LM-396

Evaluation of Systems of Weed Control in Chrysanthemums Grown for Flower Production Outdoors

(BOF 30)

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FINAL REPORT (FEBRUARY 1995)

Project Number:	BOF 30
Title:	Evaluation of systems of weed control in chrysanthemums grown for flower production outdoors.
Project Leader:	L R Mason, Horticultural Consultant, ADAS Terrington, Norfolk
Location of Project:	Mr J G Freeman, Bronte House, WISBECH, Cambs
Project Co-ordinator:	Mr M E Louis, Sun King Flowers, Shrove House, Moulton Chapel SPALDING, Lincs, PE12 0XQ
Date Project Commenced:	June 1993
Date Project Completed:	October 1994.

ADAS

PRINCIPAL WORKERS

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AUTHENTICATION

The work summarised in this report was done under my supervision according to the procedures described, and this report is a true and accurate account of it.

Lyndon R. Mason ..... Lyndon Mason
Contract Manager
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Date 28/3/95 .....

Report authorised by ..... Nick Hurford
Team Manager
ADAS Taunton

Date 30.3.95 .....

COMMERCIAL IN CONFIDENCE

RELEVANCE TO GROWERS AND PRACTICAL APPLICATION

APPLICATION

The Objective of the Project

The objective of the trial was to evaluate systems of weed control in outdoor chrysanthemums using chemicals and ground level mulches with a view to finding the safest system with the most persistence and broadest spectrum of weed control. The costs of different treatments were determined.

The Key Results

In the first year of the trial a small number of herbicides were identified as being very satisfactory for use on outdoor chrysanthemums. These included metazachlor (Butisan S), a tank mix of chlorthal-dimethyl (Dacthal W75) and propachlor (Ramrod Flowable), a combination of trifluralin (Treflan) and oxadiazon (Ronstar liquid) and also mulches. It was necessary to undertake a second year of trial work in order that the results be verified.

Unfortunately in the second year of the trial some of these chemicals did not perform as well, especially the metazachlor (Butisan S) and chlorthal-dimethyl/propachlor (Dacthal W75/Ramrod) tank mix. The combination of trifluralin (Treflan) and oxadiazon (Ronstar liquid) still gave very good weed control in what was a very different year to the previous one.

In addition to the above, pentanochlor (Croptex Bronze) was shown to be a possibility in safely controlling weeds at an advanced stage particularly chickweed and red shank.

The Opportunity for Application

The trial has identified a number of both chemical and non chemical options for weed control in outdoor chrysanthemums. As these are likely to perform very differently for individual growers situations it is now up to the industry to conduct wider trials to determine the suitability of the treatment for their own nurseries.

Very few of the herbicides referred to in this report have a label for use on chrysanthemums. Herbicides have also in some cases been used in a method excluded by the label, eg pentanochlor (Croptex Bronze) as an over the top application. As such it is important for growers to note that any such usage would be entirely at the users own risk.

SUMMARY

Scope and Objective

Outdoor flowers include a wide range of species which are from different botanical families and genera. Although it has always been considered to be a small sector in UK horticulture it is nevertheless becoming increasingly important both in area grown and sales throughout the UK and it does tend to give high returns per unit area. Not surprisingly very few label recommendations exist for cut flowers, especially where herbicides are concerned and unfortunately the mainstay of the herbicide programme in a number of cut flower crops i.e. chloroxuron (Tenoran) was withdrawn from the market some years ago and has left the selection of chemicals for a number of families quite limited.

One of these families is *Compositae* and this was chosen to be looked at in this trial because it contains a number of important outdoor flower species such as chrysanthemums, asters, helichrysum, sunflowers etc. Because by far the largest of these was chrysanthemums it was decided this was the most appropriate crop to concentrate on as the development of a successful weed control strategy would be of the greatest benefit to the industry as a whole.

Results

The first year's experiment - June 1993 to October 1993

In the first year outstanding weed control was obtained using metazachlor (Butisan S) with no signs of any crop damage. A tank mix of chlorthal-dimethyl (Dacthal W75) and propachlor (Ramrod Flowable) and the combination of oxadiazon (Ronstar Liquid) and trifluralin (Treflan) also gave good control. Polythene and wool mulches were also very encouraging in both their effect on the crop and their degree of weed control.

The second year's experiment - May 1994 to October 1994

In the second year of the trial the best weed control was obtained by the use of a combination of oxadiazon (Ronstar Liquid) and trifluralin (Treflan). The use of pentanochlor (Croptex Bronze) at both the 5.6 litre/ha and 11 litre/ha rate indicated that safe control of established weeds could also be obtained if the right weed spectrum was present. Again the use of mulches (paper and polythene) was quite encouraging.

The performance of encouraging herbicides from the previous year i.e. metazachlor (Butisan S) and a tank mix of chlorthal-dimethyl (Dacthal W75) and propachlor (Ramrod Flowable) was disappointing. A severe infestation of red shank which is not controlled by metazachlor (Butisan S) severely effected weed control in the trial as polygonums are moderately resistant to metazachlor (Butisan S).

ACTION POINTS FOR GROWERS

1. The use of metazachlor (Butisan S) at a rate of 1.5 litres of product per ha depending on soil type and cultural conditions.

2. The use of oxadiazon (Ronstar Liquid) at a rate of 4 litres of product per ha and trifluralin (Treflan) at a rate of 2.3 litres of product per ha applied pre-planting.

3. The use of a tank mix of chlorthal-dimethyl (Dacthal W75) at a rate of 9 kg of product per ha and propachlor (Ramrod Flowable) at a rate of 9 litres of product per ha.

4. The use of pentanochlor (Croptex Bronze) at either 5.6 litres of product per ha or 11 litres of product per ha applied post-weed emergence, even to established weeds of certain species such as chickweed or red shank.

5. The possible use of polythene or paper mulches.

Notes

1. Few the herbicides referred to above have specific label recommendations for chrysanthemums. Some chemicals eg pentanochlor (Croptex Bronze) have been applied in a method specifically excluded by the label..

2. This is particularly applicable to metazachlor (Butisan S) which was widely used by the industry during the second year of the trial and unfortunately in some circumstances showed severe stunting and damage to the crop. It is not clear why this damage occurred but it would appear likely that it relates to soil type and cultural conditions prevalent at the time. Despite this, certain growers have used the product and have achieved very good weed control with no damage. However, as potential for damage is there it must be treated with great caution by the industry.

3. The use of pentanochlor (Croptex Bronze) as an over the top spray is totally against label recommendations as the label states it should be applied as a directed spray avoiding foliage. However, the trial indicates this may be an unnecessary precaution but it is of course possible that damage could still occur in certain situations.

4. When applying herbicides post planting the risk of phytotoxicity is increased if the peat modules are exposed to the herbicide.

5. Annual weed species not controlled pre-emergence by specific herbicides.

Butisan S	Charlock, fumitory, knotgrass, field penny-cress, red shank.
Ramrod Flowable	Black bindweed, charlock, fumitory, field penny-cress, knotgrass, volunteer cereals, red shank.
Ronstar liquid	Chickweed, annual meadow grass, black bindweed.
Treflan	Annual mercury, charlock, cleavers, corn marigold, field penny-cress, groundsel, hairy bittercress, mayweed, shepherds-purse, smooth sow thistle, wild radish, willowherb.
Kerb 50W	Clover, common ragwort, dandelion, field bindweed, gallant soldier, groundsel, mayweed, scarlet pimpernel and thistle.
Dacthal W-75+ Ramrod Flowable	Common fumitory, hedge mustard, field penny-cress, wild radish
Croptex Bronze	Black-grass, black nightshade, corn camomile, corn marigold, fools parsley, pineapple weed, scented mayweed, stinking camomile, wild oat.

Practical and financial anticipated benefits

If the weed control strategies outlined previously are widely adopted by the industry the potential saving in labour as a result of reduced hand weeding is considerable.

EXPERIMENTAL SECTION

INTRODUCTION

The demise of chloroxuron (Tenoran) left a large gap in the weed control strategies available for a number of important outdoor flower crops. One particular family for which herbicide choices are now very difficult is the Compositae family. This family consists of a large number of flower crops including:- chrysanthemum, aster, sunflower, dahlia, achillea, helichrysum, calendula, cornflower, pyrethrum, solidago and solidaster. There are few recommended herbicides for this group and of those that are available, some are effective only by virtue of their contact action and give little residual activity. Those that do have residual activity are usually short lived or do not control weeds that belong to the Compositae family such as groundsel and mayweed.

The main advantages of chloroxuron (Tenoran) were:-

1. It was usually persistent enough to last the life of the crop.

2. It controlled emerged weeds.

3. It was very effective on chickweed.

4. It was relatively cheap.

It is unlikely that we will find another herbicide with all of these properties but in an attempt to do so, the trial included a wide range of chemicals.

As statistics indicate that 154 hectares of chrysanthemums are grown in this country it was thought work on this crop would be of the greatest benefit to growers.

MATERIALS AND METHODS

First Year Experiment

Crop Details

* The crop was grown to standard outdoor chrysanthemum production techniques using overhead irrigation.

* Planting was on 8 June 1993 to ensure that no damage occurred from late frosts as any such problems would have complicated the results. In retrospect such caution was unnecessary.

* Three varieties, Heide, Payton Glow and Payton Prince were planted to determine if any differences in phytotoxicity occurred.

* As with the nurseries normal practice a base dressing of 3 oz/yd^2 of Palmers No. 1 was applied. Liquid feeds were also applied.

Chemical Application Details

* The herbicides were applied using an Oxford Precision Sprayer.

* All chemicals to be used as a pre-planting treatment were applied on 7 June 1993 and the trifluralin (Treflan) was incorporated within 40 minutes.

* Post-planting chemicals were applied within 36 hours of planting on 10 June 1993.

Experimental Design and Analysis

* Treatments were arranged in a randomised block with 3 replicates of each treatment.

* Guard plants were present at the end of each block and also between treatments.

Each plot consisted of the following arrangement of the 3 varieties.

Heide	Payton Glow	Payton Prince
10 plants	8 plants	10 plants

Data was examined using analysis of variance.

Treatments

The following treatments were included in the trial.

(1) An evaluation of chlorpropham + pentanochlor **(Atlas Brown)** at a rate of 5.6 litre/ha applied pre-planting as per label recommendation.

(2) The use of chlorpropham + pentanochlor **(Atlas Brown)** as an "over the top application" at a rate of 5.6 litre/ha.

(3) An evaluation of pentanochlor **(Croptex Bronze)** at a rate of 5.6 litre/ha applied as a directed spray as per label recommendation.

(4) The use of pentanochlor **(Croptex Bronze)** as an "over the top application" at rate of 5.6 litre/ha.

(5) Propyzamide **(Kerb 50W)** at a rate of 2.1 litre/ha.

(6) Trifluralin **(Treflan)** at a rate of 2.3 litre/ha.

(7) Trifluralin **(Treflan)** at a rate of 2.3 litre/ha applied pre-planting followed by propyzamide (**Kerb 50W**) at a rate of 2.1 litre/ha one month later.

(8) Oxadiazon **(Ronstar liquid)** at a rate of 4.0 litre/ha and trifluralin **(Treflan)** at a rate of 2.3 litre/ha applied pre-planting.

(9) A tank mix of chlorthal-dimethyl **(Dacthal W75)** at a rate of 7.5 kg/ha and diphenamid **(Enide 50W)** at a rate of 7.5 kg/ha.

(10) Metazachlor **(Butisan S)** at a rate of 1.5 litre of product per ha.

(11) Isoxaben **(Flexidor)** at a rate of 300 ml/ha.

(12) Napropamide **(Devrinol)** at a rate of 7.0 litre/ha..

(13) Pendimethalin **(Sovereign 330EC)** at a rate of 4.0 litre/ha.

(14) Tank mix of chlorthal-dimethyl **(Dacthal W75)** at a rate of 9.0 kg/ha and propachlor **(Ramrod Flowable)** at a rate of 9.0 litre/ha.

(15) The use of a **wool mulch (Wulch).**

(16) The use of a black **polythene mulch.**

(17) Control - **unweeded plot**

(18) Control - **hand weeded plot**

The herbicides were applied in the equivalent of 450 litres of water per hectare.

Assessments

The following assessments were made on the growing crop:-

1. Species of weed present in the trial.

2. Number of weeds present in the trial.

3. Vigour of each variety.

4. Height of each variety.

5. Phytotoxicity of the chemicals.

6. Final flower quality.

A number of these results have been presented as bar charts.

A statistical analysis was undertaken on the height assessments to determine if any of the chemicals exhibited any growth suppressing properties.

Crop Diary

7 June	Pre-planting chemicals applied. Trifluralin (Treflan) was incorporated into the soil.
8 June	Cuttings planted.
10 June	Post-planting chemicals applied.
15 June	Assessment of phytotoxicity.
6 July	Assessment of phytotoxicity and plant vigour.
21 July	Assessment of plant height, weed cover, type and number of weeds present.
23 August	Final assessment of weed count.
13 September	Final assessment of height and flower quality.

Second Year Experiment

Crop Details

* The crop was grown to standard outdoor chrysanthemum production techniques using overhead irrigation.

* Planting was on 25 May 1994 and the land was subsoiled, leyled and the beds rotavated before planting.

* The chrysanthemum variety Beppie was used in the trial.

* Fertiliser was applied as per analysis at a rate of 5 oz/yd^2 of Palmers No. 2 + 2 oz/yd^2 of Triple super phosphate.

* Liquid feeds were also applied.

Chemical Application Details

* The herbicides were applied using an Oxford Precision Sprayer.

* Mulches were laid on 24 May and the trifluralin (Treflan) was also incorporated on this date.

* The pre-planting treatment of oxadiazon (Ronstar liquid) was applied after trifluralin (Treflan) incorporation.

* The second application of metazachlor (Butisan S) was applied to treatment 8 on 6 July. Pentanochlor (Croptex Bronze) was applied to treatment 1 on the same day.

* A second application of pentanochlor (Croptex Bronze) was applied to treatment 1 on 31 July. The higher rate of pentanochlor (Croptex Bronze) was applied to treatment 4 on the same day.

Experimental Design and Analysis

* Treatment was arranged in a randomised block with 4 replicates of each treatment.

  *Guard plants were present at the end of each block and also between treatments.

Treatments

The following treatments were included in the trial.

(1) Pentanochlor **(Croptex Bronze)** as an "over the top application" at a rate of 5.6 litre/ha post weed emergence with a follow up treatment if required.

(2) Propyzamide **(Kerb 50W)** at a rate of 2.1 litre/ha.

(3) Trifluralin **(Treflan)** at a rate of 2.3 litre/ha applied pre-planting followed by oxadiazon **(Ronstar liquid)** at a rate of 4 litre/ha pre weed emergence.

(4) Pentanochlor **(Croptex Bronze)** as an "over the top application" at a rate of 11 litre/ha post weed emergence.

(5) Oxadiazon **(Ronstar liquid)** at a rate of 4 litre/ha post-planting.

(6) Metazachlor **(Butisan S)** at a rate of 1.5 litre/ha post-planting.

(7) Metazachlor **(Butisan S)** at a rate of 1.5 litre/ha post weed emergence.

(8) Metazachlor **(Butisan S)** at a rate of 1.5 litre/ha post-planting followed by hand weeding and a top up application 6 weeks after the first.

(9) Pendimethalin **(Sovereign 330EC)** at a rate of 4 litre/ha.

(10) Tank mix of chlorthal-dimethyl **(Dacthal W75)** at a rate of 9 kg/ha and propachlor **(Ramrod Flowable)** at a rate of 9 litre/ha.

(11) The use of a **paper mulch**.

(12) The use of a black **Polythene mulch**.

(13) Control - **unweeded plot**.

(14) Control - **hand weeded plot**.

All chemicals were applied in the equivalent of 450 litre of water/ha.

Treatment 2, 5, 6, 9 and 10 were applied within 3 days of planting, i.e. before any weeds had germinated.

Crop Diary

24 May	Fertiliser applied as per analysis. Mulches laid + pre-planting chemicals applied. Trifluralin (Treflan) was incorporated into the soil.
25 May	Cuttings planted.
28 May	Post-planting chemicals applied.
29 May	Assessment of phytotoxicity.
4 July	Assessment plant vigour, weed type, number of weeds and percentage weed cover.
21 July	Assessment of plant height.
9 August	Final assessment of weed count.
17 October	Final assessment of height and flower quality.

Type of Weeds Present

A broad spectrum of weeds was present on the trial site and these included fat hen, annual meadow grass, groundsel, annual nettle, charlock, knotgrass, red shank, chickweed, shepherds purse, dead nettle, sow thistle, mayweed, speedwell and bindweed.

RESULTS
(All results are shown in the form of bar charts at Appendix 1)

Year One

Plant Height

Unfortunately growth retardation was present on a few areas of the site but it was felt this was a result of some unexplained site factor as no logical explanation could be found. Indeed statistical analysis showed the chemical treatments to have had no effect on the overall height of the plants.

Weed Infestation

The most effective treatments in terms of weed control were a combination of oxadiazon (Ronstar liquid) and trifluralin (Treflan), a tank mix of chlorthal-dimethyl (Dacthal W75) and diphenamid (Enide 50W), metazachlor (Butisan S), tank mix of chlorthal-dimethyl (Dacthal W75) and propachlor (Ramrod Flowable) and the wool and polythene mulch. Reasonable control was also obtained with the use of pendimethalin (Sovereign EC) and propyzamide (Kerb 5W). Very poor control was obtained by chlorpropham (Atlas Brown) + pentanochlor (Croptex Bronze), trifluralin (Treflan) and napropamide (Devrinol). Unfortunately before the trial was completed diphenamid (Enide 50W) was withdrawn from the market and as such is now unavailable to the industry.

Plant Vigour

Very little difference in plant vigour was noted except for the metazachlor (Butisan S) treatment and also the 2 mulches.

As the first year was primarily a screening trial no further detailed assessments were undertaken on the crop except at flowering it was noted that no flower malformation was evident from any of the treatments.

Year Two

Height Assessments

Statistical analysis showed the treatments to have produced significant differences in terms of height. However, when considering the final assessment undertaken on 17 October the difference between the shortest and the tallest treatment was only 6 cm and even though this may be statistically significant it is not really significant in terms of the marketing of the crop itself.

Plant Vigour

Significant statistical differences were found with plant vigour from the different treatments. This was particularly noticeable in the early stages with the 2 mulch treatments especially the polythene mulch, but this difference became less evident as the trial progressed. On the final assessment the main reason for lack of vigour appeared to be the level of weed infestation as the unweeded control was the less vigorous of all the treatments.

Percentage Weed Cover

Assessments were undertaken of the percentage of weeds that actually covered the soil surface. The results show that the treatment which gave by far the least weed cover was the combination of trifluralin (Treflan) and oxadiazon (Ronstar liquid) pre-planting. The effect of pentanochlor (Croptex Bronze) applied post weed emergence could also quite clearly be seen in the reduction of weed cover obtained in treatment 1. It is also interesting to note the mulches did not keep weeds down completely as a heavy infestation of red shank caused severe problems with some of the mulch plots.

Weed Count

An assessment of the total number of weeds present again showed the combination of trifluralin (Treflan) and oxadiazon (Ronstar liquid) to have given the best weed control. The mulches also successfully reduced the number of weeds present although as mentioned in the previous section the percentage cover by aggressive weed such as red shank was still quite significant.

Percentage of Flowers Ready at Final Assessment

At the final assessment on 17 October it was very apparent that different treatments would flower at different times and when looking at the percentage coming into flower on the day of assessment it became clear that as expected the main reason for delayed flowering was the degree of weed infestation, with the unweeded plot having only 16% of flowers ready, whereas the hand weeded plot and the polythene mulch had 59% and 69% respectively.

Nutritional Status of the Crop

To certain extent the same rules applied as to the percentage of flowers ready at final harvest as it appeared that the degree of weed infestation had effected the nutritional status of the crop. This is again not surprising as the weeds will be competing for the available nutrient.

Phytotoxicity

Apart from severe scorch from the oxadiazon (Ronstar liquid) post-planting treatment and a slight amount of yellowing from the pentanochlor (Croptex Bronze) no phytotoxicity was evident in the trial.

CONCLUSIONS

Depending on individual situations there is the possibility to use metazachlor (Butisan S), a combination of trifluralin (Treflan) and oxadiazon (Ronstar liquid) or a tank mix of chlorthal-dimethyl (Dacthal W75) and propachlor (Ramrod Flowable) pre weed emergence.

Pentanochlor (Croptex Bronze) has also been identified as a possible control of established weeds, especially red shank and chickweed.

The use of ground level mulches such as paper, polythene or wool have been identified as useful alternatives to chemical control.

ACKNOWLEDGEMENTS

The author acknowledges the co-operation and help of Mr J and Mrs L Freeman, Bronte House, Wisbech, Cambs. in the provision of the trial site and crop care throughout the 2 years of the trial.

The author also thanks Mr W M Lawes of ADAS Kirton for carrying out much of the trial work and Mrs F M O'Donnell of the ADAS Biometrics Unit at Cheltenham for help with statistical analysis.

Special thanks also go to Mr J B Briggs of ADAS Kirton for his help and support during the 2 years of the trial.

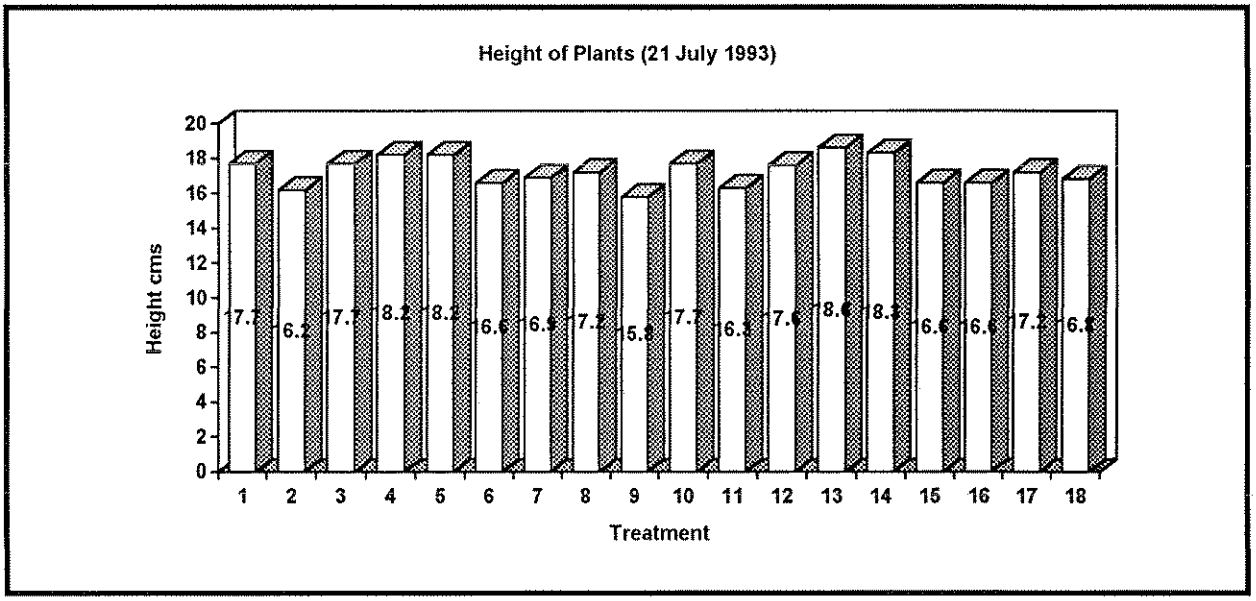
APPENDIX 1

RESULTS

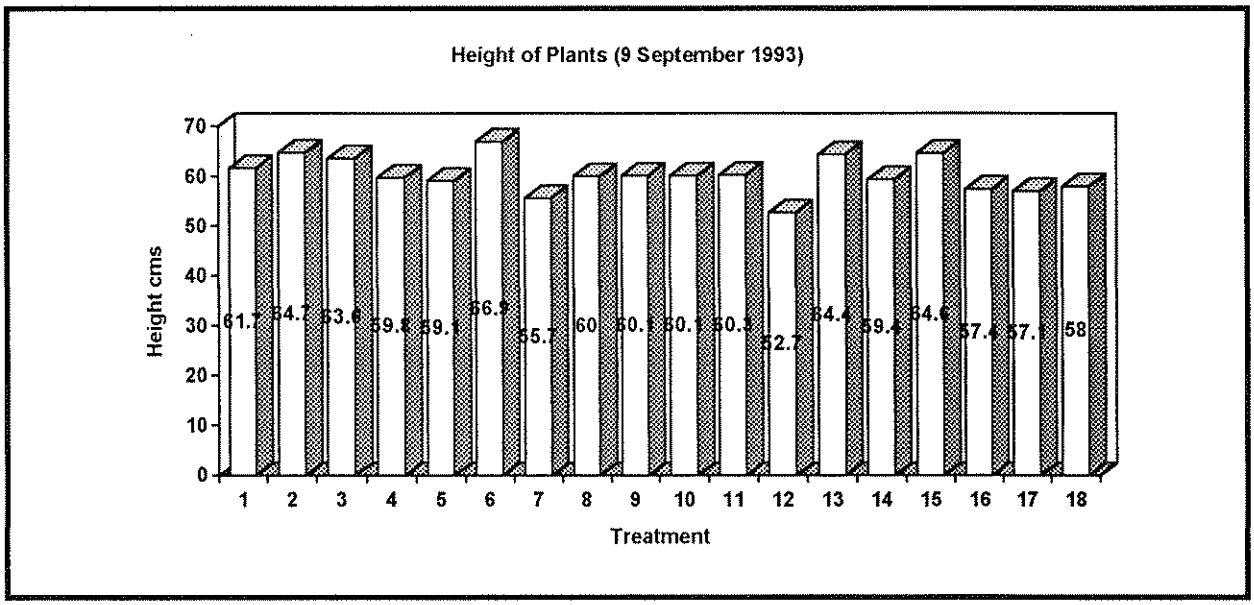
Year One

Plant Height

Graph 1



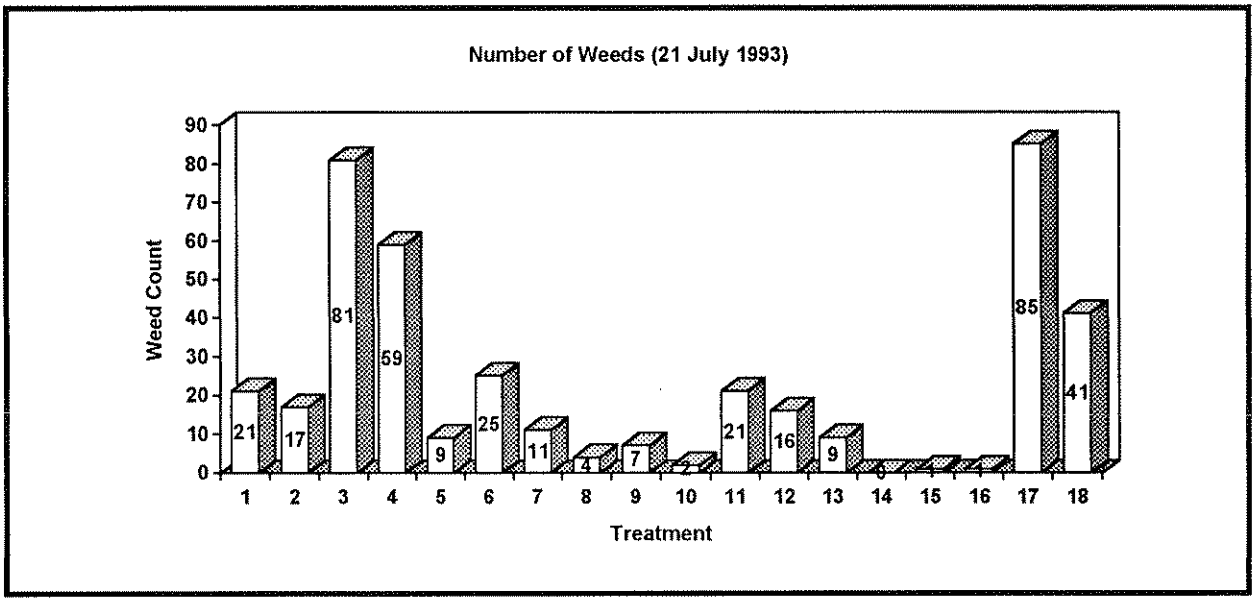
Graph 2



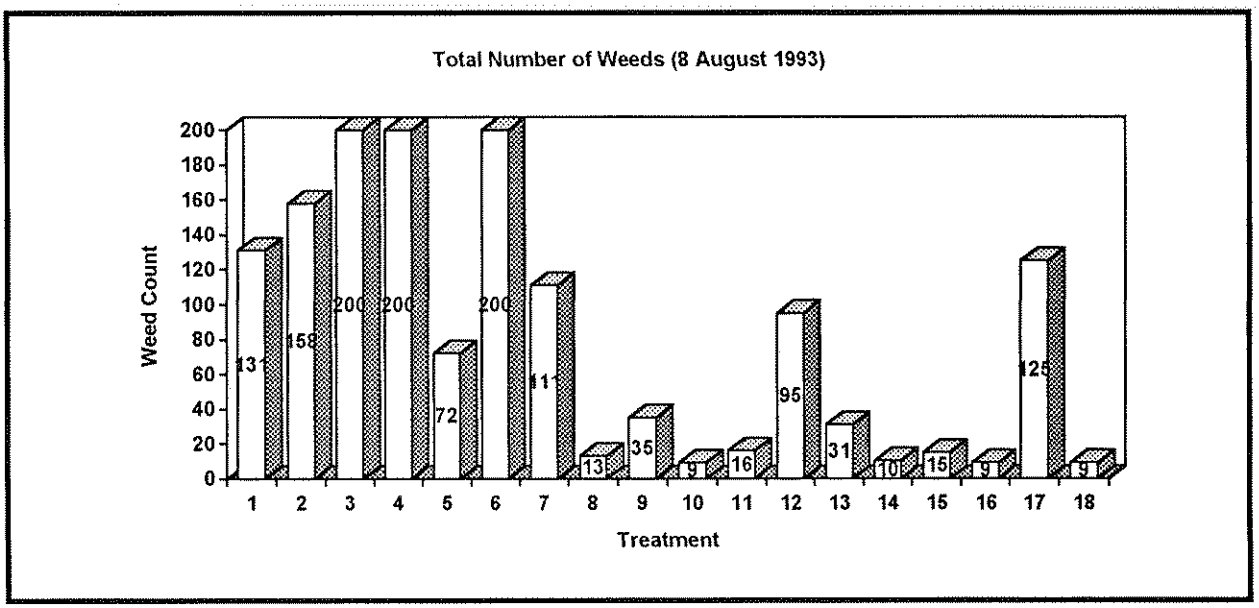
Weed Infestation

An assessment was done on 2 areas per plot, each area 0.33 m².

Graph 3



Graph 4



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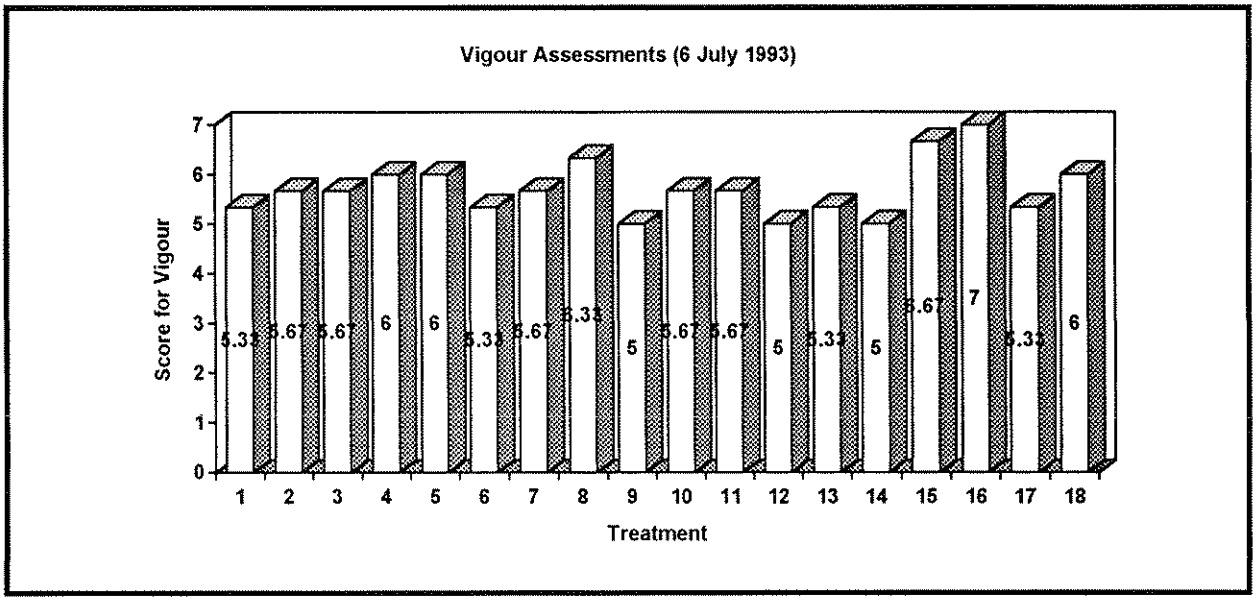
Plant Vigour

Based on a score of 1 to 9 with 9 being best and 1 worst.

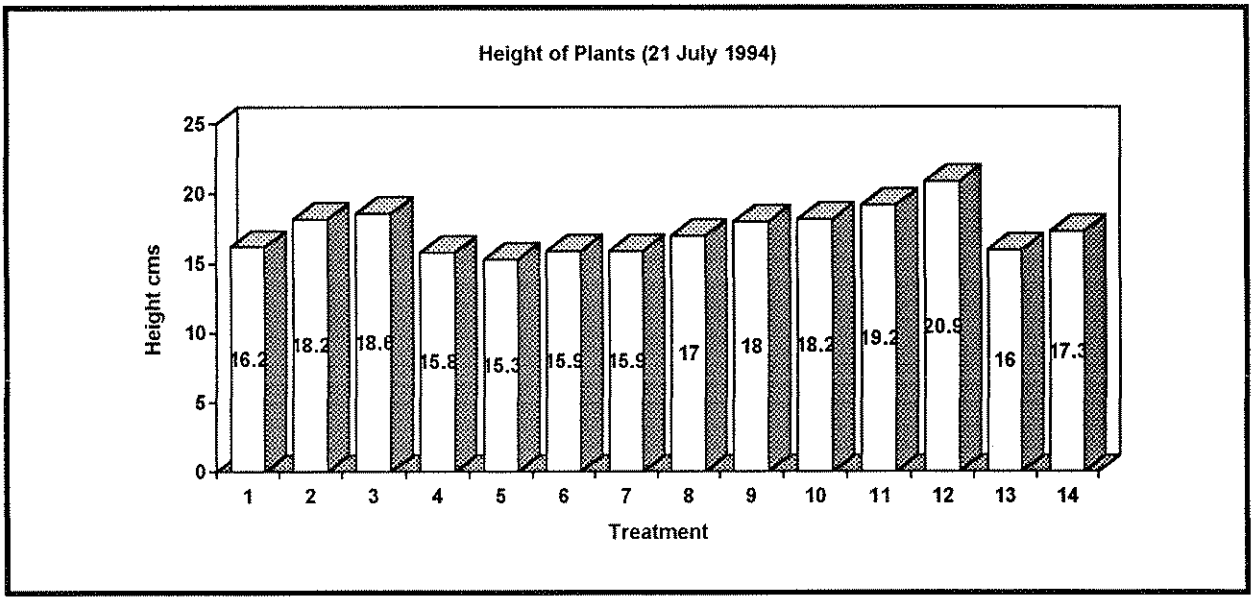
Graph 5



Year 2

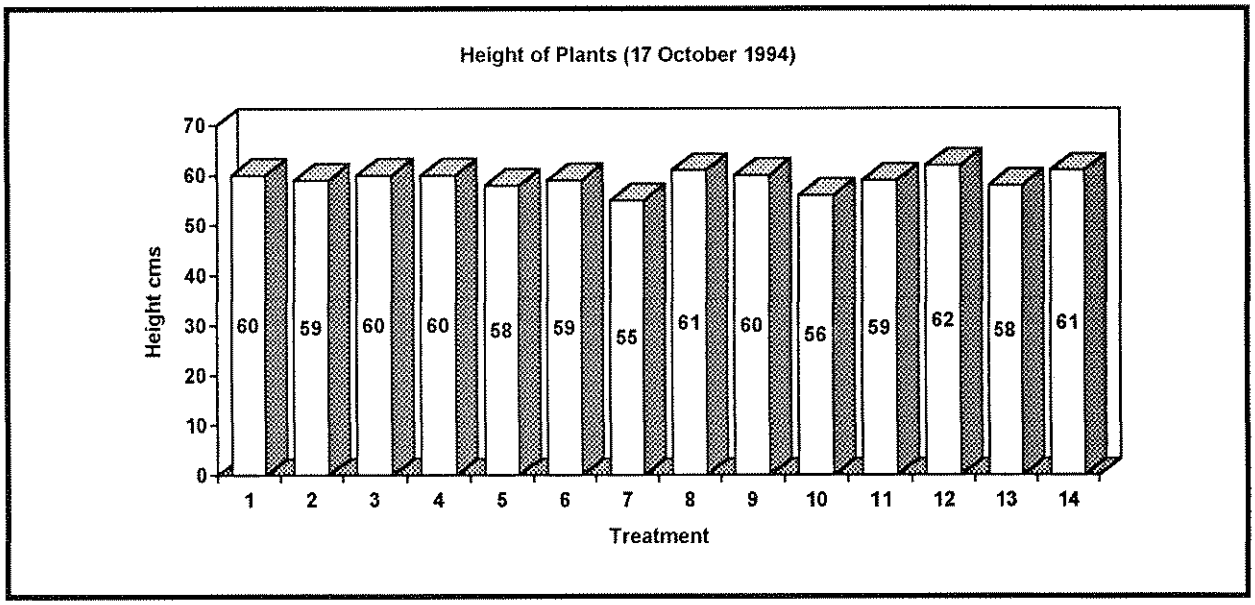
Height Assessments

Graph 6



Plant Height

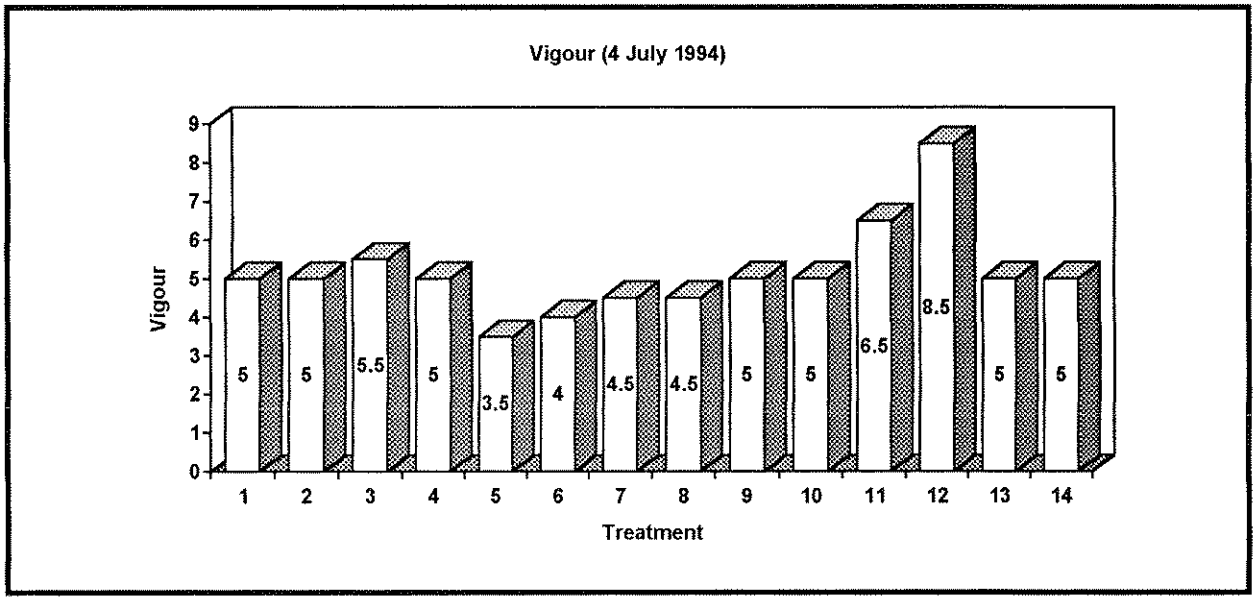
Graph 7



Plant Vigour

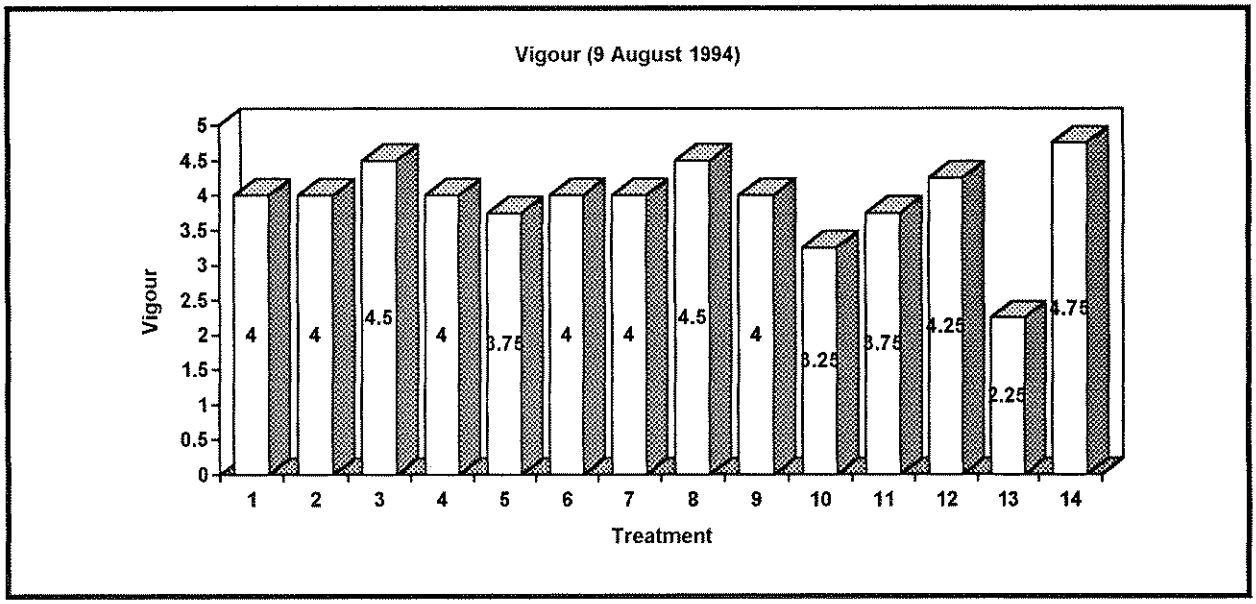
Based on a score of 1 to 9 with 9 being best and 1 worst.

Graph 8



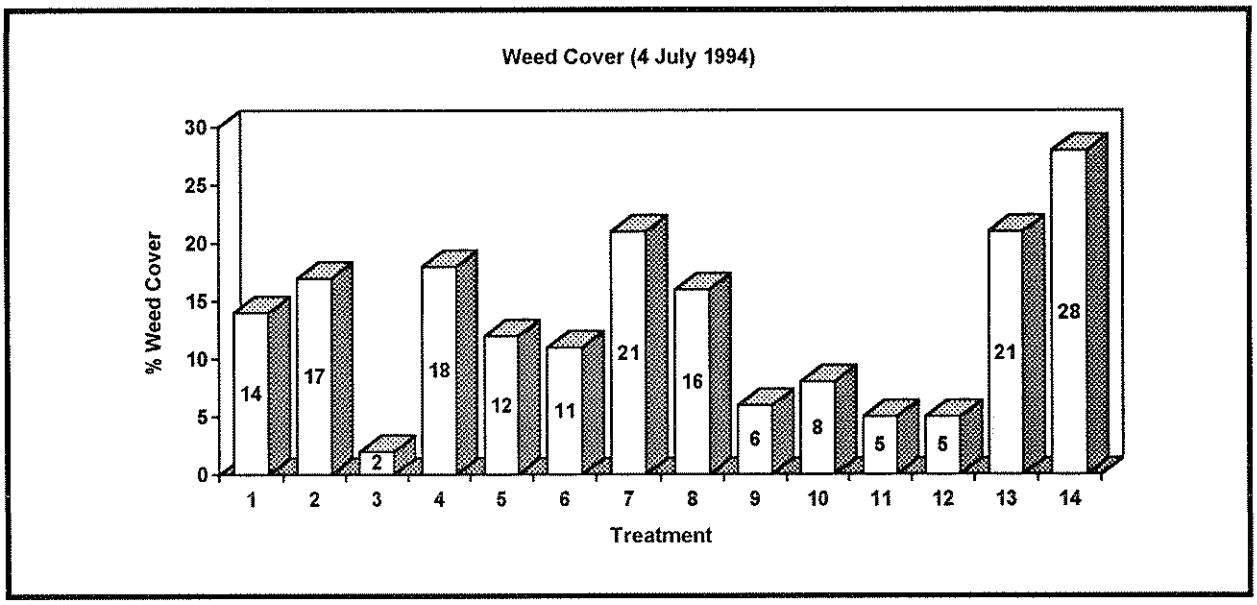
Based on a score of 1-5 with 5 being best and 1 worst.

Graph 9

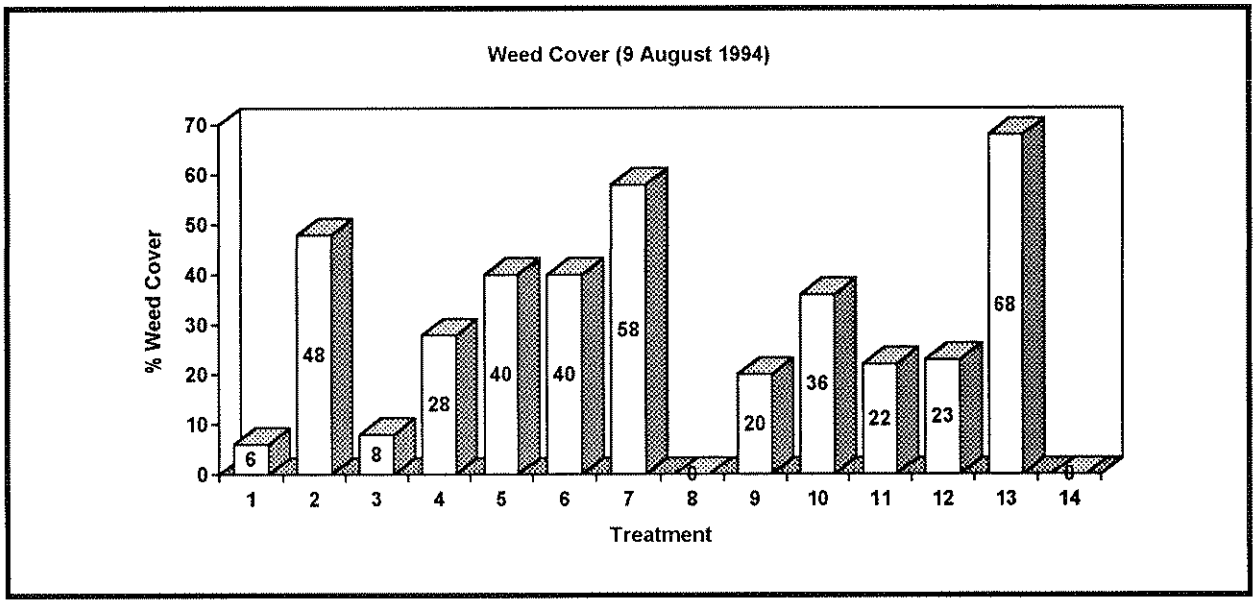


Percentage Weed Cover

Graph 10

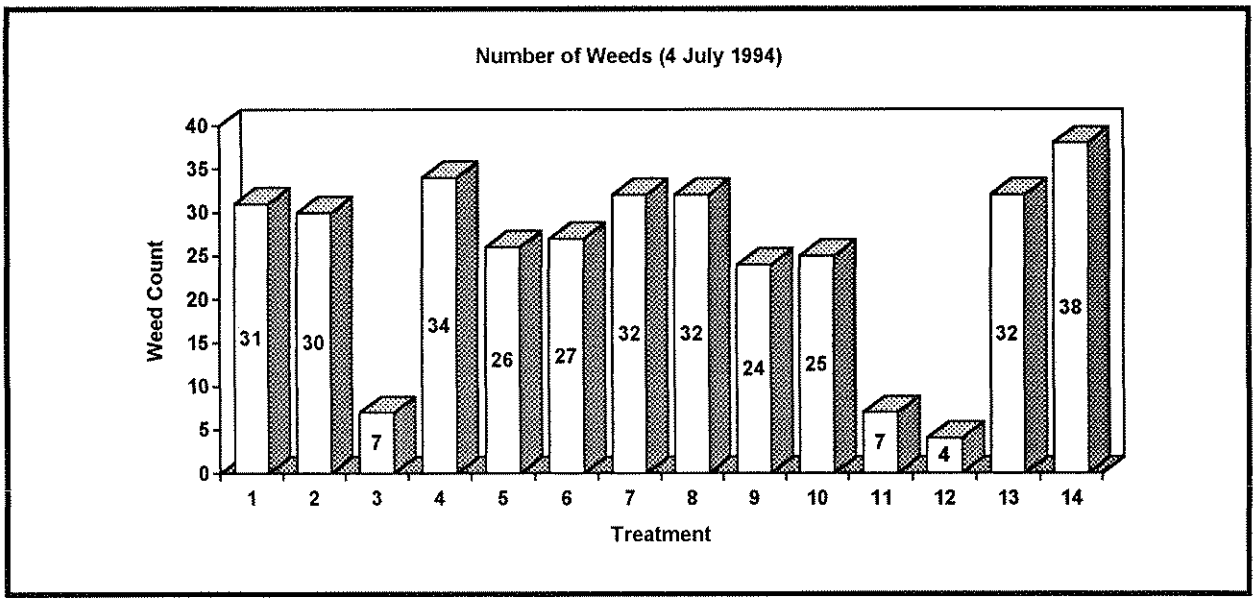


Graph 11

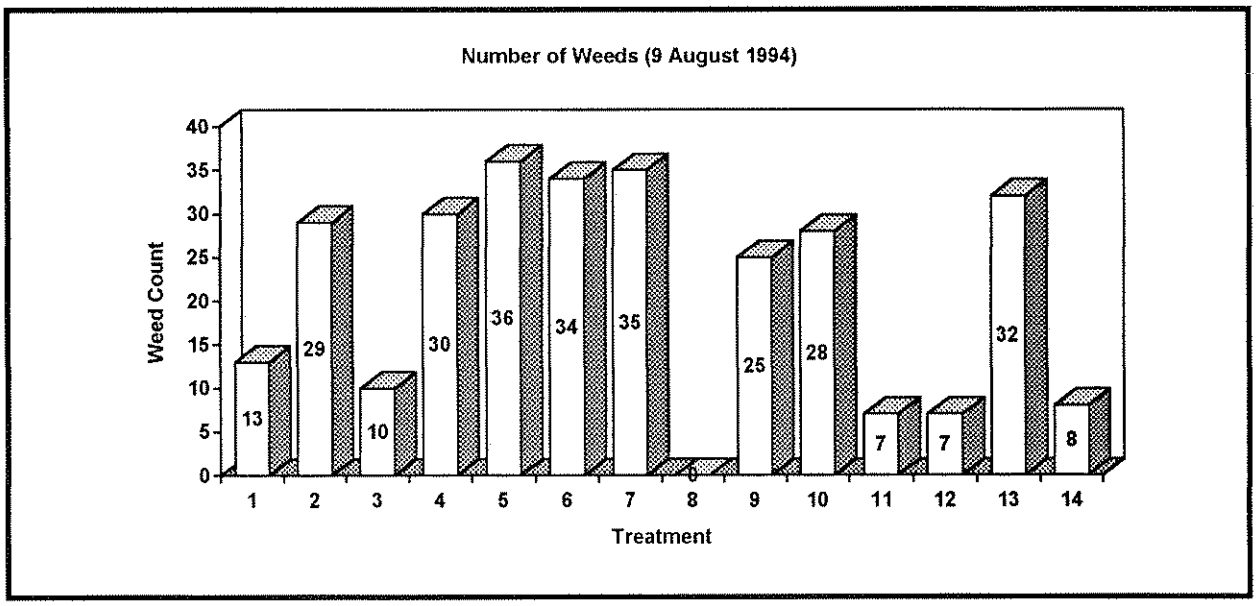


Weed Count

Graph 12



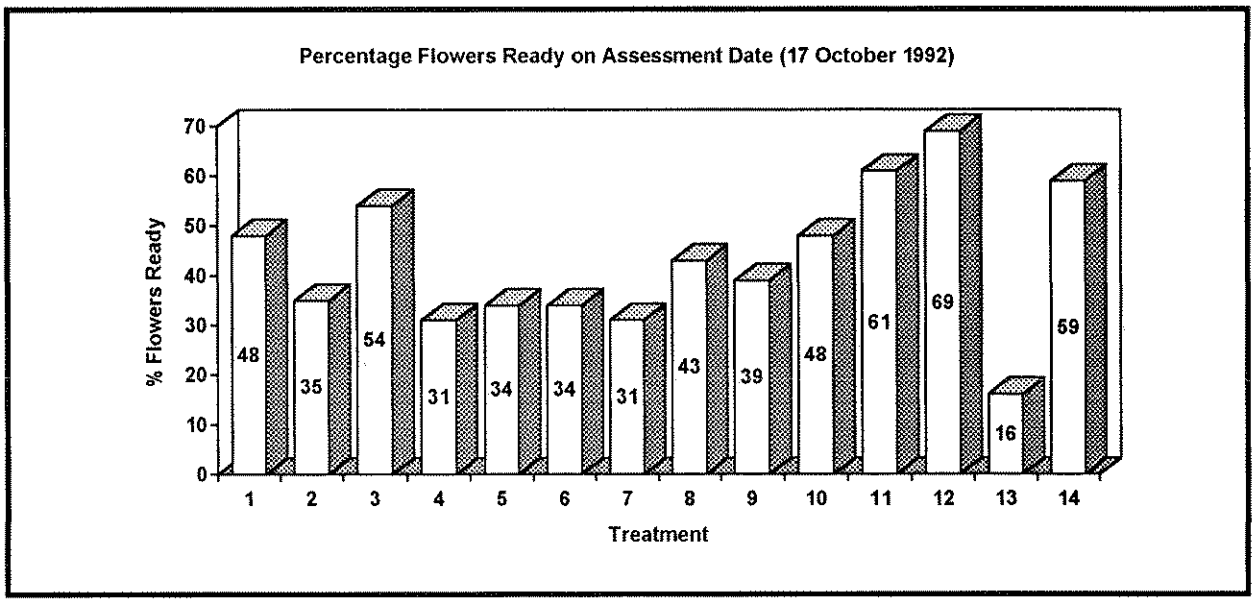
Graph 13



Percentage of Flowers Ready at Final Assessment

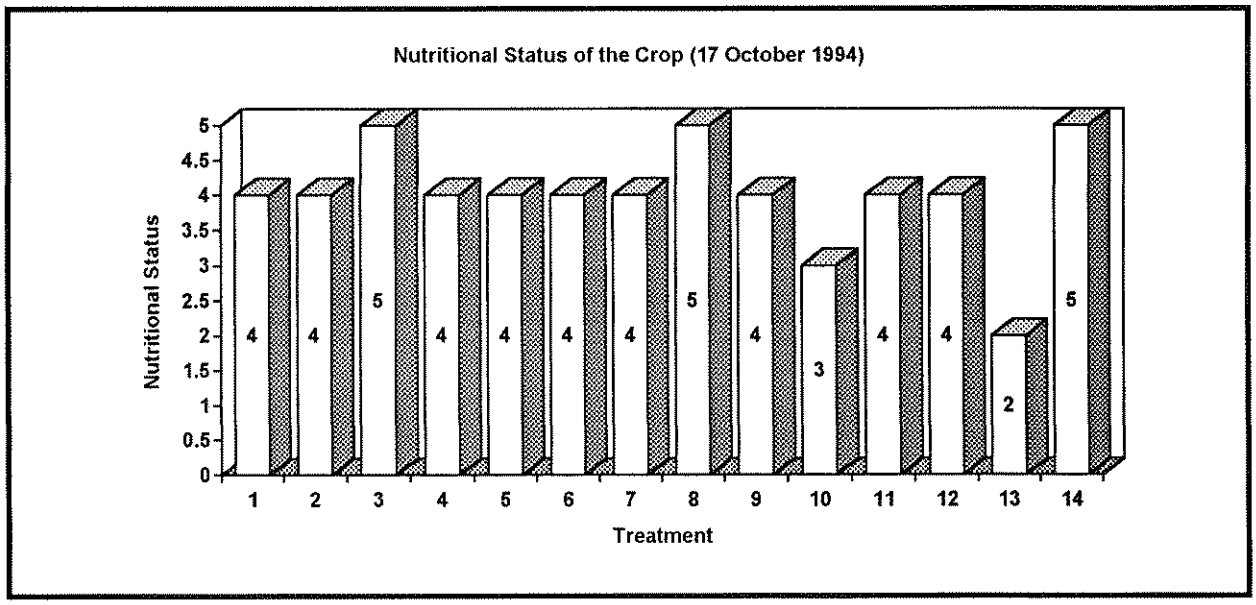
An assessment was done on the percentage of flowers ready at the time of final height assessment.

Graph 14



Nutritional Status of Crop (0 = poor to 5 = excellent)

Graph 15



APPENDIX 2

STATISTICAL ANALYSIS

1993

ANALYSIS OF PLANT HEIGHT DATA FOR VARIETY C

Variate: Height

Analysis of Variance

Source of variation	df	ss	ms	vr	F pr
Block - herbicide stratum					
Block	2	25.356	12.678	0.76	0.475
Herbicide	17	526.133	30.949	1.86	0.061
Residual	34	565.978	16.646	2.34	
Block - herbicide plant stratum	216	1538.400	7.122		
Total	**269**	**2655.867**			

Tables of means

Grand Mean 14.31

Block	**1**	**2**	**3**
	14.37	13.91	14.66

Herbicide	**A**	**B**	**C**	**D**	**E**	**G**	**H**	**J**	**K**
	15.73	13.00	14.80	13.73	14.93	14.93	14.47	14.93	13.60
	M	**N**	**P**	**Q**	**R**	**S**	**T**	**U**	**W**
	13.87	12.40	12.07	18.40	14.27	13.00	15.20	14.80	13.47

Standard errors of differences of means

Table	Block	Herbicide
rep	90	15
sed	0.608	1.490

Stratum standard errors and coefficients of variation

Stratum	df	se	cv%
Block - herbicide	34	1.825	12.7
Block - herbicide plant	216	2.669	18.6

1994

Plant Height on 21/7/94

Analysis of variance

Source of variation	df	ss	ms	vr	F pr
Block - Wplot stratum					
Block	3	581.345	193.782	11.39	<.001
Treatment	13	945.821	72.755	4.28	<.001
Residual	39	663.488	17.013	2.91	
Block - Wplot Sample No. stratum	280	1635.333	5.840		
Total	**335**	**3825.988**			

Table of means

Grand Mean 17.42

Block	**1**	**2**	**3**	**4**
	16.30	19.24	16.05	18.11

Treatment	**A**	**B**	**C**	**D**	**E**	**G**	**H**
	16.12	18.37	18.79	16.21	14.42	16.08	16.04
	J	**K**	**M**	**N**	**P**	**Q**	**R**
	17.17	18.17	18.29	19.33	21.21	16.25	17.46

Standard errors of differences of means

Table	Block	Treatment
rep	84	24
sed	0.636	1.191

Stratum standard errors and coefficients of variation

Stratum	df	se	cv%
Block - Wplot	39	1.684	9.7
Block - Wplot Sample No.	280	2.417	13.9

Plant Height on 17/10/94

Analysis of variance

Source of variation	df	ss	ms	vr	F pr
Block - Wplot stratum					
Block	3	192.052	64.017	2.07	0.120
Treatment	13	1886.156	145.089	4.69	<.001
Residual	39	1205.584	30.912	3.60	
Block - Wplot Sample No. stratum	560	4806.182	8.582		
Total	**615**	**8089.974**			

Table of means

Grand mean 58.99

Block	**1**	**2**	**3**	**4**
	59.59	58.55	59.50	58.33

Treatment	**A**	**B**	**C**	**D**	**E**	**G**	**H**
	60.14	58.57	59.50	59.75	58.50	58.50	55.05
	J	**K**	**M**	**N**	**P**	**Q**	**R**
	61.07	59.86	56.20	59.34	61.61	57.39	60.43

Standard errors of differences of means

Table	Block	Treatment
rep	154	44
sed	0.634	1.185

Stratum standard errors and coefficients of variation

Stratum	df	se	cv%
Block - Wplot	39	1.676	2.8
Block - Wplot Sample No.	560	2.930	5.0

V(1) Weed cover 4/7/94 - Square root transformation used, data = SQRT (d a)

Analysis of variance

Source of variation	df	ss	ms	vr	F pr
Block - Wplot stratum					
Block	3	5.4898	1.8299	4.60	0.007
Treatment	13	60.4149	4.6473	11.69	<.001
Residual	39	15.5064	0.3976		
Total	**55**	**81.4111**			

Table of means

Grand mean 3.406

Block	1	2	3	4
	3.624	3.467	3.655	2.878

Treatment	A	B	C	D	E	G	H
	3.695	4.058	1.470	4.217	3.491	3.295	4.466
	J	**K**	**M**	**N**	**P**	**Q**	**R**
	3.919	2.441	2.794	2.075	2.131	4.586	5.044

Standard errors of differences of means

Table	Block	Treatment
rep	14	4
sed	0.2383	0.4459

Stratum standard errors and coefficients of variation

Stratum	df	se	cv%
Block - Wplot	39	0.6306	18.5

V(4) Weed cover 9/8/94 - Angular transformation used, data = ANG (data)

Analysis of variance

Source of variation	df	ss	ms	vr	F pr
Block - Wplot stratum					
Block	3	1224.8	408.3	2.40	0.083
Treatment	13	12513.8	962.6	5.66	<.001
Residual	39	6638.6	170.2		
Total	**55**	**20377.2**			

Table of means

Grand mean 29.2

Block	1	2	3	4
	30.9	34.6	29.6	21.8

Treatment	A	B	C	D	E	G	H
	13.1	43.3	15.7	31.0	39.2	35.2	49.4
	J	**K**	**M**	**N**	**P**	**Q**	**R**
	11.3	26.5	36.7	27.2	25.3	55.3	0.0

Standard errors of differences of means

Table	Block	Treatment
rep	14	4
sed	4.93	9.23

Stratum standard errors and coefficients of variation

Stratum	df	se	cv%
Block - Wplot	39	13.05	44.6

Number of Weeds 4/7/94

Analysis of variance

Source of variation	df	ss	ms	vr	F pr
Block - Wplot stratum					
Block	3	100.9	33.6	0.30	0.822
Treatment	13	6179.2	475.3	4.31	<.001
Residual	39	4306.1	110.4		
Total	**55**	**10586.2**			

Table of means

Grand Mean 25.8

Block	1	2	3	4
	26.4	24.1	27.6	25.1

Treatment	A	B	C	D	E	G	H
	30.5	29.5	14.3	33.5	26.0	27.3	31.8
	J	**K**	**M**	**N**	**P**	**Q**	**R**
	32.2	23.8	25.3	7.2	3.5	32.2	44.5

Standard errors of differences means

Table	Block	Treatment
rep	14	4
sed	3.97	7.43

Stratum standard errors and coefficients of variation

Stratum	df	se	cv%
Block - Wplot	39	10.51	40.7

Number of weeds 9/8/94 - Square root transformation used, data = SQRT (data)

Analysis of variance

Source of variation	df	ss	ms	vr	F pr
Block - Wplot stratum					
Block	3	7.679	2.560	2.50	0.075
Treatment	12	165.357	13.780	13.43	<.001
Residual	36	36.930	1.026		
Total	**51**	**209.966**			

Table of means

Grand mean 4.00

Block	1	2	3	4
	3.75	4.53	4.17	3.54

Treatment	A	B	C	D	E	G	H
	3.55	5.35	3.07	5.45	5.91	5.69	5.84
	J	**K**	**M**	**N**	**P**	**Q**	**R**
	0.84	5.05	5.29	2.51	2.42		1.00

Standard errors of differences of means

Table	Block	Treatment
rep	13	4
sed	0.397	0.716

Stratum standard errors and coefficients of variation

Stratum	df	se	cv%
Block - Wplot	36	1.013	25.3

APPENDIX 3

Cost of Treatments

The cost per hectare of each treatment is calculated in Table 7.

Unfortunately after starting the trial Enide 50W was withdrawn from the market and is hence unavailable.

Table 7. Cost of treatments.

	Chemical applied.	Unit (kg or l) per hectare.	Approximate cost/unit (kg or l)	Approximate cost per hectare.
1	Atlas Brown - pre planting.	5.6	£14.38	£80.50
2	Atlas Brown - "over the top"	5.6	£14.38	£80.50
3	Croptex Bronze - directed spray	5.6	£15.00	£84.00
4	Croptex Bronze - "over the top.	5.6	£15.00	£84.00
5	Kerb 50 W	2.1	£27.00	£56.70
6	Treflan	2.3	£2.56	£5.88
7	Treflan and Kerb 50 W	2.3 and 2.1	£ 27.00 + £2.56	£62.58
8	Ronstar liquid and Treflan	4.0 and 2.3	£28.50 + £2.56	£119.88
9	Dacthal W75 and Enide 50W	7.5 and 7.5	N/A	N/A
10	Butisan S	1.5	£22.23	£33.34
11	Flexidor	0.3	£45.00	£13.5
12	Devrinol	7.0	£28.00	£196.00
13	Sovereign 330EC	4.0	£8.34	£33.36
14	Dacthal W75 and Ramrod Flowable.	9.0 and 9.0	£14.20 + £2.99	£154.71
15	Wool mulch (Wulch)	N/A	£1.00 per sq.m	£6000.00
16	Polythene mulch	N/A	N/A	£500.00
17	Unweeded control	N/A	N/A	N/A
18	Hand weeded control	N/A	N/A	N/A

Nb. The price of the wool and polythene mulch assumes 60 % space utilisation.

CONTRACT

1. Title of Project

Contract No: BOF 30
Contract Date: 21/5/93

EVALUATION OF SYSTEMS OF WEED CONTROL IN CHRYSANTHEMUMS GROWN FOR FLOWER PRODUCTION OUTDOORS.

2. Background and Commercial Objective

The demise of Tenoran (chloroxuron) has left a large gap in the weed control strategies available for a number of important outdoor flower crops. One particular family for which herbicide choices are now very difficult is the Compositae family. This family consists of a large number of flower crops including:- chrysanthemum, aster, sunflower, dahlia, achillea, helichrysum, calendula, cornflower, pyrethrum, solidago and solidaster. There are few recommended herbicides for this group and of those that are available, some are effective only by virtue of their contact action and give little residual activity. Those that do have residual activity are usually short lived or do not control weeds that belong to the Compositae family such as groundsel and mayweed.

The main advantages of Tenoran were:-

(i) It was very persistent.
(ii) It controlled emerged weeds.
(iii) It was very effective on chickweed.
(iv) It was relatively cheap.

The proposer has consulted widely during the preparation of this report including chemical manufacturers such as Hortichem; the ADAS Weed Consultant, Andrew Greenfield; Don Gilbert and Jim Briggs.

3. Potential Financial Benefit to the Industry

Results would enable optimum weed control systems to be identified. With a total area of about 154 ha, work on chrysanthemums would be of the greatest benefit to a large number of growers of outdoor flowers.

4. Scientific/Technical Target of the Work

To record:-

(i) Total weed cover at monthly intervals between planting and start of flowering.
(ii) The individual weed species present.
(iii) The effects on plant stand and vigour.
(iv) The effects on flower yield and quality.
(v) The suitability of polythene and paper mulches.

5. Closely Related Work Completed or in Progress

As far as the proposer is aware, there is no comparable work being done in the UK.

6. Description of the Work

Treatments will be applied using an Oxford Precision Sprayer using a directed spray or an "over the top application". A directed spray means that the chemical should be applied in a form that ensures that it does not come into contact with the plant tissue. In practice, this would mean keeping the spray nozzle almost at ground level and carefully spraying around the base of each plant. With a crop such as chrysanthemums planted at a spacing of 8 x 8 inches and supported by wires, this operation is very impractical. As a consequence of this, growers prefer to apply the chemical "over the top" i.e. so that both the leaves and soil come into contact with the chemical during what is then a simple spraying operation.

The following treatments will be applied to the transplanted crop in the first year of the trial. These treatments may need to be altered in the second year depending on the results initially obtained.

(i) An evaluation of **Atlas Brown** (chlorpropham + pentanochlor) at a rate of 5.6 litre/ha.

(ii) The use of **Atlas Brown** (chlorpropham + pentanochlor) as an "over the top application" at a rate of 5.6 litre/ha.

(iii) An evaluation of **Croptex Bronze or Atlas Solan 40** (pentanochlor) at a rate of 5.6 litre/ha.

(iv) The use of **Croptex Bronze** as an "over the top application" at a rate of 5.6 litre/ha.

(v) **Kerb** (propyzamide) at a rate of 2.1 litre/ha.

(vii) **Treflan** (trifluralin) at a rate of 2.3 litre/ha applied pre-planting followed by **Kerb** (propyzamide) at a rate of 2.1 litre/ha one month later.

(viii) **Ronstar** liquid (oxadiazon) at a rate of 4 litre/ha and **Treflan** (trifluralin) at a rate of 2.3 litre/ha applied pre-planting.

(ix) A tank mix of **Dacthal** (chlorthal-dimethyl) at a rate of 7.5 kg/ha and **Enide** (diphenamid) at a rate of 7.5 kg/ha.

(x) A tank mix of **Dacthal** (chlorthal-dimethyl) at a rate of 9 kg/ha and **Croptex Amber** (propachlor) at a rate of 9 litre/ha.

(xi) **Butisan S** (metazachlor) at a rate of 1.5 litre of product per ha.

(xii) **Flexidor** (isoxaben) at a rate of 300 ml/ha.

(xiii) **Devrinol** (napropamide) at a rate of 7 litre/ha.

(xiv) **Sovereign 330EC** (pendimethalin) at a rate of 4 litre/ha.

(xv) The use of a black **paper mulch**.

(xvi) The use of a black **polythene mulch**.

(xvii) Control - **unweeded plot**.

Notes

(i) Standard chrysanthemum cultural techniques to be used.

(ii) Three replicates for each treatment is proposed.

(iii) The trial area amounts to approximately 1000 sq m (.25 ac).

(iv) All treatments comply with the current pesticide legislation.

Reporting & dissemination

An interim report will be produced in November 1993 and a final report will be produced in November 1994. The reports will contain an economic appraisal of the most promising treatments. It is also envisaged that a grower walk will be organised to enable HDC levy payers to view the results.

7. Commencement Date and Duration

Start date 01/05/93; two seasons (May-November 1993; May-November 1994)

8. Staff Responsibilities

Project leader: Mr L R Mason, Horticultural Consultant, ADAS, Vancouver House, County Court Road, King's Lynn, Norfolk, PE30 5EH.

Key collaborative staff: Mr W M Lawes, Scientific Officer, ADAS Kirton, Willington Road, Kirton, Boston, Lincs., PE20 1EJ.

9. Location

Commercial Unit in Norfolk: Mr J G Freeman, Bronte House, Lynn Road, Wisbech, Cambs. PE14 7QB. (0945) 582044.