	(17.6)
B	Basagran	0.3 ml	56.7	44.8	(49.7)	31.4	(28.8)	0.0	(0.0)	90.0	(100.0)	0.0	(0.0)	90.0	(100.0)
C	Croptex Bronze	0.56 ml	76.0	60.8	(75.8)	7.1	(3.9)	1.3	(0.2)	74.2	(89.9)	0.0	(0.0)	74.4	(90.1)
D	Ronstar Liquid	0.3 ml	57.5	29.1	(23.9)	60.9	(76.1)	10.0	(3.4)	72.6	(90.6)	0.0	(0.0)	72.6	(90.6)
E	Croptex Steel	2.0 g	73.0	44.9	(49.6)	0.0	(0.0)	0.0	(0.0)	20.2	(15.6)	0.0	(0.0)	27.2	(21.2)
F	Atlas CIPC 40	0.5 ml	55.7	16.4	(10.5)	0.0	(0.0)	26.3	(22.7)	51.1	(59.0)	2.2	(0.6)	51.7	(60.1)
G	Betanal E	0.5 ml	73.8	30.1	(26.0)	4.4	(1.2)	4.5	(1.3)	52.7	(62.2)	0.0	(0.0)	53.4	(63.3)
H	Fortrol	0.2 ml	56.7	37.6	(37.5)	13.9	(10.0)	1.7	(0.3)	66.4	(82.8)	0.0	(0.0)	67.1	(83.7)
I	Kerb 50 W	0.34 g	69.8	5.7	(2.2)	0.0	(0.0)	52.2	(56.2)	35.7	(40.9)	30.9	(32.6)	52.6	(62.6)
J	Nortron	0.5 ml	84.3	1.8	(0.4)	0.0	(0.0)	87.5	(99.2)	2.5	(0.8)	16.5	(16.3)	16.0	(8.4)
K	Sovereign	0.25 ml	72.3	47.5	(54.0)	24.5	(17.8)	10.2	(4.2)	68.3	(85.3)	2.3	(0.6)	68.5	(85.6)
L	Dow Shield	0.035 ml	73.3	4.2	(1.1)	0.0	(0.0)	0.0	(0.0)	90.0	(100.0)	0.0	(0.0)	90.0	(100.0)
M	Diuron 80 WP	0.05 g	76.8	46.6	(52.4)	9.5	(3.9)	0.0	(0.0)	90.0	(100.0)	0.0	(0.0)	90.0	(100.0)
N	Carbetamex	0.3 g	75.5	2.4	(0.7)	0.0	(0.0)	0.0	(0.0)	9.9	(6.0)	0.0	(0.0)	14.8	(7.6)
O	Armillatox	4.5 ml	69.3	3.3	(0.7)	0.0	(0.0)	0.0	(0.0)	5.9	(2.5)	0.0	(0.0)	12.2	(6.9)
P	Skirmish 495 SC	0.1 ml	66.0	48.0	(55.2)	5.0	(1.7)	1.6	(0.3)	88.4	(99.7)	0.0	(0.0)	88.4	(99.7)
Q	Goltix WG	0.3 g	69.0	19.8	(11.2)	0.0	(0.0)	0.0	(0.0)	37.3	(36.8)	0.0	(0.0)	38.1	(38.3)
R	Gesagard 50 WP	0.23 g	80.8	38.7	(39.4)	11.3	(4.3)	0.0	(0.0)	88.5	(99.7)	0.0	(0.0)	86.6	(99.3)
S	Atlas Red	2.2 ml	68.8	44.8	(49.3)	9.5	(5.6)	5.0	(1.5)	79.8	(95.2)	0.0	(0.0)	80.1	(95.9)
	d.f. = 54	*SED = ±*		*5.33*		*4.60*		*5.92*		*7.39*		*5.25*		*6.29*	
		LSD (5%) = ±		*10.7*		*9.2*		*11.8*		*14.8*		*10.5*		*12.6*	

Data were arcsine transformed before analysis; actual data are given in parentheses.

APPENDIX III

Table 21

Second Sowing: 3-4 True Leaves - *Poa annua* (annual meadow grass)

(Figures are a mean of 4 replicates, 3 pots/plot)

Treatment Application Date: 10 April 1996

Treatment Code	Chemical	Rate/m²	Pre-spray Count 9/4/96 No. Germinated	First Record 25/4/96 % Scorched		First Record 25/4/96 % Dead	Second Record 28/5/96 % Scorched		Second Record 28/5/96 % Dead		Third Record 10/6/96 % Scorched		Third Record 10/6/96 % Dead	
					(actual %)			(actual %)		(actual %)		(actual %)		(actual %)
A	Untreated	-	65.8	0.0	(0.0)	0.0	4.6	(2.5)	0.0	(0.0)	0.0	(0.0)	4.6	(2.5)
B	Basagran	0.3 ml	65.8	2.6	(0.8)	0.0	0.0	(0.0)	0.0	(0.0)	0.0	(0.0)	1.9	(0.4)
C	Croptex Bronze	0.56 ml	70.8	19.1	(10.9)	0.0	9.5	(5.4)	2.7	(0.8)	0.0	(0.0)	6.1	(4.2)
D	Ronstar Liquid	0.3 ml	64.3	90.0	(100.0)	0.0	17.5	(17.2)	0.0	(0.0)	0.0	(0.0)	0.0	(0.0)
E	Croptex Steel	2.0 g	62.5	41.5	(44.7)	0.0	40.2	(47.0)	10.2	(6.2)	0.0	(0.0)	11.2	(7.4)
F	Atlas CIPC 40	0.5 ml	58.5	10.4	(4.4)	0.0	0.0	(0.0)	2.7	(0.9)	0.0	(0.0)	2.7	(0.9)
G	Betanal E	0.5 ml	61.7	4.9	(1.6)	0.0	0.0	(0.0)	0.0	(0.0)	0.0	(0.0)	0.0	(0.0)
H	Fortrol	0.2 ml	62.0	42.1	(45.0)	0.0	2.5	(0.7)	28.9	(29.6)	0.0	(0.0)	28.9	(29.6)
I	Kerb 50 W	0.34 g	65.3	7.6	(3.6)	0.0	68.0	(84.5)	22.0	(15.5)	17.1	(16.5)	72.9	(83.5)
J	Nortron	0.5 ml	72.3	0.0	(0.0)	0.0	0.0	(0.0)	0.0	(0.0)	0.0	(0.0)	0.0	(0.0)
K	Sovereign	0.25 ml	61.7	4.5	(1.2)	0.0	7.1	(5.6)	0.0	(0.0)	0.0	(0.0)	0.0	(0.0)
L	Dow Shield	0.035 ml	62.5	0.0	(0.0)	0.0	33.8	(34.9)	2.5	(0.7)	0.0	(0.0)	2.5	(0.7)
M	Diuron 80 WP	0.05 g	68.8	23.6	(16.7)	0.0	0.0	(0.0)	5.8	(3.8)	0.0	(0.0)	5.8	(3.8)
N	Carbetamex	0.3 g	59.2	0.0	(0.0)	0.0	31.0	(27.8)	10.0	(6.1)	0.0	(0.0)	10.0	(6.1)
O	Armillatox	4.5 ml	52.7	44.9	(49.9)	0.0	0.0	(0.0)	0.0	(0.0)	0.0	(0.0)	0.0	(0.0)
P	Skirmish 495 SC	0.1 ml	58.0	40.6	(43.4)	0.0	9.8	(3.9)	53.1	(62.3)	0.0	(0.0)	53.1	(62.3)
Q	Goltix WG	0.3 g	60.0	12.2	(5.1)	0.0	0.0	(0.0)	0.0	(0.0)	0.0	(0.0)	0.0	(0.0)
R	Gesagard 50 WP	0.23 g	66.0	6.3	(2.5)	0.0	0.0	(0.0)	5.7	(3.8)	0.0	(0.0)	5.7	(3.8)
S	Atlas Red	2.2 ml	60.5	58.1	(71.4)	0.0	31.1	(28.4)	41.2	(43.5)	0.0	(0.0)	45.0	(50.0)
	d.f. = 54	*SED = ±*		*5.12*			*8.95*		*6.55*				*7.59*	
		LSD (5%) = ±		*10.2*			*17.9*		*13.1*				*15.2*	

Data were arcsine transformed before analysis; actual data are given in parentheses.

APPENDIX III

Table 22 **Second Sowing: 3-4 True Leaves - *Sagina procumbens* (pearlwort)**

(Figures are a mean of 4 replicates, 3 pots/plot)

Treatment Application Date: 10 April 1996

Treatment Code	Chemical	Rate/m²	Pre-spray Count 9/4/96 No. Germinated	First Record 25/4/96 % Scorched	(actual %)	First Record 25/4/96 % Dead	(actual %)	Second Record 28/5/96 % Scorched	(actual %)	Second Record 28/5/96 % Dead	(actual %)	Third Record 10/6/96 % Scorched	(actual %)	Third Record 10/6/96 % Dead	(actual %)
A	Untreated	-	81.5	0.0	(0.0)	0.0	(0.0)	0.0	(0.0)	0.0	(0.0)	0.0	(0.0)	0.0	(0.0)
B	Basagran	0.3 ml	84.3	44.6	(49.2)	2.5	(0.7)	1.5	(0.3)	86.7	(98.7)	1.5	(0.3)	86.7	(98.7)
C	Croptex Bronze	0.56 ml	97.5	39.1	(39.9)	0.0	(0.0)	0.0	(0.0)	45.3	(50.5)	0.0	(0.0)	41.6	(44.4)
D	Ronstar Liquid	0.3 ml	81.3	7.9	(2.7)	0.0	(0.0)	0.0	(0.0)	3.6	(1.5)	0.0	(0.0)	3.6	(1.5)
E	Croptex Steel	2.0 g	86.3	1.8	(0.4)	0.0	(0.0)	45.9	(50.4)	29.1	(25.0)	21.7	(14.0)	45.1	(50.1)
F	Atlas CIPC 40	0.5 ml	94.5	14.8	(6.8)	0.0	(0.0)	25.4	(18.7)	56.0	(68.4)	2.6	(0.8)	56.4	(68.9)
G	Betanal E	0.5 ml	90.5	25.9	(19.1)	0.0	(0.0)	0.0	(0.0)	12.6	(9.1)	0.0	(0.0)	12.6	(9.1)
H	Fortrol	0.2 ml	95.0	45.2	(50.3)	0.0	(0.0)	0.0	(0.0)	86.5	(99.2)	0.0	(0.0)	86.5	(99.2)
I	Kerb 50 W	0.34 g	77.3	3.4	(1.4)	0.0	(0.0)	34.6	(32.5)	29.9	(26.3)	11.3	(5.4)	37.3	(38.6)
J	Nortron	0.5 ml	76.8	0.0	(0.0)	0.0	(0.0)	60.9	(75.4)	26.4	(20.3)	9.6	(3.9)	42.9	(46.3)
K	Sovereign	0.25 ml	81.3	24.8	(17.9)	5.1	(3.1)	0.0	(0.0)	23.2	(20.2)	0.0	(0.0)	23.2	(20.2)
L	Dow Shield	0.035 ml	97.8	0.0	(0.0)	0.0	(0.0)	0.0	(0.0)	3.0	(1.1)	0.0	(0.0)	3.0	(1.1)
M	Diuron 80 WP	0.05 g	87.0	43.9	(48.1)	0.0	(0.0)	0.0	(0.0)	86.8	(99.4)	0.0	(0.0)	86.8	(99.4)
N	Carbetamex	0.3 g	90.5	0.0	(0.0)	0.0	(0.0)	0.0	(0.0)	0.0	(0.0)	0.0	(0.0)	0.0	(0.0)
O	Armillatox	4.5 ml	81.8	13.4	(5.4)	0.0	(0.0)	0.0	(0.0)	0.0	(0.0)	0.0	(0.0)	0.0	(0.0)
P	Skirmish 495 SC	0.1 ml	90.3	63.4	(78.4)	1.4	(0.2)	0.0	(0.0)	90.0	(100.0)	0.0	(0.0)	90.0	(100.0)
Q	Goltix WG	0.3 g	92.0	27.1	(20.8)	0.0	(0.0)	2.3	(0.6)	20.4	(15.8)	0.0	(0.0)	20.9	(16.4)
R	Gesagard 50 WP	0.23 g	89.3	56.3	(68.8)	0.0	(0.0)	0.0	(0.0)	90.0	(100.0)	0.0	(0.0)	90.0	(100.0)
S	Atlas Red	2.2 ml	77.3	35.8	(34.2)	1.9	(0.4)	1.9	(0.4)	85.2	(98.4)	0.0	(0.0)	87.3	(99.1)
	d.f. = 54	*SED = ±*		*3.63*		*1.96*		*4.17*		*5.48*		*2.14*		*5.83*	
		LSD (5%) = ±		*7.3*		*3.9*		*8.3*		*11.0*		*4.3*		*11.7*	

Data were arcsine transformed before analysis; actual data are given in parentheses.

APPENDIX III

Table 23

Second Sowing: 3-4 True Leaves - *Senecio vulgaris* (groundsel)

(Figures are a mean of 4 replicates, 3 pots/plot)

Treatment Application Date: 10 April 1996

Treatment Code	Chemical	Rate/m²	Pre-spray Count 9/4/96 No. Germinated	First Record 25/4/96 % Scorched		First Record 25/4/96 % Dead		Second Record 28/5/96 % Scorched		Second Record 28/5/96 % Dead		Third Record 10/6/96 % Scorched	Third Record 10/6/96 % Dead	
					(actual %)		(actual %)		(actual %)		(actual %)			(actual %)
A	Untreated	-	47.0	4.2	(1.1)	0.0	(0.0)	0.0	(0.0)	0.0	(0.0)	0.0	6.6	(4.9)
B	Basagran	0.3 ml	51.2	54.4	(64.3)	21.6	(23.5)	3.3	(1.3)	52.5	(61.6)	0.0	54.6	(64.5)
C	Croptex Bronze	0.56 ml	52.0	27.4	(23.4)	2.4	(0.7)	2.4	(0.7)	29.4	(25.0)	0.0	30.7	(27.0)
D	Ronstar Liquid	0.3 ml	49.0	74.4	(80.3)	15.6	(19.7)	2.5	(0.8)	30.2	(31.8)	0.0	38.5	(39.2)
E	Croptex Steel	2.0 g	55.0	54.8	(60.1)	0.0	(0.0)	0.0	(0.0)	13.0	(10.3)	0.0	22.8	(15.9)
F	Atlas CIPC 40	0.5 ml	45.5	27.1	(22.7)	0.0	(0.0)	0.0	(0.0)	18.8	(13.7)	0.0	25.0	(18.1)
G	Betanal E	0.5 ml	49.5	50.4	(59.2)	20.6	(16.3)	0.0	(0.0)	46.8	(52.6)	0.0	47.6	(53.8)
H	Fortrol	0.2 ml	41.5	39.0	(42.1)	48.7	(54.4)	2.0	(0.5)	76.9	(92.9)	0.0	76.9	(92.9)
I	Kerb 50 W	0.34 g	36.2	21.7	(15.2)	0.0	(0.0)	0.0	(0.0)	4.0	(1.9)	0.0	3.5	(1.5)
J	Nortron	0.5 ml	40.7	15.0	(10.0)	0.0	(0.0)	0.0	(0.0)	9.2	(5.1)	0.0	13.0	(9.7)
K	Sovereign	0.25 ml	44.2	73.7	(88.6)	13.6	(10.5)	0.0	(0.0)	36.9	(36.2)	0.0	38.2	(38.5)
L	Dow Shield	0.035 ml	47.2	90.0	(100.0)	0.0	(0.0)	0.0	(0.0)	90.0	(100.0)	0.0	90.0	(100.0)
M	Diuron 80 WP	0.05 g	50.2	29.8	(25.6)	0.0	(0.0)	0.0	(0.0)	19.8	(15.9)	0.0	25.4	(19.4)
N	Carbetamex	0.3 g	49.0	12.0	(5.8)	0.0	(0.0)	0.0	(0.0)	22.5	(15.1)	0.0	23.4	(16.3)
O	Armillatox	4.5 ml	43.2	35.3	(33.5)	0.0	(0.0)	0.0	(0.0)	3.9	(1.9)	0.0	6.5	(2.7)
P	Skirmish 495 SC	0.1 ml	38.5	26.0	(21.2)	0.0	(0.0)	0.0	(0.0)	15.9	(10.6)	0.0	19.6	(14.7)
Q	Goltix WG	0.3 g	43.7	39.5	(40.7)	9.6	(6.3)	0.0	(0.0)	30.3	(31.6)	0.0	34.7	(33.9)
R	Gesagard 50 WP	0.23 g	45.7	30.9	(27.2)	18.6	(14.3)	0.0	(0.0)	46.5	(52.6)	0.0	48.1	(55.4)
S	Atlas Red	2.2 ml	51.2	52.7	(63.2)	21.5	(17.8)	2.1	(0.5)	39.8	(42.7)	0.0	43.6	(48.0)
	d.f. = 54	*SED = ±*		*9.85*		*8.92*		*1.76*		*8.77*			*7.99*	
		LSD (5%) = ±		*19.7*		*17.8*		*3.5*		*17.5*			*16.0*	

Data were arcsine transformed before analysis; actual data are given in parentheses.

APPENDIX III

Table 24

Second Sowing: 3-4 True Leaves - *Oxalis corniculata*

(Figures are a mean of 4 replicates, 3 pots/plot)

Treatment Application Date: 10 April 1996

Treatment Code	Chemical	Rate/m²	Pre-spray Count 10/4/96 No. Germinated	First Record 29/4/96				Second Record 29/5/96				Third Record 10/6/96			
				% Scorched		% Dead		% Scorched		% Dead		% Scorched		% Dead	
					(actual %)		(actual %)		(actual %)		(actual %)		(actual %)		(actual %)
A	Untreated	-	52.0	4.3	(1.1)	0.0	(0.0)	3.9	(1.8)	0.0	(0.0)	0.0	(0.0)	0.0	(0.0)
B	Basagran	0.3 ml	49.5	65.0	(79.3)	25.0	(20.7)	12.9	(7.7)	41.0	(45.3)	0.0	(0.0)	41.0	(45.3)
C	Croptex Bronze	0.56 ml	45.0	62.1	(74.7)	25.0	(24.3)	16.5	(11.9)	28.6	(29.0)	0.0	(0.0)	28.6	(29.0)
D	Ronstar Liquid	0.3 ml	42.2	0.0	(0.0)	90.0	(100.0)	15.9	(8.2)	68.9	(86.9)	0.0	(0.0)	69.4	(87.5)
E	Croptex Steel	2.0 g	50.0	77.3	(92.5)	5.7	(2.0)	68.7	(81.4)	11.8	(5.9)	39.2	(46.1)	12.5	(6.7)
F	Atlas CIPC 40	0.5 ml	47.0	25.3	(18.5)	6.1	(4.3)	60.4	(74.3)	20.6	(17.1)	24.0	(21.9)	55.3	(67.1)
G	Betanal E	0.5 ml	50.7	19.1	(11.0)	0.0	(0.0)	26.3	(19.8)	0.0	(0.0)	0.0	(0.0)	0.0	(0.0)
H	Fortrol	0.2 ml	55.7	38.0	(42.7)	52.0	(57.3)	13.3	(11.6)	69.9	(82.3)	0.0	(0.0)	69.7	(81.8)
I	Kerb 50 W	0.34 g	52.0	17.0	(8.7)	0.0	(0.0)	38.7	(39.5)	51.3	(60.5)	0.0	(0.0)	90.0	(100.0)
J	Nortron	0.5 ml	48.7	61.5	(69.1)	0.0	(0.0)	27.4	(25.0)	7.4	(3.4)	0.0	(0.0)	7.4	(3.4)
K	Sovereign	0.25 ml	47.2	28.0	(22.5)	2.3	(0.7)	21.9	(14.4)	7.0	(3.0)	0.0	(0.0)	7.0	(3.0)
L	Dow Shield	0.035 ml	46.0	31.7	(27.9)	0.0	(0.0)	45.4	(50.3)	37.2	(37.7)	28.9	(26.0)	58.9	(70.2)
M	Diuron 80 WP	0.05 g	45.0	13.5	(10.8)	76.5	(89.2)	2.0	(0.5)	85.9	(99.0)	0.0	(0.0)	85.9	(99.0)
N	Carbetamex	0.3 g	45.7	25.3	(19.5)	0.0	(0.0)	61.4	(71.0)	28.6	(29.0)	45.2	(50.2)	43.8	(48.6)
O	Armillatox	4.5 ml	45.7	21.7	(14.4)	0.0	(0.0)	16.4	(9.2)	0.0	(0.0)	0.0	(0.0)	0.0	(0.0)
P	Skirmish 495 SC	0.1 ml	41.2	38.4	(39.7)	51.6	(60.3)	16.3	(8.4)	71.4	(89.5)	0.0	(0.0)	71.9	(90.0)
Q	Goltix WG	0.3 g	42.0	90.0	(100.0)	0.0	(0.0)	15.8	(9.9)	10.4	(6.9)	0.0	(0.0)	10.4	(6.9)
R	Gesagard 50 WP	0.23 g	41.0	59.4	(71.5)	20.2	(21.4)	16.4	(8.2)	30.2	(32.4)	0.0	(0.0)	31.5	(33.9)
S	Atlas Red	2.2 ml	43.2	77.4	(85.1)	0.0	(0.0)	32.8	(30.9)	57.2	(69.1)	0.0	(0.0)	83.6	(97.5)
	d.f. = 54	*SED = ±*		*10.37*		*8.51*		*8.77*		*7.97*		*9.65*		*8.33*	
		LSD (5%) = ±		*20.7*		*17.0*		*17.5*		*15.9*		*19.3*		*16.7*	

Data were arcsine transformed before analysis; actual data are given in parentheses.

APPENDIX III

Table 25 **Second Sowing: 8 Leaves (Observation) - *Cardamine hirsuta* (hairy bitter-cress)**

(Figures are a mean of 3 pots/treatment)

Treatment Application Date: 26 April 1996

Treatment Code	Chemical	Rate/m²	Pre-spray Count 23/4/96 No. Germinated	First Record 30/4/96 % Scorched	First Record 30/4/96 % Dead	Second Record 29/5/96 % Scorched	Second Record 29/5/96 % Dead	Third Record 14/6/96 % Scorched	Third Record 14/6/96 % Dead
A	Untreated	-	5.3	0.0	0.0	31.3	0.0	37.5	0.6
B	Basagran	0.3 ml	6.3	89.5	10.5	0.0	100.0	0.0	100.0
C	Croptex Bronze	0.56 ml	5.3	62.5	6.3	0.0	93.8	0.0	94.4
D	Ronstar Liquid	0.3 ml	5.7	41.2	58.8	0.0	100.0	0.0	70.0
E	Croptex Steel	2.0 g	6.0	100.0	0.0	5.6	22.2	16.7	21.7
F	Atlas CIPC 40	0.5 ml	4.7	50.0	0.0	28.6	35.7	36.4	27.1
G	Betanal E	0.5 ml	6.7	90.0	5.0	0.0	65.0	34.5	65.5
H	Fortrol	0.2 ml	4.7	28.6	0.0	0.0	21.4	79.3	20.7
I	Kerb 50 W	0.34 g	4.3	30.8	0.0	38.5	0.0	69.2	0.8
J	Nortron	0.5 ml	5.3	93.8	6.3	0.0	100.0	0.0	100.0
K	Sovereign	0.25 ml	6.0	11.1	0.0	72.2	0.0	55.0	16.7
L	Dow Shield	0.035 ml	5.3	25.0	0.0	18.8	18.8	37.5	19.4
M	Diuron 80 WP	0.05 g	6.3	68.4	15.8	0.0	100.0	0.0	100.0
N	Carbetamex	0.3 g	7.0	90.5	4.8	4.8	90.5	10.0	90.0
O	Armillatox	4.5 ml	5.7	94.1	5.9	5.9	64.7	30.0	64.7
P	Skirmish 495 SC	0.1 ml	4.0	75.0	25.0	0.0	100.0	0.0	100.0
Q	Goltix WG	0.3 g	5.0	93.3	6.7	0.0	100.0	0.0	100.0
R	Gesagard 50 WP	0.23 g	6.0	100.0	0.0	0.0	100.0	0.0	100.0
S	Atlas Red	2.2 ml	4.0	91.7	8.3	0.0	100.0	0.0	100.0

APPENDIX III

Table 26

Second Sowing: 8 Leaves (Observation) - *Epilobium roseum* (pedicelled willowherb)

(Figures are a mean of 3 pots/treatment)

Treatment Application Date: 26 April 1996

Treatment Code	Chemical	Rate/m²	Pre-spray Count 25/4/96 No. Germinated	First Record 30/4/96 % Scorched	First Record 30/4/96 % Dead	Second Record 29/5/96 % Scorched	Second Record 29/5/96 % Dead	Third Record 14/6/96 % Scorched	Third Record 14/6/96 % Dead
A	Untreated	-	14.7	0.0	0.0	0.0	6.8	0.0	6.6
B	Basagran	0.3 ml	15.7	23.4	0.0	0.0	100.0	0.0	100.0
C	Croptex Bronze	0.56 ml	13.0	38.5	5.1	0.0	87.2	0.0	86.9
D	Ronstar Liquid	0.3 ml	11.7	22.9	77.1	8.6	91.4	6.0	94.0
E	Croptex Steel	2.0 g	14.3	44.2	55.8	4.7	93.0	4.9	90.2
F	Atlas CIPC 40	0.5 ml	15.0	4.4	0.0	88.9	6.7	71.3	24.0
G	Betanal E	0.5 ml	12.3	27.0	0.0	2.7	86.5	2.4	87.0
H	Fortrol	0.2 ml	9.7	20.7	0.0	34.5	58.6	34.1	58.6
I	Kerb 50 W	0.34 g	9.0	51.9	0.0	37.0	63.0	30.0	70.0
J	Nortron	0.5 ml	14.7	11.4	0.0	4.5	95.5	4.8	95.2
K	Sovereign	0.25 ml	11.0	0.0	0.0	93.9	6.1	90.9	9.1
L	Dow Shield	0.035 ml	11.3	26.5	0.0	11.8	88.2	0.0	100.0
M	Diuron 80 WP	0.05 g	14.7	38.6	0.0	0.0	100.0	0.0	100.0
N	Carbetamex	0.3 g	12.3	32.4	5.4	18.9	78.4	18.6	78.9
O	Armillatox	4.5 ml	9.3	42.9	0.0	14.3	71.4	10.7	75.4
P	Skirmish 495 SC	0.1 ml	11.7	11.4	0.0	0.0	100.0	0.0	100.0
Q	Goltix WG	0.3 g	8.3	32.0	8.0	0.0	100.0	0.0	100.0
R	Gesagard 50 WP	0.23 g	14.3	41.9	2.3	0.0	100.0	0.0	100.0
S	Atlas Red	2.2 ml	11.7	40.0	0.0	0.0	100.0	0.0	100.0

APPENDIX III

Table 27

Second Sowing: 8 Leaves (Observation) - *Poa annua* (annual meadow grass)

(Figures are a mean of 3 pots/treatment)

Treatment Application Date: 26 April 1996

Treatment Code	Chemical	Rate/m²	Pre-spray Count 25/4/96 No. Germinated	First Record 30/4/96 % Scorched	First Record 30/4/96 % Dead	Second Record 29/5/96 % Scorched	Second Record 29/5/96 % Dead	Third Record 14/6/96 % Scorched	Third Record 14/6/96 % Dead
A	Untreated	-	6.3	0.0	0.0	42.1	0.0	42.6	0.0
B	Basagran	0.3 ml	8.0	0.0	0.0	0.0	0.0	0.0	0.0
C	Croptex Bronze	0.56 ml	7.0	28.6	0.0	19.0	0.0	18.6	0.0
D	Ronstar Liquid	0.3 ml	7.0	100.0	0.0	100.0	0.0	100.0	0.0
E	Croptex Steel	2.0 g	8.0	91.7	0.0	87.5	0.0	87.5	0.0
F	Atlas CIPC 40	0.5 ml	8.7	7.7	0.0	88.5	11.5	88.8	11.2
G	Betanal E	0.5 ml	6.0	5.6	0.0	22.2	0.0	21.7	0.0
H	Fortrol	0.2 ml	7.0	0.0	0.0	4.8	0.0	10.0	0.0
I	Kerb 50 W	0.34 g	7.7	0.0	0.0	87.0	13.0	78.3	21.7
J	Nortron	0.5 ml	5.7	29.4	0.0	76.5	23.5	75.9	24.1
K	Sovereign	0.25 ml	6.3	0.0	0.0	94.7	0.0	94.7	0.5
L	Dow Shield	0.035 ml	4.7	0.0	0.0	0.0	0.0	0.0	0.0
M	Diuron 80 WP	0.05 g	6.7	0.0	0.0	60.0	0.0	60.0	0.0
N	Carbetamex	0.3 g	5.7	0.0	0.0	100.0	0.0	100.0	0.0
O	Armillatox	4.5 ml	9.3	100.0	0.0	67.9	0.0	67.5	0.4
P	Skirmish 495 SC	0.1 ml	7.0	0.0	0.0	52.4	9.5	67.1	22.9
Q	Goltix WG	0.3 g	7.7	13.0	0.0	43.5	0.0	43.0	0.9
R	Gesagard 50 WP	0.23 g	7.3	9.1	0.0	27.3	0.0	27.3	0.5
S	Atlas Red	2.2 ml	10.0	23.3	0.0	100.0	0.0	100.0	0.0

APPENDIX III

Table 28

Second Sowing: 8 Leaves (Observation) - *Sagina procumbens* (pearlwort)

(Figures are a mean of 3 pots/treatment)

Treatment Application Date: 26 April 1996

Treatment Code	Chemical	Rate/m²	Pre-spray Count 25/4/96 No. Germinated	First Record 30/4/96 % Scorched	First Record 30/4/96 % Dead	Second Record 29/5/96 % Scorched	Second Record 29/5/96 % Dead	Third Record 14/6/96 % Scorched	Third Record 14/6/96 % Dead
A	Untreated	-	20.7	1.6	0.0	0.0	0.0	0.0	27.4
B	Basagran	0.3 ml	21.3	71.9	3.1	1.6	89.1	0.0	92.0
C	Croptex Bronze	0.56 ml	23.3	72.9	4.3	0.0	85.7	0.0	85.9
D	Ronstar Liquid	0.3 ml	16.0	18.8	0.0	0.0	0.0	0.0	0.0
E	Croptex Steel	2.0 g	17.7	15.1	0.0	1.9	5.7	1.7	6.0
F	Atlas CIPC 40	0.5 ml	17.3	3.8	0.0	53.8	1.9	53.7	1.9
G	Betanal E	0.5 ml	16.3	75.5	8.2	8.2	87.8	4.3	91.4
H	Fortrol	0.2 ml	17.7	0.0	0.0	26.4	0.0	24.3	2.1
I	Kerb 50 W	0.34 g	19.7	0.0	0.0	0.0	0.0	0.0	0.0
J	Nortron	0.5 ml	21.3	54.7	37.5	0.0	100.0	0.0	100.0
K	Sovereign	0.25 ml	16.0	0.0	0.0	83.3	12.5	73.1	22.5
L	Dow Shield	0.035 ml	16.3	0.0	0.0	0.0	0.0	0.0	0.2
M	Diuron 80 WP	0.05 g	19.7	57.6	28.8	0.0	100.0	0.0	100.0
N	Carbetamex	0.3 g	14.3	11.6	0.0	7.0	7.0	7.0	7.2
O	Armillatox	4.5 ml	18.0	64.8	0.0	0.0	0.0	0.0	0.0
P	Skirmish 495 SC	0.1 ml	21.3	93.8	0.0	0.0	100.0	0.0	100.0
Q	Goltix WG	0.3 g	13.7	82.9	2.4	7.3	90.2	5.1	92.7
R	Gesagard 50 WP	0.23 g	17.7	77.4	18.9	0.0	100.0	0.0	100.0
S	Atlas Red	2.2 ml	13.7	73.2	0.0	0.0	100.0	0.0	100.0

APPENDIX III

Table 29 **Second Sowing: 8 Leaves (Observation) - *Senecio vulgaris* (groundsel)**

(Figures are a mean of 3 pots/treatment)

Treatment Application Date: 26 April 1996

Treatment Code	Chemical	Rate/m²	Pre-spray Count 25/4/96 No. Germinated	First Record 30/4/96 % Scorched	First Record 30/4/96 % Dead	Second Record 29/5/96 % Scorched	Second Record 29/5/96 % Dead	Third Record 14/6/96 % Scorched	Third Record 14/6/96 % Dead
A	Untreated	-	6.5	7.7	0.0	7.7	7.7	7.7	7.7
B	Basagran	0.3 ml	10.5	100.0	0.0	42.9	57.1	42.9	57.1
C	Croptex Bronze	0.56 ml	4.0	75.0	0.0	0.0	0.0	0.0	0.0
D	Ronstar Liquid	0.3 ml	7.0	57.1	42.9	0.0	78.6	35.7	14.3
E	Croptex Steel	2.0 g	7.5	93.3	6.7	26.7	20.0	13.3	80.0
F	Atlas CIPC 40	0.5 ml	6.5	23.1	0.0	92.3	7.7	92.3	7.7
G	Betanal E	0.5 ml	4.0	25.0	0.0	25.0	75.0	12.5	87.5
H	Fortrol	0.2 ml	7.5	20.0	0.0	0.0	26.7	0.0	26.7
I	Kerb 50 W	0.34 g	6.5	7.7	0.0	0.0	15.4	0.0	15.4
J	Nortron	0.5 ml	5.5	18.2	0.0	0.0	100.0	0.0	100.0
K	Sovereign	0.25 ml	6.5	0.0	0.0	30.8	53.8	30.8	0.0
L	Dow Shield	0.035 ml	5.5	100.0	0.0	54.5	45.5	0.0	100.0
M	Diuron 80 WP	0.05 g	6.5	0.0	0.0	69.2	30.8	69.2	30.8
N	Carbetamex	0.3 g	7.0	28.6	0.0	85.7	0.0	85.7	0.0
O	Armillatox	4.5 ml	3.0	100.0	0.0	100.0	0.0	100.0	0.0
P	Skirmish 495 SC	0.1 ml	10.5	42.9	0.0	52.4	47.6	52.4	47.6
Q	Goltix WG	0.3 g	13.0	92.3	0.0	30.8	65.4	26.9	69.2
R	Gesagard 50 WP	0.23 g	11.5	39.1	0.0	21.7	78.3	21.7	78.3
S	Atlas Red	2.2 ml	8.0	50.0	0.0	31.3	68.8	31.3	68.8

APPENDIX III

Table 30

Second Sowing: 8 Leaves (Observation)- *Oxalis corniculata*

(Figures are a mean of 3 pots/treatment)

Treatment Application Date: 26 April 1996

Treatment Code	Chemical	Rate/m²	Pre-spray Count 25/4/96 No. Germinated	First Record 30/4/96 % Scorched	First Record 30/4/96 % Dead	Second Record 29/5/96 % Scorched	Second Record 29/5/96 % Dead	Third Record 14/6/96 % Scorched	Third Record 14/6/96 % Dead
A	Untreated	-	11.3	26.7	0.0	11.1	0.0	17.8	0.0
B	Basagran	0.3 ml	8.7	88.5	3.8	0.0	38.5	0.0	38.8
C	Croptex Bronze	0.56 ml	12.0	80.6	0.0	5.6	44.4	10.8	45.0
D	Ronstar Liquid	0.3 ml	10.0	20.0	80.0	0.0	100.0	0.0	100.0
E	Croptex Steel	2.0 g	8.5	82.4	17.6	17.6	17.6	35.3	17.6
F	Atlas CIPC 40	0.5 ml	11.0	21.2	0.0	97.0	3.0	54.5	45.5
G	Betanal E	0.5 ml	14.0	50.0	4.8	71.4	28.6	71.4	28.6
H	Fortrol	0.2 ml	8.7	57.7	0.0	42.3	0.0	46.2	0.0
I	Kerb 50 W	0.34 g	8.7	7.7	0.0	80.8	19.2	42.7	57.3
J	Nortron	0.5 ml	12.7	21.1	0.0	0.0	100.0	0.0	100.0
K	Sovereign	0.25 ml	12.3	16.2	0.0	35.1	0.0	38.1	0.0
L	Dow Shield	0.035 ml	10.7	25.0	31.3	81.3	18.8	81.6	18.4
M	Diuron 80 WP	0.05 g	10.0	23.3	0.0	0.0	100.0	0.0	73.0
N	Carbetamex	0.3 g	13.3	15.0	0.0	70.0	30.0	52.5	47.5
O	Armillatox	4.5 ml	9.0	92.6	0.0	22.2	0.0	33.3	0.0
P	Skirmish 495 SC	0.1 ml	11.3	50.0	0.0	0.0	100.0	0.0	100.0
Q	Goltix WG	0.3 g	11.3	100.0	0.0	29.4	61.8	29.1	62.1
R	Gesagard 50 WP	0.23 g	10.0	16.7	0.0	26.7	73.3	27.0	73.0
S	Atlas Red	2.2 ml	11.0	30.3	0.0	33.3	66.7	9.1	90.9

APPENDIX IV

HONS Phytotoxicity Records

Table 31 **Assessed on 14 March 1996**

Treatment Application Date: 30 January 1996

Treatment Code	Chemical	Rate/m²	Species	Phytotoxicity
D	**Ronstar Liquid**	**0.3 ml**	*Prunus*	Some leaf necrosis
F	**Atlas CIPC 40**	**0.5 ml**	*Chamaecyparis*	Moderate tip necrosis

Table 32 **Assessed on 17 April 1996**

Treatment Application Dates: 30 January 1996 + 17 April 1996

Treatment Code	Chemical	Rate/m²	Species	Phytotoxicity
C	**Croptex Bronze**	**0.56 ml**	*Prunus*	Reduced new growth
E	**Croptex Steel**	**2.0 g**	*Prunus*	Moderate leaf necrosis and leaf drop
			Chamaecyparis	Slight tip necrosis
L	**Dow Shield**	**0.035 ml**	*Prunus*	Slight leaf necrosis

APPENDIX IV

HONS Phytotoxicity Records

Table 33 **Assessed on 20 May 1996**

Treatment Application Date: 30 January 1996 + 17 April 1996

Treatment Code	Chemical	Rate/m²	Species	Phytotoxicity
B	**Basagran**	**0.3 ml**	*Prunus*	Some reduced growth
D	**Ronstar Liquid**	**0.3 ml**	*Prunus*	Some reduced growth
E	**Croptex Steel**	**2.0 g**	*Chamaecyparis*	Reduced amount of new growth
N	**Carbetamex**	**0.3 g**	*Chamaecyparis*	Reduced amount of new growth

Table 34 **Assessed on 20 June 1996**

Treatment Application Dates: 30 January 1996 + 17 April 1996

Treatment Code	Chemical	Rate/m²	Species	Phytotoxicity
B	**Basagran**	**0.3 ml**	*Prunus*	Some chlorosis and necrosis of lower leaves
D	**Ronstar Liquid**	**0.3 ml**	*Prunus*	Some necrotic spots on older foliage; reduced growth
			Chamaecyparis	Reduced new growth
E	**Croptex Steel**	**2.0 g**	*Prunus*	Moderate leaf necrosis and leaf drop
			Chamaecyparis	Some necrotic patches; little new growth
F	**Atlas CIPC 40**	**0.5 ml**	*Chamaecyparis*	Necrotic patches on lower foliage; reduced growth
M	**Diuron 80 WP**	**0.05 g**	*Prunus*	Reduced growth
N	**Carbetamex**	**0.3 g**	*Chamaecyparis*	Necrotic patches; reduced growth
S	**Atlas Red**	**2.2 ml**	*Prunus*	Reduced growth
			Chamaecyparis	Some necrosis; reduced growth

APPENDIX IV

HONS Phytotoxicity Records

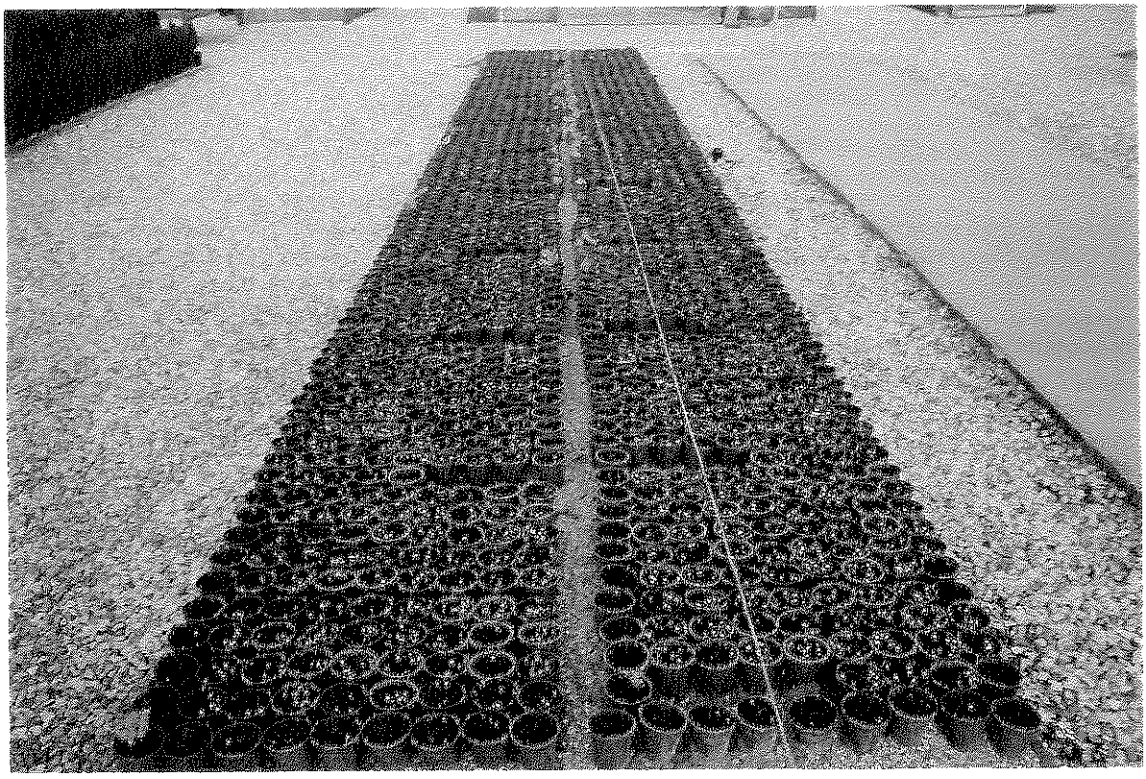
Table 35 **Final Growth Records – 24 June 1996**
(Figures are a mean of 12 plants)
Treatment Application Date: 26 January 1996

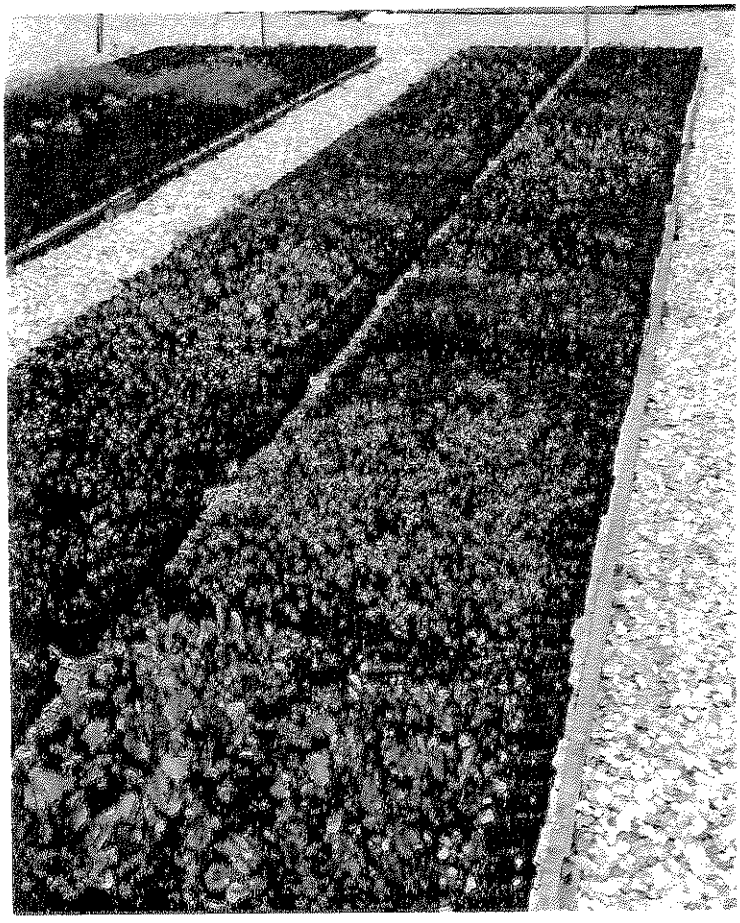
Treatment Code	Chemical	Rate/m^2	*Prunus lusitanica* Size Score 1 to 5 (5 = largest)	*Prunus lusitanica* Stage of New Growth Score 1 to 5 (5 – most advanced)	*C.l.* 'Ellwood's Gold' Size Score 1 to 5 (5 = largest)	*C.l.* 'Ellwood's Gold' Stage of New Growth Score 1 to 5 (5 = most advanced)
A	Untreated	-	4.00	3.83	4.09	4.27
B	Basagran	0.3 ml	4.17	3.17	4.00	4.50
C	Croptex Bronze	0.56 ml	4.00	3.33	4.50	4.83
D	Ronstar Liquid	0.3 ml	3.17	3.17	4.17	3.50
E	Croptex Steel	2.0 g	4.50	3.33	3.00	3.17
F	Atlas CIPC 40	0.5 ml	4.00	3.83	3.00	3.83
G	Betanal E	0.5 ml	4.67	3.67	4.82	4.64
H	Fortrol	0.2 ml	4.67	3.67	4.17	4.67
I	Kerb 50 W	0.34 g	4.00	3.83	4.33	4.00
J	Nortron	0.5 ml	3.67	3.33	4.33	3.83
K	Sovereign	0.25 ml	4.00	3.33	4.17	4.33
L	Dow Shield	0.035ml	5.00	4.17	3.67	4.33
M	Diuron 80 WP	0.05 g	3.17	3.17	4.17	4.17
N	Carbetamex	0.3 g	4.33	3.50	2.83	3.50
O	Armillatox	4.5 ml	4.50	3.67	4.33	4.67
P	Skirmish 495 SC	0.1 ml	4.17	3.67	4.45	4.45
Q	Goltix WG	0.3 g	4.33	3.83	3.50	3.67
R	Gesagard 50 WP	0.23 g	3.00	3.33	4.00	3.67
S	Atlas Red	2.2 ml	2.83	2.50	2.17	1.17

APPENDIX V

Plate 1 General Layout of Replicated Weed Trial

February 1996





May 1996

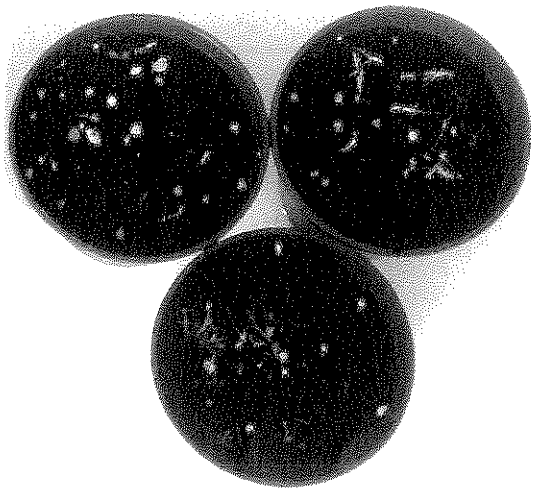
APPENDIX V

Plate 2

First Sowing: 3-4 Leaf Stage
Treatment Comparisons – *Poa annua*

26 March 1996 (Treatments applied 26 February 1996)

Control



Ronstar Liquid 0.3 ml/m^2

Croptex Steel 2.0 ml/m^2

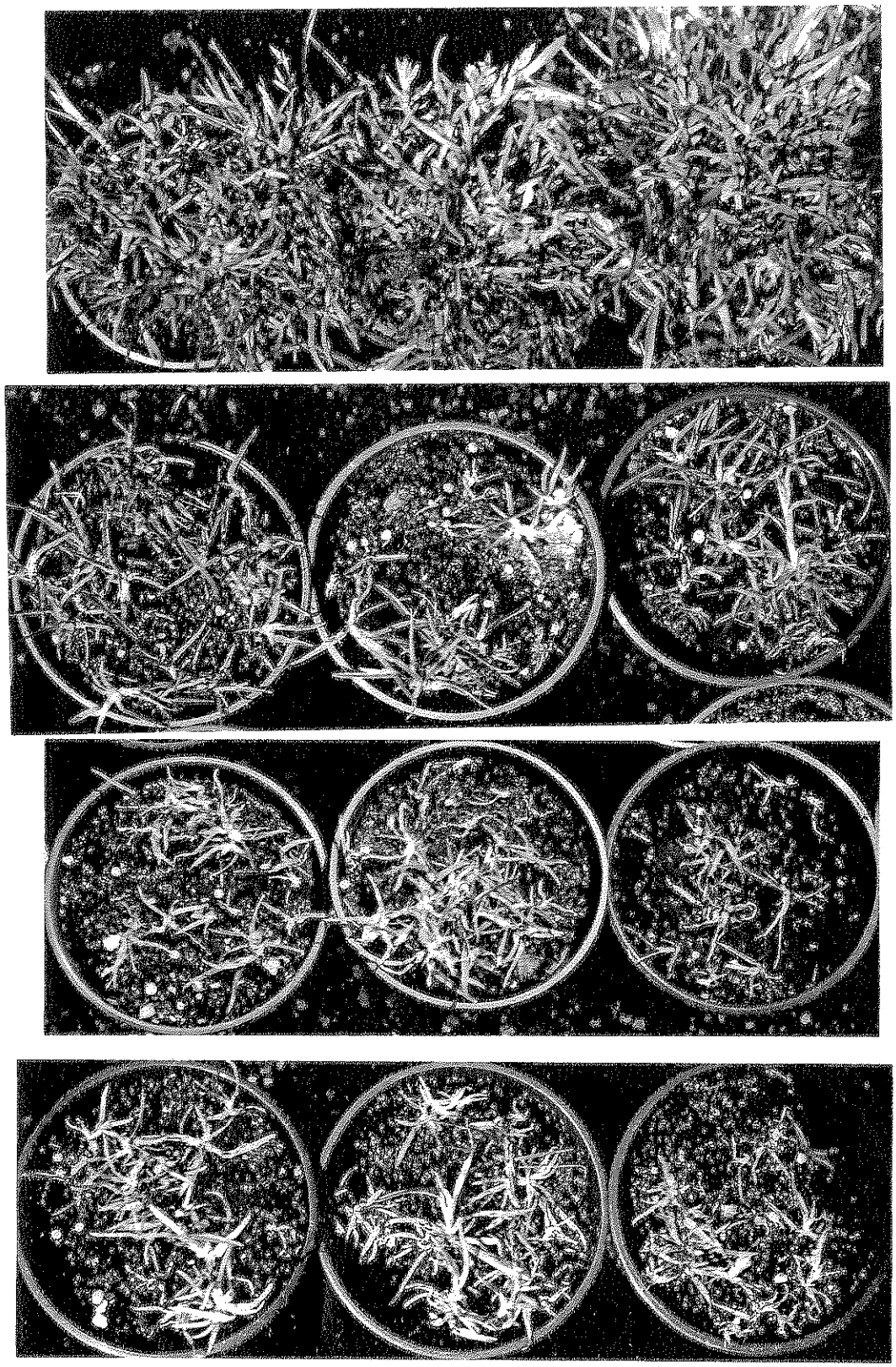
Kerb 50 W 0.34 g/m^2

APPENDIX V

Plate 3

First sowing: 8 Leaf Stage Observation
Treatment Comparisons – *Poa annua*

28 May 1996 (Treatments applied 6 March 1996)



Control

Atlas CIPC 40
0.5 ml/m^2

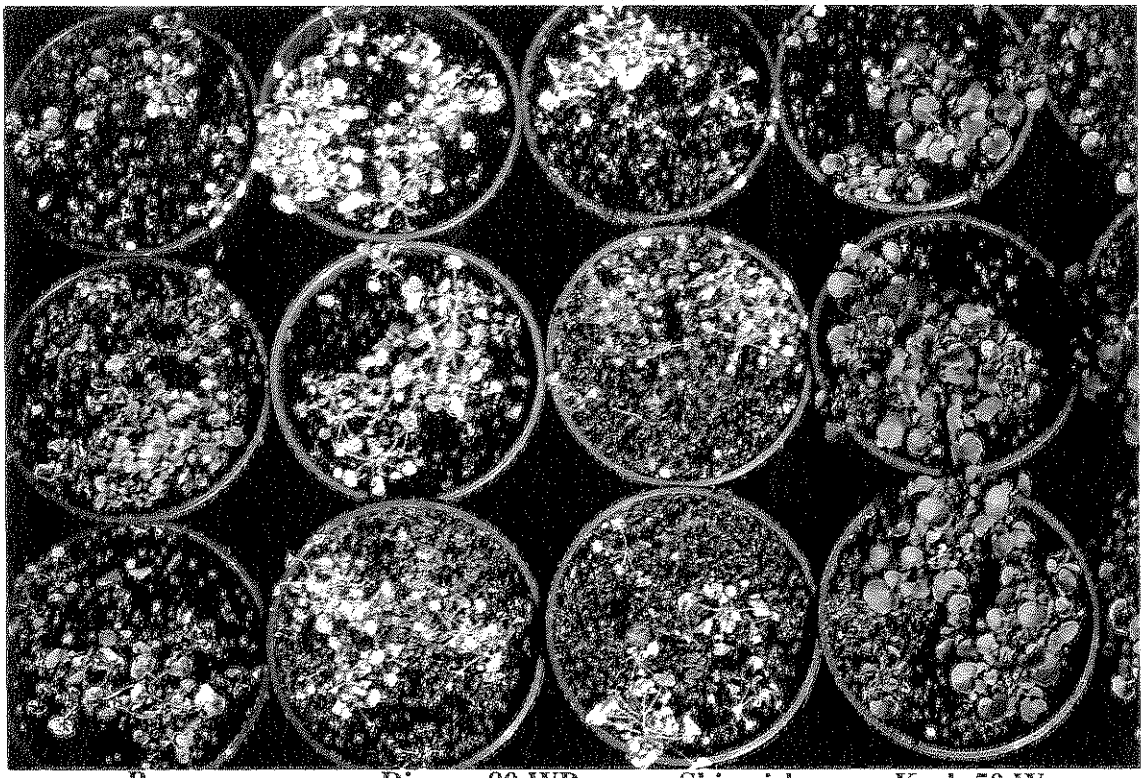
Carbetamex
0.3 g/m^2

Kerb 50 W
0.34 g/m^2

APPENDIX V

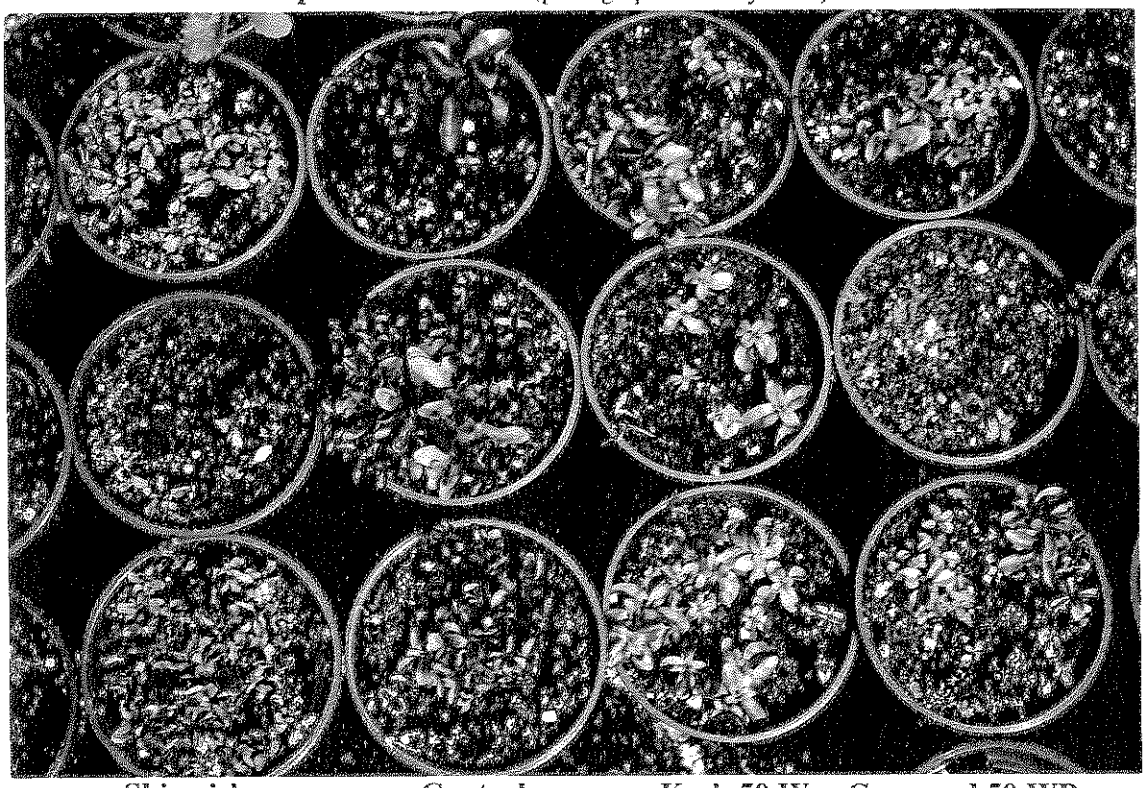
Plate 4 **Second Sowing: 3-4 Leaf Stage** (Treatments applied 10 April 1996)

Cardamine hirsuta (photographed 8 May 1996



Basagran	Diuron 80 WP	Skirmish	Kerb 50 W
0.3ml/m^2	0.05 ml/m^2	0.1 ml/m^2	0.34g/m^2

Epilobium roseum (photographed 8 May 1996)

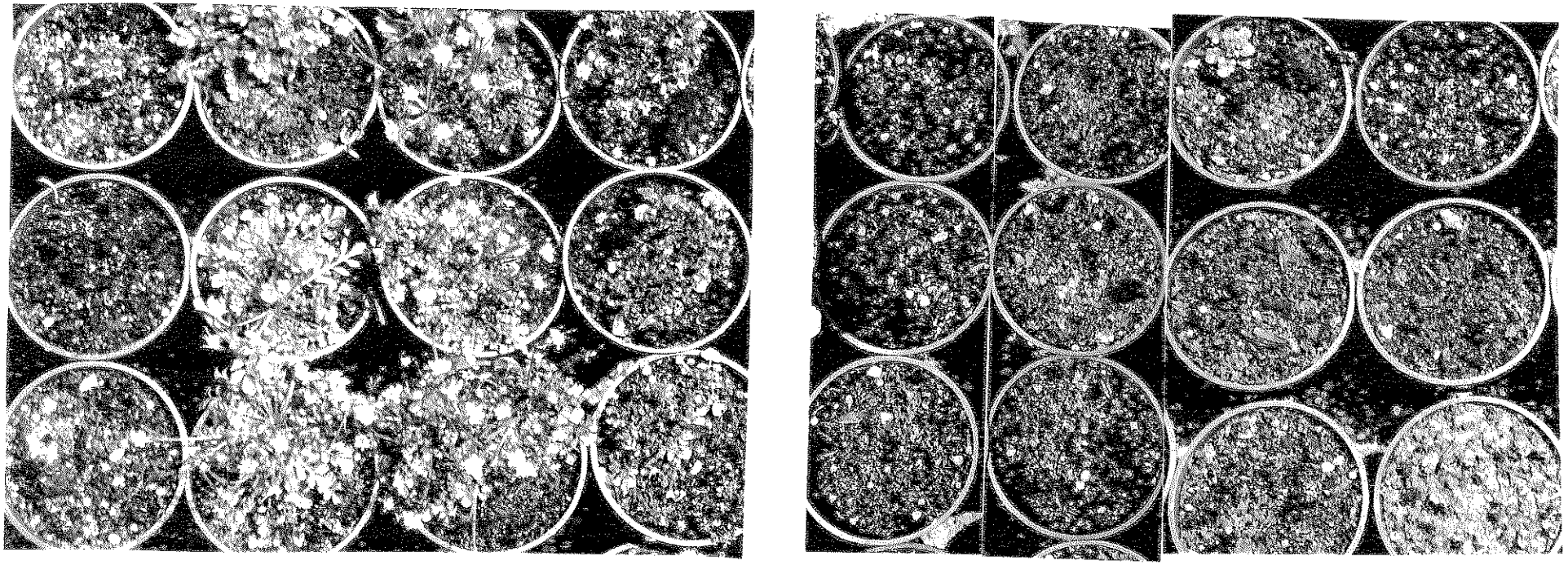


Skirmish	Control	Kerb 50 W	Gesagard 50 WP
0.1 ml/m^2		0.34 g/m^2	0.23 g/m^2

APPENDIX V

Plate 5 **Second Sowing: 3-4 Leaf Stage** (Treatments applied 10 April 1996)

Cardamine hirsuta (photographed 4 June 1996)

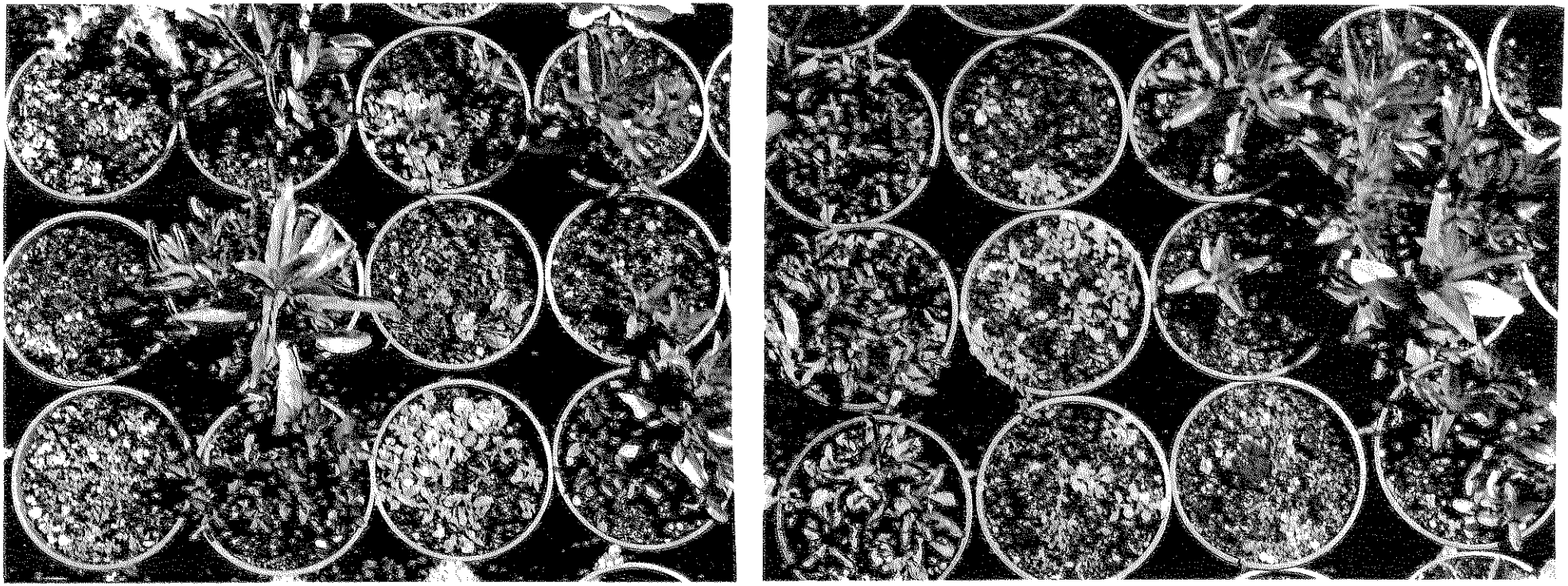


Diuron	Control	Kerb 50 W	Dow Shield	Skirmish	Basagran	Fortrol	Gesagard 50 WP
0.05 g/m^2		0.34 g/m^2	0.035 ml/m^2	0.1 ml/m^2	0.3 ml/m^2	0.2 ml/m^2	0.23 g/m^2

APPENDIX V

Plate 6 **Second Sowing: 3-4 Leaf Stage** (Treatments applied 10 April 1996)

Epilobium roseum (photographed 4 June 1996)

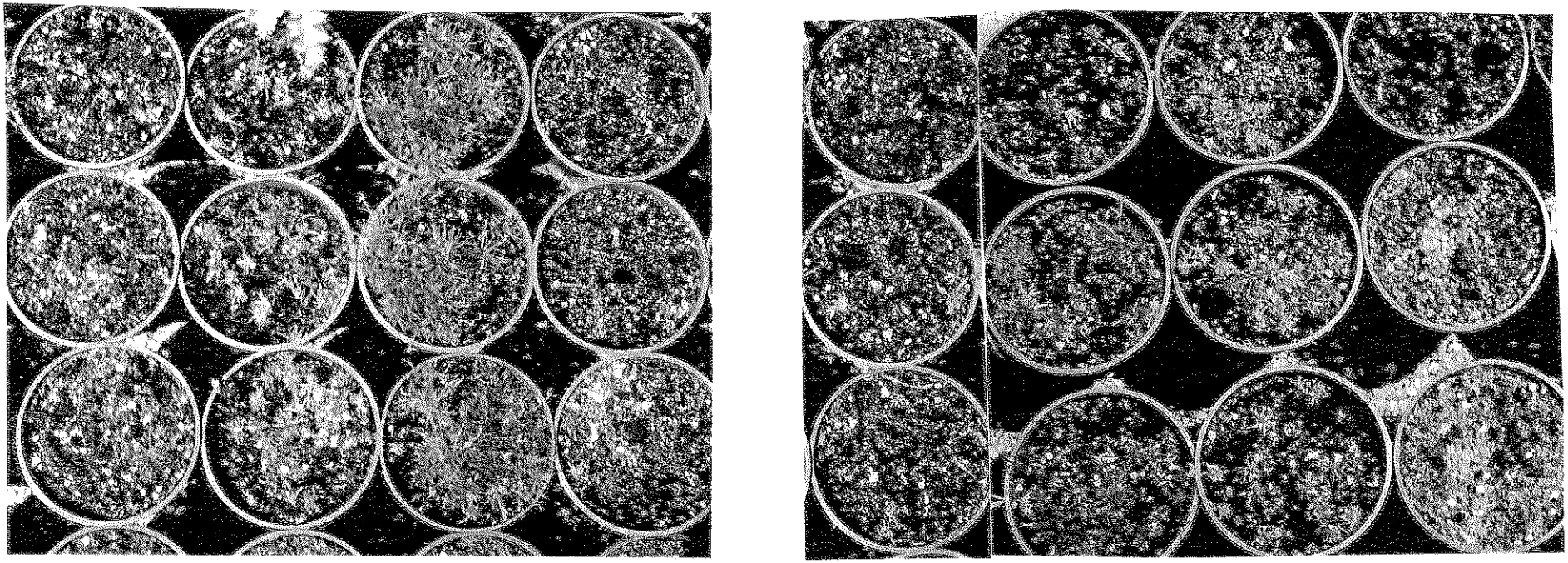


Diuron	Control	Kerb 50 W	Carbetamex	Nortron	Dow Shield	Fortrol	Control
0.05 g/m^2		0.34 g/m^2	0.3g/m^2	0.5 ml/m^2	0.035 ml/m^2	0.2 ml/m^2	

APPENDIX V

Plate 7 **Second Sowing: 3-4 Leaf Stage** (Treatments applied 10 April 1996)

Sagina procumbens (photographed 28 May 1996)

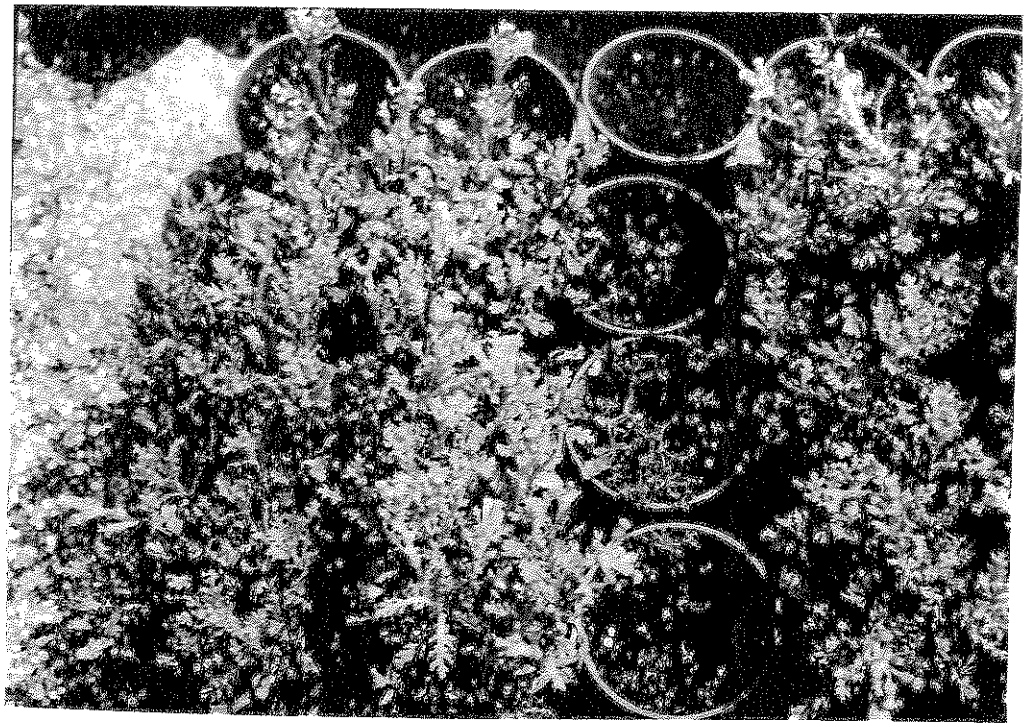


Fortrol 0.2 ml/m^2 | **Croptex Steel** 2.0 g/m2 | **Control** | **Basagran** 0.3 ml/m^2 | **Diuron** 0.05 ml/m^2 | **Kerb** 0.34 g/m^2 | **Nortron** 0.5 ml/m^2 | **Skirmish** 0.1 ml/m^2

APPENDIX V

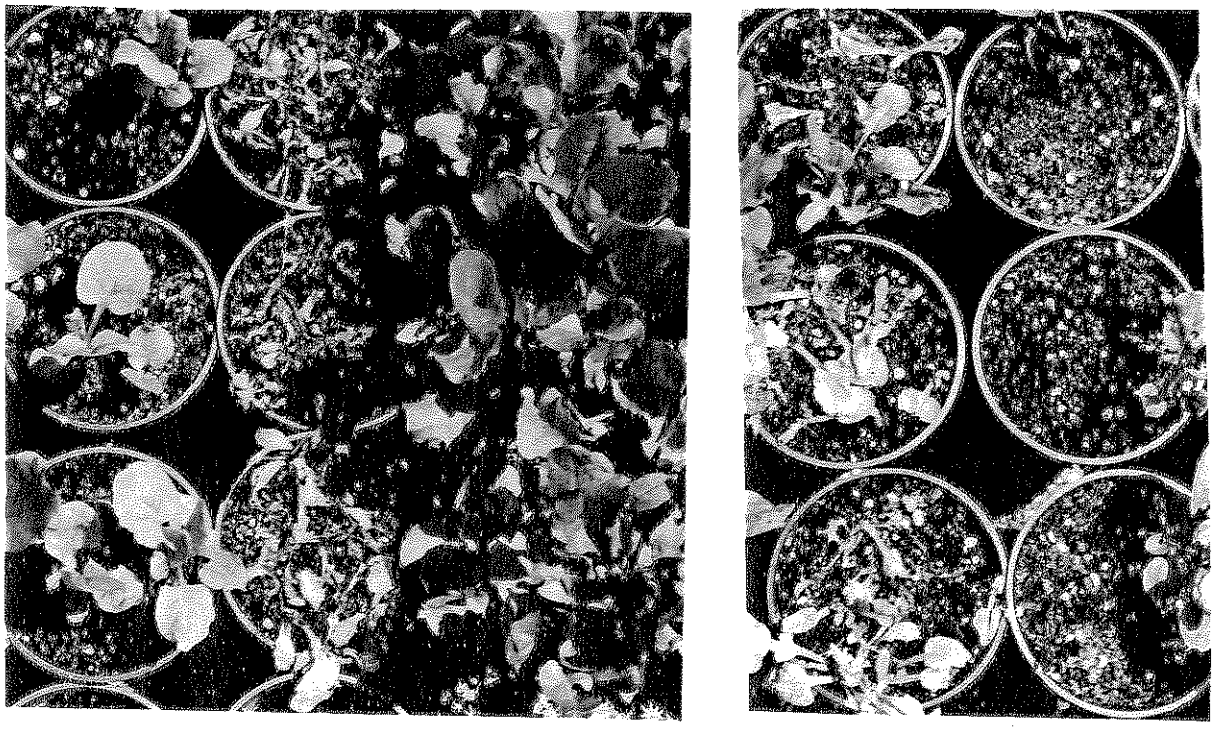
Plate 8 **Second Sowing: 3-4 Leaf Stage** (Treatments applied 10 April 1996)

Senecio vulgaris (photographed 28 May 1996)



Control | **Diuron 0.05 g/m²** | **Dow Shield 0.035 ml/m²** | **Skirmish 0.1 ml/m²**

Oxalis corniculata (photographed 28 May 1996)



Fortrol 0.2 ml/m² | **Diuron 0.05 g/m²** | **Control** | **Kerb 50 W 0.34 g/m²** | **Skirmish 0.1 ml/m²**

APPENDIX V

Plate 9 Phytotoxicity Assessment – Plant Grade Scores

Chamaecyparis lawsoniana 'Ellwoods Gold' (photographed 24 June 1996)

Plant Size Scores

1 3 5

Stage of Growth

1 3 5

APPENDIX VI

HRI Efford Meteorological Data

Table 36 Rainfall (mm)

	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
1996	**58.2**	**95.2**	**46.5**	**36.2**	**58.7**	**26.7**						
1995	143.8	116.8	40.2	27.1	22.2	10.1	26.7	3.4	142.9	38.6	**144.3**	**81.7**
1994	132.2	89.4	57.8	61.3	81.7	23.4	19.6	47.6	70.9	125.8	91.4	116.9
1993	98.0	6.2	45.2	74.7	45.7	61.6	86.2	35.8	120.7	169.3	64.4	185.0
1992	21.7	28.6	51.6	70.4	19.6	32.2	63.1	88.1	78.9	81.5	145.3	81.2
1991	88.5	29.3	77.9	42.3	4.0	113.0	63.3	12.3	48.6	63.0	49.2	33.4
1990	112.7	166.5	6.4	43.9	11.2	55.3	12.2	23.1	28.9	98.6	53.6	62.3
1989	30.6	69.8	74.8	71.7	13.7	34.6	22.5	23.6	37.3	91.0	56.6	242.4
1988	170.9	47.3	82.0	39.5	27.9	34.3	71.8	63.6	41.6	98.4	20.7	20.8
1987	15.8	60.4	89.4	69.1	19.3	54.4	61.4	16.4	37.7	195.6	78.3	43.2
1986	109.9	11.3	61.3	58.9	74.3	25.3	46.6	87.6	33.9	79.2	114.6	102.6
1985	69.5	47.0	51.6	43.8	44.6	61.1	37.8	88.2	24.3	32.4	53.4	88.0
1984	120.5	36.1	81.3	0.3	86.4	18.6	12.0	18.7	62.1	94.6	127.9	96.2
12/13 yr mean	90.2	61.8	58.9	49.2	39.2	42.4	43.6	42.4	60.7	97.3	83.3	96.1
41/42 yr mean	83.9	55.2	59.0	45.3	47.8	54.1	46.9	57.7	70.0	83.8	83.2	88.3

N.B. **Bold** figures in body of table relate to the period of the trial.

APPENDIX VI

HRI Efford Meteorological Data

Table 37 Mean Daily Sunshine Hours

	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
1996	**1.3**	**3.9**	**2.7**	**5.2**	**6.6**	**9.9**						
1995	1.7	2.7	6.2	6.2	8.7	8.4	8.5	9.9	5.7	3.9	**3.0**	**1.6**
1994	2.5	2.7	3.7	6.3	5.8	9.5	9.0	6.8	5.0	5.7	1.3	2.0
1993	1.1	2.3	4.6	4.5	6.7	8.3	6.0	8.2	4.6	4.3	2.8	1.9
1992	2.4	2.1	2.0	5.5	9.3	8.3	5.4	5.2	4.7	4.2	2.0	1.7
1991	2.2	2.8	3.6	5.8	5.8	5.2	7.2	8.6	6.1	3.0	2.2	1.7
1990	1.5	3.2	5.2	8.1	9.6	4.6	10.2	8.6	6.3	3.5	3.0	2.0
1989	2.2	3.7	3.0	5.7	10.6	9.3	9.8	9.3	4.8	3.6	3.6	1.1
1988	2.0	4.6	3.4	6.5	8.0	6.1	6.7	5.9	3.8	3.5	3.5	1.5
1987	2.1	3.0	4.0	6.7	7.8	5.8	7.2	6.5	5.0	3.5	2.1	1.4
1986	2.0	2.7	3.6	5.6	5.9	7.2	6.2	5.7	5.6	3.4	2.8	2.1
1985	2.5	3.0	4.3	5.7	6.9	6.0	7.9	6.5	5.4	4.1	2.8	1.2
1984	2.8	2.9	3.0	8.2	4.9	9.9	8.9	6.8	4.0	2.9	2.2	1.9
12/13 mean	2.0	3.0	3.8	6.1	7.4	7.6	7.7	7.3	5.1	3.8	2.6	1.7
41/42 yr mean	2.0	2.8	4.1	5.9	7.1	7.3	7.3	6.7	5.3	3.9	2.5	1.8

N.B. **Bold** figures in body of table relate to the period of the trial.

APPENDIX VI HRI Efford Meteorological Data

Table 38 Mean Daily Maximum Temperature (°C)

	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
1996	**7.2**	**6.6**	**8.0**	**12.2**	**13.5**	**18.9**						
1995	9.2	10.6	10.7	13.6	16.7	20.2	22.8	25.5	18.5	17.2	**12.4**	**6.8**
1994	9.5	8.2	11.5	12.2	14.8	18.7	22.2	21.2	17.5	15.6	13.8	11.3
1993	9.8	7.8	10.4	13.2	16.5	19.5	19.1	19.6	17.1	13.0	9.4	9.7
1992	7.2	9.0	10.9	12.7	18.7	20.6	20.1	19.5	17.6	12.9	12.3	8.2
1991	7.3	5.1	11.0	12.2	15.5	15.5	20.5	21.0	20.0	14.0	10.9	8.5
1990	10.4	11.2	11.8	13.6	18.4	16.9	21.9	22.7	19.1	16.1	10.8	7.9
1989	9.9	10.0	11.5	10.8	19.3	20.2	23.9	21.6	19.5	16.5	11.5	9.5
1988	9.1	8.9	10.2	12.7	16.7	18.8	17.5	19.1	17.7	15.1	10.6	10.7
1987	3.9	7.4	8.1	13.4	15.2	16.6	20.5	20.4	18.1	14.7	10.5	8.3
1986	7.8	2.2	8.3	9.9	13.7	20.0	19.4	17.9	15.9	15.4	12.3	10.0
1985	4.2	5.8	8.4	12.7	15.8	17.2	20.5	18.1	18.4	14.9	8.3	9.8
1984	8.5	7.7	8.6	13.7	14.4	19.5	22.0	22.0	18.0	15.0	12.1	9.8
12/13 yr mean	8.0	7.7	9.9	12.5	16.1	18.7	20.9	20.7	18.1	15.0	11.2	9.2
41/42 yr mean	7.5	7.4	9.8	11.9	15.6	18.4	20.4	20.3	18.3	15.0	10.9	8.7

N.B. **Bold** figures in body of table relate to the period of the trial.

APPENDIX VI

HRI Efford Meteorological Data

Table 39 **Mean Daily Minimum Temperature (°C)**

	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
1996	**3.5**	**-0.1**	**2.1**	**4.7**	**5.4**	**9.3**						
1995	3.2	5.8	2.6	5.7	7.8	10.2	13.7	13.8	10.5	11.0	**5.1**	**1.2**
1994	4.1	2.1	5.6	4.4	8.6	10.4	13.8	13.7	10.9	7.7	9.6	5.3
1993	5.1	3.3	3.8	6.5	8.8	11.4	12.4	11.3	10.0	7.0	2.8	4.1
1992	1.7	2.8	5.3	5.6	9.2	10.8	13.5	13.4	12.0	5.4	6.2	2.7
1991	3.1	0.5	5.4	4.8	7.0	9.4	12.9	12.8	11.5	8.1	4.8	4.0
1990	5.5	6.3	5.6	4.3	8.6	10.8	12.6	13.5	9.7	10.3	5.8	3.3
1989	4.3	3.3	5.1	3.9	9.4	10.9	14.3	13.0	12.0	10.0	5.6	4.3
1988	4.0	2.5	4.5	4.8	8.8	10.7	12.4	11.9	10.3	7.6	3.0	5.3
1987	0.6	1.7	1.9	6.1	7.0	9.7	12.4	11.9	11.9	8.4	4.8	4.5
1986	1.8	2.2	2.2	2.9	7.8	10.5	12.4	11.5	7.6	8.8	5.9	4.2
1985	1.3	0.2	1.5	4.5	7.3	9.2	11.9	12.5	11.1	8.7	2.2	5.5
1984	2.7	2.1	2.3	3.7	6.7	10.3	11.6	13.3	11.2	9.3	6.6	3.2
12/13 yr mean	3.1	2.5	3.7	4.8	7.9	10.3	12.8	12.7	9.9	8.5	5.2	4.0
41/42 yr mean	2.3	1.9	3.3	4.4	7.5	10.3	12.3	12.3	10.7	8.2	4.9	3.4

N.B. **Bold** figures in body of table relate to the period of the trial.

APPENDICES

SECTION B

YEAR 2

ADAS: COBLANDS NURSERIES LTD

APPENDIX VII

Other Recorded Data From The Trial

Table 40

Weed Number and Average Weed Number per Plot per Recording Date

	Treatments											
	Untreated		Skirmish - Skirmish		Atlas CIPC 40 - Basagran		Carbetamex - Diuron Flowable		Kerb 50W – Gesagard 50 WP		Nortron – Nortron	
Date	Weed No per plot	Av. weed No	Weed No per plot	Av. weed No	Weed No per plot	Av. weed No	Weed No per plot	Av. weed No	Weed No per plot	Av. weed No	Weed No per plot	Av. weed No
29/11/96	17,11,20	16	6,13,11	10	9,25,14	16	26,13,24	21	9,15,19	14	27,26,22	25
13/01/97	21,9,17	16	8,8, 11	9	11,19,10	13	19,7,24	17	12,17,11	13	22,13,20	18
18/02/97	26,12,25	21	9,12,10	10	11,24,9	15	30,9,20	20	13,26,12	17	33,16,15	21
11/03/97	36,18,26	27	8,10,8	9	19,19,10	16	27,12,27	22	11,24,12	16	36,14,17	22
14/04/97	22,13,28	21	9,10,3	7	6,9,6	7	15,5,19	13	9,8,5	7	20,13,12	15
16/05/97	30,12,33	25	8,11,4	8	11,12,9	11	19,8,13	13	11,11,9	10	16,7,6	10
10/06/97	37,18,31	29	9,11,9	10	11,23,4	13	18,14,16	16	26,19,17	21	25,12,14	17
09/07/97	31,22,29	27	7,6,8	7	19,19,5	14	14,11,25	17	20,19,15	18	23,7,6	12

APPENDIX VII

Table 41

Individual Weed Species Number per Treatment per Recording Date

	Weed Species						
Treatment	Bittercress	Willowherb	Groundsel	Sow thistle	Pearlwort	Chickweed	A. m. grass
29/11/96							
1	14	1	2	2	25	4	0
2	1	6	2	0	13	7	1
3	1	9	6	1	24	7	0
4	10	4	1	0	41	5	2
5	11	0	5	0	22	4	1
6	16	8	4	0	38	9	0
13/01/97							
1	11	4	1	2	25	4	0
2	3	4	1	0	12	6	1
3	6	10	3	1	18	2	0
4	10	5	2	0	29	4	0
5	8	5	5	0	18	3	1
6	7	9	3	0	31	5	0
18/02/97							
1	19	11	4	2	22	5	0
2	1	10	1	0	12	6	1
3	9	10	5	1	17	2	0
4	16	8	4	0	29	2	0
5	17	9	6	0	16	3	0
6	16	9	5	0	25	9	0
11/03/97							
1	27	6	4	1	35	7	0
2	1	6	3	0	11	4	1
3	15	9	7	1	15	1	0
4	20	4	5	0	37	0	0
5	18	5	4	0	19	1	0
6	12	5	4	0	37	9	0

Herbicide treatments

1. ***Untreated Control***. 2. ***Skirmish Skirmish***. 3. ***Atlas CIPC 40 - Basagran***.
4. ***Carbetamex - Diuron Flowable***. 5. ***Kerb 50W - Gesagard 50WP***. 6. ***Nortron - Nortron***.

APPENDIX VII

Table 42

Individual Weed Species Number per Treatment per Recording Date

	Weed Species						
Treatment	Bittercress	Willowherb	Groundsel	Sow thistle	Pearlwort	Chickweed	A. m. grass
14/04/97							
1	14	7	3	1	31	7	0
2	0	3	0	0	14	4	1
3	5	0	1	0	14	1	0
4	2	3	5	0	28	1	0
5	3	1	7	0	11	0	0
6	5	3	8	0	22	6	1
16/05/97							
1	20	3	3	1	38	8	2
2	2	3	1	0	12	3	2
3	7	0	3	0	19	1	2
4	2	1	7	0	25	4	1
5	10	2	6	0	11	2	0
6	6	3	6	0	8	5	1
10/06/97							
1	28	6	4	4	32	7	5
2	1	5	5	0	12	3	3
3	14	1	5	0	14	1	3
4	9	3	11	0	23	2	0
5	16	1	23	0	19	3	0
6	13	5	6	0	18	8	1
09/07/97							
1	36	2	4	3	29	5	3
2	2	2	2	0	11	1	3
3	27	1	1	0	9	0	5
4	19	1	3	0	24	3	0
5	21	2	11	0	15	5	0
6	19	1	3	0	7	5	1

Herbicide treatments

1. ***Untreated Control***. 2. ***Skirmish - Skirmish***. 3. ***Atlas CIPC 40 - Basagran***.
4. ***Carbetamex - Diuron Flowable***. 5. ***Kerb 50W - Gesagard 50WP***. 6. ***Nortron - Nortron***.

APPENDIX VII

Table 43

Number and Average Number of Pots Containing Moss and or Liverwort per Plot at each Recording Date

	Treatments											
	Untreated		Skirmish - Skirmish		Atlas CIPC 40 - Basagran		Carbetamex - Diuron Flowable		Kerb 50W - Gesagard 50 WP		Nortron – Nortron	
Date	No. pots per plot	Av. no pots per plot	No. pots per plot	Av. no pots per plot	No. pots per plot	Av. no pots per plot	No. pots per plot	Av. no pots per plot	No. pots per plot	Av. no pots per plot	No. pots per plot	Av. no pots per plot
29/11/96	6,6,3	5.0	6,5,6	5.7	7,7,3	5.7	6,6,3	5.0	4,4,4	4.0	3,5,4	4.0
13/01/97	5,5,2	4.0	3,3,6	4.0	12,6,3	7.0	3,5,6	4.7	3,5,6	4.7	1,4,2	2.3
18/02/97	6,6,5	5.7	4,4,3	3.7	8,4,0	4.0	5,4,4	4.3	6,2,0	2.7	8,4,5	5.7
11/03/97	9,8,5	7.3	5,3,7	5.0	7,5,2	4.7	3,5,3	3.7	2,2,3	2.3	4,5,3	4.0
14/04/97	5,3,3	3.7	6,0,2	2.7	2,0,0	0.7	2,0,0	0.7	2,0,1	1.0	3,1,2	2.0
16/05/97	4,5,3	4.0	6,0,2	2.7	3,0,0	1.0	0,0,0	0	2,0,0	0.7	6,5,6	5.7
10/06/97	1,5,0	2.0	3,1,3	2.3	0,2,2	1.3	0,0,2	0.7	4,0,0	1.3	6,3,7	5.3
09/07/97	7,6,4	5.7	3,2,5	3.3	1,2,5	2.3	0,0,0	0	3,3,0	2.0	7,4,11	7.3

APPENDIX VII

Table 44

Average Plant Height (cm) per Species per Plot - 22 Nov 1996

	Plant Species											
Plot	A	B	C	D	E	F	G	H	I	J	K	L
1	40.0	38.7	43.7	45.3	31.7	66.0	64.0	25.0	54.0	24.0	52.3	41.3
2	43.7	38.3	51.3	50.3	35.7	71.3	57.7	25.7	64.7	20.7	44.7	40.0
3	32.7	44.3	52.3	45.0	33.3	65.7	57.0	21.7	53.0	23.3	54.3	36.3
4	42.0	45.7	51.0	45.7	32.3	58.7	53.7	23.7	50.3	26.7	54.0	37.3
5	44.7	45.3	50.3	46.7	29.7	54.3	67.7	24.7	59.3	28.7	53.0	38.0
6	38.7	47.7	48.7	48.0	36.0	51.0	48.3	23.3	40.0	29.7	49.0	41.7
7	40.7	52.0	55.3	47.3	38.7	74.7	54.3	19.3	65.7	22.7	44.3	41.0
8	42.3	46.0	50.3	47.7	32.0	64.0	56.3	30.3	53.3	22.7	47.3	37.7
9	43.7	39.7	50.7	48.7	34.7	61.7	58.0	26.3	52.7	25.3	51.0	38.7
10	38.0	42.0	48.0	41.7	29.7	50.7	53.0	28.7	55.3	24.3	54.7	39.0
11	46.3	40.3	57.0	45.7	34.3	72.7	59.0	26.0	54.0	27.7	55.7	40.0
12	38.3	47.7	56.3	52.7	31.0	49.3	51.7	21.3	57.7	28.3	51.0	41.3
13	45.3	47.3	46.3	48.7	29.7	57.3	53.7	23.7	57.0	22.0	47.7	40.3
14	41.0	35.3	49.3	49.0	28.0	67.3	61.0	27.7	58.7	22.7	50.3	38.3
15	42.3	39.0	51.7	49.0	32.0	62.3	57.3	22.3	60.0	21.0	50.3	41.3
16	43.3	49.0	53.3	57.7	25.0	57.3	60.3	21.3	53.7	25.0	49.7	42.3
17	44.0	44.0	50.3	48.3	34.7	62.0	53.3	25.7	55.3	28.0	53.3	44.3
18	48.0	44.7	54.0	48.7	29.3	58.3	57.7	17.7	60.0	25.7	48.0	41.3

KEY

A - *Mahonia* 'Charity' B - *Azalea* 'Strawberry Ice' C - *Thuja plicata* D - *Viburnum tinus*
E - *Bergenia cordifolia* F - *Buddleia davidii* 'Pixie Red' G - *Forsythia* 'Lynwood'
H - *Euonymus fortunei* I - *Weigela* 'Bristol Ruby' J - *Chamaecyparis lawsoniana* 'Ellwoodii'
K - *Cornus alba* L - *Prunus laurocerasus* 'Otto Luyken'.

APPENDIX VII

Table 45

Average Plant Height (cm) per Species per Plot - 22 Aug 1997

	Plant Species											
Plot	A	B	C	D	E	F	G	H	I	J	K	L
1	46.3	43.3	79.3	50.0	27.3	91.3	87.0	28.3	53.0	41.3	99.0	43.6
2	55.7	59.0	91.0	50.7	27.7	98.0	71.0	29.7	81.0	37.3	88.7	41.7
3	46.7	58.0	91.3	47.7	24.7	99.7	65.7	23.7	96.0	32.0	57.3	39.0
4	46.3	61.7	87.0	47.3	29.3	94.3	73.7	32.0	74.7	47.7	92.0	41.7
5	55.7	56.3	81.3	50.0	27.3	83.3	67.0	25.0	62.3	44.3	83.3	41.7
6	51.0	57.0	80.0	48.3	28.7	103.3	61.3	27.7	56.3	43.0	83.0	44.7
7	52.7	63.0	88.7	49.0	26.0	97.7	67.3	31.7	60.0	39.0	73.3	44.3
8	48.7	50.7	88.7	46.0	22.0	94.0	87.0	38.0	72.3	35.0	96.3	41.0
9	47.7	58.0	84.3	48.0	21.3	98.0	70.7	30.7	53.0	34.3	106.3	43.7
10	42.0	53.0	87.0	48.0	24.3	100.3	63.0	39.3	80.7	35.3	81.7	45.3
11	47.0	47.3	88.0	50.7	25.0	92.0	72.0	24.7	81.3	40.3	90.7	42.0
12	47.0	61.0	91.7	53.3	24.3	95.7	72.3	18.3	55.0	41.7	70.0	46.3
13	54.7	58.7	83.3	49.0	24.3	100.0	72.3	28.7	71.7	-*	97.3	43.7
14	47.7	58.0	84.0	52.3	29.3	94.7	86.3	27.7	65.0	37.0	94.7	43.0
15	41.0	54.3	84.7	52.0	24.7	91.3	75.3	20.0	62.3	33.7	105.3	43.3
16	43.7	63.7	88.3	54.3	23.3	96.0	69.7	28.3	64.0	31.7	76.3	48.3
17	55.3	49.7	88.7	48.7	25.0	84.0	76.7	26.7	63.3	50.0	90.7	47.7
18	50.0	48.3	86.3	52.7	24.3	89.3	75.0	24.3	65.7	39.3	67.3	47.3

KEY

A - *Mahonia* 'Charity' B - *Azalea* 'Strawberry Ice' C - *Thuja plicata* D - *Viburnum tinus*
E - *Bergenia cordifolia* F - *Buddleia davidii* 'Pixie Red' G - *Forsythia* 'Lynwood'
H - *Euonymus fortunei* I - *Weigela* 'Bristol Ruby' J - *Chamaecyparis lawsoniana* 'Ellwoodii'
K - *Cornus alba* L - *Prunus laurocerasus* 'Otto Luyken'.
-* No plants in plot to record.

APPENDIX VII

Table 46

Growth Score (0-5) per Species per Plot - 29 Nov 1996

	Plant Species											
Plot	A	B	C	D	E	F	G	H	I	J	K	L
1	5	5	4	5	5	5	5	5	5	5	4	5
2	5	5	5	5	5	5	5	5	5	5	5	5
3	4	4	5	5	5	5	5	4	5	5	5	5
4	4	5	5	5	5	5	5	5	5	5	5	5
5	5	5	5	5	5	5	5	5	5	5	5	5
6	5	5	5	5	5	5	5	5	5	5	5	5
7	4	5	5	5	5	5	5	4	5	4	5	5
8	5	5	5	5	5	5	5	5	5	5	5	5
9	5	5	5	5	5	5	5	5	5	5	5	5
10	5	5	5	5	5	5	5	5	5	5	5	5
11	5	5	5	5	5	5	5	5	5	5	5	5
12	4	5	5	5	4	5	5	5	5	5	5	5
13	5	5	5	5	5	5	5	5	5	5	5	5
14	5	5	5	5	5	5	5	5	5	5	5	5
15	5	5	5	5	5	5	5	5	5	5	5	5
16	5	5	5	5	5	5	5	5	5	5	5	5
17	5	5	5	5	5	5	5	5	5	5	5	5
18	5	5	5	5	5	5	5	4	5	5	5	5

KEY

A - *Mahonia* 'Charity' B - *Azalea* 'Strawberry Ice' C - *Thuja plicata* D - *Viburnum tinus*
E - *Bergenia cordifolia* F - *Buddleia davidii* 'Pixie Red' G - *Forsythia* 'Lynwood'
H - *Euonymus fortunei* I - *Weigela* 'Bristol Ruby' J - *Chamaecyparis lawsoniana* 'Ellwoodii'
K - *Cornus alba* L - *Prunus laurocerasus* 'Otto Luyken'.

APPENDIX VII

Table 47

Growth Score (0-5) per Species per Plot - 22 Aug 1997

	Plant Species											
Plot	A	B	C	D	E	F	G	H	I	J	K	L
1	4	4	4	4	5	4	5	5	4	5	5	4
2	5	5	4	4	5	4	5	5	4	4	4	4
3	3	4	4	4	5	5	5	3	5	4	4	4
4	3	4	4	5	5	4	4	4	4	4	5	5
5	5	4	4	3	5	4	5	4	3	5	5	5
6	4	3	4	4	5	5	4	4	3	4	4	4
7	4	3	5	5	5	4	4	5	4	4	3	4
8	4	4	4	4	5	4	5	5	5	3	5	4
9	3	5	5	4	5	4	4	5	4	4	5	4
10	3	4	5	5	5	4	4	4	5	3	5	4
11	4	4	5	5	5	4	5	4	5	4	4	4
12	4	5	5	4	5	5	4	1	3	5	3	4
13	3	4	4	3	5	4	4	4	3	-	5	4
14	4	4	4	4	5	4	4	5	3	4	5	4
15	2	4	4	3	5	4	5	4	3	4	5	4
16	3	5	4	4	5	4	4	4	3	3	4	4
17	4	4	4	5	4	4	5	5	4	4	5	4
18	3	4	5	4	5	5	3	3	3	4	4	4

KEY
A - *Mahonia* 'Charity' B - *Azalea* 'Strawberry Ice' C - *Thuja plicata* D - *Viburnum tinus*
E - *Bergenia cordifolia* F - *Buddleia davidii* 'Pixie Red' G - *Forsythia* 'Lynwood'
H - *Euonymus fortunei* I - *Weigela* 'Bristol Ruby' J - *Chamaecyparis lawsoniana* 'Ellwoodii'
K - *Cornus alba* L - *Prunus laurocerasus* 'Otto Luyken'.

- No plants in plot to record.

APPENDIX VIII

Table 48

Statistical Analysis of Weed Counts

1. Analysis of variance

Treatment	Mean Weed Count Per Plot				
	November	January	March	April	July
Control	16	16	27	21	27
Skirmish / Skirmish	10	9	9	7	7
Atlas CIPC 40 / Basagran	16	13	16	7	14
Carbetamex / Diuron	21	17	22	13	17
Kerb 50W / Gesagard 50 WP	14	13	16	7	18
Nortron / Nortron	25	18	22	15	12
Treatment 'p value'	0.110	0.435	0.153	**0.035**	**0.042**
Covariate 'p value'	-	0.935 (Nov)	0.228 (Nov)	0.233 (Mar)	**0.032** (Nov)
SED – Covariate d.f. = 10	4.78	4.49	6.29	4.11	5.12
SED + Covariate d.f. = 9	-	3.32 (Nov)	5.03 (Nov)	3.35 (Mar)	4.80 (Nov)
LSD – Covariate (5%)	-*	-*	-*	9.16	11.41
LSD + Covariate (5%)	-	-*	-*	_*	10.86

The above analyses were used to examine the magnitude of the treatment effect in November, January, March, April and July. The months of November and March were also used as covariates for assessing whether 'pretreatment' weed counts affected the observed weed count by adjusting for the same.

Further analysis of significant data is presented in Table 19.

Covariate months in brackets.
'*p* values' were adjudged to be significant if less than 0.05 (in bold).
-* *LSD* not calculated as treatment effect was not significant.

APPENDIX VIII

Table 49

Statistical Analysis of Weed Counts

2. Dunnett's and Duncan's multiple range test

Treatment code	Mean value	Dunnett significance	Duncan Rank	Duncan Suffix
APRIL				
Control	21.0		3	a
Skirmish/Skirmish	7.3	SIG	2	a
AtlasCIPC 40/Basagran	7.0	SIG	5	a
Carbetamex/Diuron	13.0		4	ab
Kerb 50W/Gesagard 50WP	7.3	SIG	6	ab
Nortron/Nortron	15.0		1	b

SED=4.11; *DF*=10; Dunnett's critical value =9.91; SIG is significant using Dunnett's test; and Duncan uses significance at the 5% level.

Treatment code	Mean value	Dunnett significance	Duncan Rank	Duncan Suffix
JULY				
Control	27.3		2	A
Skirmish/Skirmish	7.0	SIG	6	A
AtlasCIPC 40/Basagran	14.3	SIG	3	A
Carbetamex/Diuron	16.7		4	Ab
Kerb 50W/Gesagard 50WP	18.0		5	ab
Nortron/Nortron	12.0	SIG	1	b

SED=5.12; *DF*=10; Dunnett's critical value =12.34; SIG is significant using Dunnett's test; and Duncan uses significance at the 5% level.

Treatment code	Mean value	Dunnett significance	Duncan Rank	Duncan Suffix
JULY (NOV-Covariate)				
Control	27.8		6	a
Skirmish/Skirmish	10.4	SIG	2	a
AtlasCIPC 40/Basagran	14.8	SIG	4	a
Carbetamex/Diuron	14.7	SIG	3	a
Kerb 50W/Gesagard 50WP	19.3		5	ab
Nortron/Nortron	8.1	SIG	1	b

SED=5.35; *DF*=9; Dunnett's critical value =11.84; SIG is significant using Dunnett's test; and Duncan uses significance at the 5% level.

APPENDIX VIII

Table 50

Statistical Analysis of Moss/Liverwort Counts

Treatment	Mean Number of Pots Containing Moss / Liverwort							
	Nov	Jan	Feb	Mar	Apr	May	Jun	Jul
1	5.0	4.0	5.7	7.3	3.7	4.0	2.0	5.7
2	5.7	4.0	3.7	5.0	2.7	2.7	2.3	3.3
3	5.7	7.0	4.0	4.7	0.7	1.0	1.3	2.3
4	4.7	4.7	4.3	3.7	0.7	0	0.7	0
5	4.7	4.7	2.7	2.3	1.0	0.7	1.3	2.0
6	2.3	2.3	5.7	4.0	2.0	5.7	5.3	7.3
Trt p value	0.646	0.232	0.198	0.157	**0.034**	**0.029**	0.233	**0.046**

Herbicide treatments
1. ***Untreated Control***. 2. ***Skirmish - Skirmish***. 3. ***Atlas CIPC 40 - Basagran***.
4. ***Carbetamex - Diuron Flowable***. 5. ***Kerb 50W - Gesagard 50WP***. 6. ***Nortron - Nortron***.

'*p* values' were adjudged to be significant if less than 0.05 (in bold).

APPENDIX VIII

Table 51

Statistical Analysis of Plant Height Data

I. Analysis of Variance

	Plant Species / Mean Plant Height 22 August 1997											
Trt	A	B	C	D	E	F	G	H	I	J	K	L
1	51.5	55.5	84.0	47.8	25.0	99.1	73.5	31.5	66.8	39.0	92.2	43.1
2	51.4	58.1	88.1	48.3	26.8	92.0	72.6	30.1	66.0	45.6	85.3	44.6
3	48.8	55.8	85.9	51.7	25.2	90.4	69.6	26.0	69.2	38.8	83.4	44.0
4	45.5	56.3	88.2	49.3	26.1	98.2	71.7	30.2	80.8	34.8	77.9	42.4
5	51.1	55.1	87.2	50.5	24.3	95.1	72.2	28.2	66.6	40.0	87.4	44.2
6	44.8	52.9	85.2	51.8	25.4	92.8	78.2	22.2	56.8	38.9	91.4	44.4
Trt p value	0.277	0.968	0.820	0.040	0.766	0.316	0.886	0.280	0.335	0.192	0.883	0.867
Cov p value	0.602	0.930	0.687	0.043	0.818	0.385	0.165	0.342	0.325	0.114	0.784	0.916
SED -Cov d.f. = 10	3.55	5.91	3.36	1.26	1.65	4.24	7.15	4.01	9.45	3.76	13.10	1.98
SED +Cov d.f. = 9	3.68	5.45	2.66	1.04	1.73	4.47	5.14	3.61	9.60	2.74	13.25	1.36
LSD -Cov (5%)	-*	-*	-*	2.81	-*	-*	-*	-*	-*	-*	-*	-*
LSD +Cov (5%)	-*	-*	-*	2.35	-*	-*	-*	-*	-*	-*	-*	-*

Key

Plant species

A - *Mahonia* 'Charity.' B - *Azalea* 'Strawberry Ice'. C - *Thuja plicata.* D - *Viburnum tinus.*
E - *Bergenia cordifolia.* F - *Buddleia davidii* 'Pixie Red'. G - *Forsythia* 'Lynwood'.
H - *Euonymus* fortunei. I - *Weigela* 'Bristol Ruby'. J - *Chamaecyparis lawsoniana* 'Ellwoodii'.
K - *Cornus alba.* L - *Prunus laurocerasus* 'Otto Luyken'.

Herbicide treatments

1. ***Untreated Control.*** 2. ***Skirmish - Skirmish.*** 3. ***Atlas CIPC 40 - Basagran.***
4. ***Carbetamex - Diuron Flowable.*** 5. - ***Kerb 50W - Gesagard 50WP.*** 6. ***Nortron - Nortron.***

'*p* values' were adjudged to be significant if less than 0.05 (in bold).
-* *LSD* not calculated as treatment effect was not significant.

APPENDIX VIII

Table 52

Statistical Analysis of Plant Height Data

2. Dunnett's and Duncan's multiple range test

Treatment code	Mean value	Dunnett significance	Duncan Rank	Duncan Suffix
AUG Species D				
Control	47.77		1	a
Skirmish/Skirmish	48.33		2	a
AtlasCIPC 40/Basagran	51.67	SIG	4	ab
Carbetamex/Diuron	49.33		5	ab
Kerb 50W/Gesagard 50WP	50.47		3	b
Nortron/Nortron	51.77	SIG	6	b

SED=1.256; DF=10; Dunnett's critical value =3.03; SIG is significant using Dunnett's test; and Duncan uses significance at the 5% level.

Treatment code	Mean value	Dunnett significance	Duncan Rank	Duncan Suffix
AUG Species D (NOV Species D-Cov)				
Control	47.76		1	a
Skirmish/Skirmish	48.63		2	a
AtlasCIPC 40/Basagran	51.11	SIG	5	ab
Carbetamex/Diuron	50.17		4	ab
Kerb 50W/Gesagard 50WP	50.14		3	b
Nortron/Nortron	51.51	SIG	6	b

SED=1.081; DF=9; Dunnett's critical value =2.56; SIG is significant using Dunnett's test; and Duncan uses significance at the 5% level.

APPENDIX VIII

Table 53

Statistical Analysis of Plant Growth Scores

	Plant Species / Mean Growth Scores 22 August 1997											
Trt	A	B	C	D	E	F	G	H	I	J	K	L
1	3.7	3.7	4.0	3.7	5.0	4.3	4.3	4.3	3.7	3.5	4.7	4.0
2	3.7	3.7	4.3	5.0	4.7	4.0	4.3	4.7	4.0	4.0	4.3	4.3
3	4.0	4.3	4.3	4.0	5.0	4.0	4.7	4.0	3.7	4.0	4.3	4.3
4	3.3	4.0	4.3	4.0	5.0	4.3	4.3	4.0	4.3	3.7	4.7	4.0
5	3.7	4.7	4.7	4.0	5.0	4.3	4.0	4.3	3.7	4.0	4.3	4.0
6	3.3	4.3	4.3	3.7	5.0	4.3	4.7	3.3	3.3	4.7	4.3	4.0
Trt p value	0.282	0.416	0.416	1.00	0.416	1.00	1.00	0.700	1.00	0.416	0.416	1.00

Key

Plant species

A - *Mahonia* 'Charity.' B - *Azalea* 'Strawberry Ice'. C - *Thuja plicata*. D - *Viburnum tinus*.
E - *Bergenia cordifolia*. F - *Buddleia davidii* 'Pixie Red'. G - *Forsythia* 'Lynwood'.
H - *Euonymus* fortunei. I - *Weigela* 'Bristol Ruby'. J - *Chamaecyparis lawsoniana* 'Ellwoodii'.
K - *Cornus alba*. L - *Prunus laurocerasus* 'Otto Luyken'.

Herbicide treatments

1. ***Untreated Control***. 2. ***Skirmish - Skirmish***. 3. ***Atlas CIPC 40 - Basagran***.
4. ***Carbetamex - Diuron Flowable***. 5. ***Kerb 50W - Gesagard 50WP***. 6. ***Nortron - Nortron***.

'*p* values' were adjudged to be significant if less than 0.05 (in bold).

APPENDIX IX

Plate 10

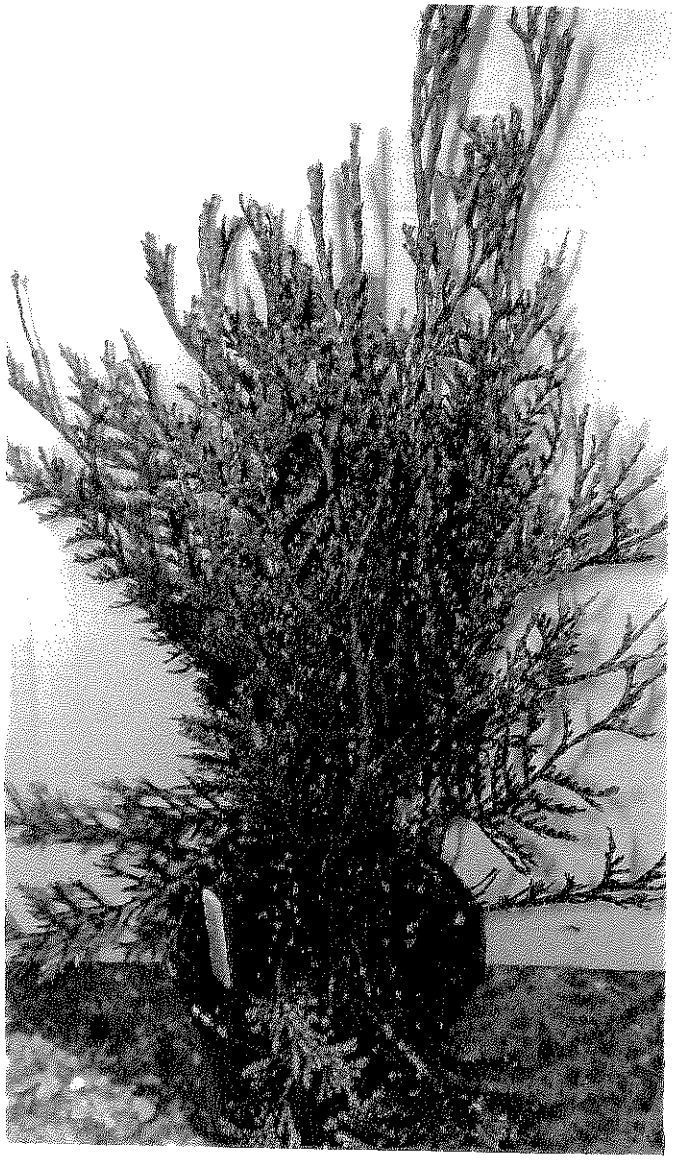
Leaf Edge Chlorosis on *Buddleia davidii* as a result of Diuron Flowable application 2 months prior (photograph taken 16 May 1997)

APPENDIX X

Plate 11

Shoot Tip Chlorosis and Necrosis on *Cham. laws.* 'Ellwoodii' and *Thuja plicata* as a result of Atlas CIPC 40 followed by Basagran (photographs taken on 16 May and 10 June 1997 respectively)

Chamaecyparis lawsoniana: 'Ellwoodii'



Thuja plicata

APPENDIX X

HRI East Malling Meteorological Data

Table 54 **Rainfall (mm)**

	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
1997	**14.1**	**69.4**	**9.5**	**6.1**	**38.5**	**125.9**	**20.2**	**102.1**				
1996	59.0	47.5	31.9	12.1	33.9	27.0	14.3	**77.1**	**30.8**	**32.1**	**120.7**	**20.6**
1995	14.1	65.8	55.3	7.6	19.8	18.7	38.0	2.9	157.9	10.2	24.2	89.5
1994	88.3	35.2	37.0	72.8	66.5	58.0	33.3	74.1	73.1	95.8	28.8	89.1
1993	56.1	8.3	17.3	64.5	53.0	30.2	46.2	42.4	90.5	107.5	43.8	95.9
1992	10.4	21.1	53.1	60.1	49.3	16.5	55.3	72.3	56.2	63.4	107.2	43.2
1991	76.2	39.9	33.1	60.6	19.7	109.6	61.1	53.3	37.0	24.5	56.7	20.4
1990	92.3	93.9	3.5	40.1	4.4	54.7	7.7	26.3	35.0	67.6	53.2	54.5
1989	22.8	46.0	59.4	84.6	2.4	40.2	16.0	26.0	44.9	44.6	37.5	115.8
1988	150.7	38.0	59.5	33.6	56.3	9.2	94.7	31.2	40.5	65.1	27.9	12.1
1987	63.4	28.6	47.1	40.6	43.0	66.4	90.8	55.0	29.5	145.8	54.6	15.9
1986	102.9	18.9	51.7	66.8	45.8	20.2	36.2	75.9	38.2	76.8	91.1	61.2
1985	60.7	19.9	48.3	37.1	52.1	67.1	45.7	77.1	9.3	19.4	62.5	107.2

N.B. **Bold** figures in body of table relate to the period of the trial

APPENDIX X

HRI East Malling Meteorological Data

Table 55 **Mean Daily Sunshine Hours**

	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
1997	**1.5**	**1.9**	**5.1**	**7.3**	**8.2**	**5.9**	**7.9**	**6.9**				
1996	0.6	2.9	2.5	5.2	6.2	8.9	7.2	**6.6**	**4.9**	**4.8**	**3.3**	**1.8**
1995	1.9	2.9	6.1	5.8	7.5	6.3	8.5	9.1	4.3	4.1	2.2	1.5
1994	2.3	2.3	4.2	5.6	5.0	8.7	8.3	6.1	3.7	4.4	1.4	2.0
1993	1.6	1.5	4.7	4.8	6.3	7.7	5.9	7.4	3.3	3.3	2.6	1.6
1992	1.7	2.5	2.3	4.6	8.6	8.1	6.0	5.3	4.8	3.7	2.2	2.0
1991	2.3	2.0	3.1	5.6	4.4	4.9	7.2	8.8	6.1	3.3	1.8	2.0
1990	1.6	3.6	5.1	8.2	8.9	5.5	9.3	8.9	5.2	4.2	2.4	1.6
1989	2.4	3.2	3.3	4.3	10.1	9.1	8.1	8.2	4.9	3.7	3.9	0.5
1988	1.9	4.2	3.1	5.1	6.5	4.7	6.2	7.0	4.7	3.7	3.0	1.3
1987	1.3	2.1	3.3	5.6	6.1	4.9	6.3	5.6	5.0	3.8	1.7	1.1
1986	2.1	2.3	3.9	4.4	7.4	8.0	6.6	6.1	5.2	3.8	2.3	2.1
1985	1.4	3.1	3.2	4.9	4.9	5.2	8.1	6.8	5.3	4.2	3.0	1.4

N.B. **Bold** figures in body of table relate to the period of the trial

APPENDIX X

HRI East Malling Meteorological Data

Table 56 **Mean Daily Maximum Temperature °C**

	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
1997	**4.7**	**10.2**	**13.2**	**14.4**	**17.3**	**19.2**	**22.4**	**25.6**				
1996	6.4	6.1	7.6	13.3	13.9	20.8	23.0	**22.3**	**18.0**	**15.9**	**9.9**	**6.1**
1995	8.3	10.5	10.7	14.2	17.9	19.4	24.9	25.2	18.4	17.9	11.5	5.4
1994	9.1	7.1	11.9	12.7	15.2	20.3	24.4	21.9	17.1	14.9	13.2	10.2
1993	9.7	6.6	11.2	14.4	16.6	20.6	20.8	20.8	17.0	13.0	8.3	9.2
1992	7.0	9.1	11.1	13.2	19.5	21.1	22.0	20.9	18.5	12.5	12.0	7.5
1991	7.2	4.9	11.9	12.7	14.6	16.6	2.02	23.7	20.5	14.3	10.1	8.1
1990	9.8	11.4	13.1	13.6	18.7	18.8	23.4	25.5	19.0	16.3	10.4	7.4
1989	9.5	9.8	12.3	10.7	19.3	20.8	24.8	23.8	20.1	16.7	10.6	9.0
1988	8.8	8.5	10.3	12.5	16.9	18.1	19.5	21.3	18.5	15.6	9.8	10.0
1987	2.6	6.9	7.5	15.5	15.2	18.2	21.0	21.3	19.2	15.1	9.6	8.7
1986	7.0	1.2	9.3	10.2	16.0	19.9	22.1	19.5	16.8	16.0	11.8	9.5
1985	3.5	5.4	8.8	13.6	15.5	17.9	22.1	19.7	20.1	15.4	7.8	9.7

N.B. **Bold** figures in body of table relate to the period of the trial

APPENDIX X

HRI East Malling Meteorological Data

Table 57 **Mean Daily Minimum Temperature °C**

	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
1997	**-0.2**	**3.6**	**4.9**	**3.7**	**7.0**	**11.5**	**12.3**	**15.4**				
1996	3.2	- 0.1	1.9	4.1	5.4	9.5	11.5	**12.0**	**10.1**	**7.8**	**3.0**	**1.6**
1995	2.3	4.8	2.2	5.8	6.5	10.3	14.3	14.8	10.1	8.6	4.5	0.9
1994	2.9	0.5	5.0	4.8	7.5	10.5	14.1	13.0	10.2	6.5	8.2	3.4
1993	3.4	2.3	2.3	6.4	9.0	11.2	12.0	10.9	9.0	6.8	1.9	3.6
1992	1.7	1.8	5.1	5.2	9.3	10.8	13.1	13.1	9.9	4.8	4.7	1.5
1991	2.1	- 1.4	5.2	4.7	6.1	9.2	13.3	13.1	10.2	6.6	4.0	1.3
1990	4.1	5.1	4.3	3.6	7.5	9.5	11.2	13.2	8.8	9.0	4.9	2.4
1989	2.5	3.0	4.6	4.3	8.4	9.8	13.4	12.2	11.6	9.2	2.4	4.0
1988	3.2	2.0	4.2	4.6	8.5	10.4	12.2	11.6	10.3	8.2	2.0	4.9
1987	-1.8	0.8	1.3	6.0	6.5	10.0	12.5	11.9	10.7	6.8	4.5	3.6
1986	1.2	- 2.9	1.5	3.1	7.3	10.9	13.1	10.5	7.1	7.9	5.0	3.3
1985	-2.9	- 0.8	1.4	5.2	7.7		12.5	11.0	10.1	7.5	0.9	5.0

N.B. **Bold** figures in body of table relate to the period of the trial