

Report for HDC
Evaluation of Systems of Weed Control
in *Dianthus barbatus* (sweet william)
grown for flower production outdoors.
HDC Project BOF 29

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**EVALUATION OF SYSTEMS OF WEED CONTROL IN *DIANTHUS BARBATUS*
(SWEET WILLIAM) GROWN FOR FLOWER PRODUCTION OUTDOORS.**

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Final Report April 1994

Project Number BOF 29

Project Title "Evaluation of Systems of Weed Control in *Dianthus barbatus* (sweet william) grown for flower production outdoors".

Project Leader J B Briggs, ADAS Horticultural Consultant, ADAS Kirton, Lincs

Location of Project M E & M L Louis Ltd, Sun King Flowers, Shrove House, Moulton Chapel, SPALDING, Lincs PE12 OXQ; site off Woodgate Road, Moulton Chapel.

Project Co-ordinator Mr M E Louis, M E & M L Louis Ltd

Date project commenced July 1991

Date project completed June 1993

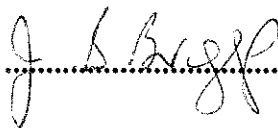
Key Words - Crop name *Dianthus barbatus*
- Weed control herbicides
- other crops to which relevant technology
Dianthus x allwoodii (hybrid pink)
Gypsophila paniculata (biennial gypsophila)

PRINCIPAL WORKERS

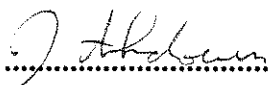
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AUTHENTICATION

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.


..... Jim Briggs
Contract Manager
ADAS Kirton

Date 5 May 1994

Report authorised by 
..... John Ashdown
ADAS Account Manager
ADAS Wolverhampton

Date 9/5/94

COMMERCIAL IN CONFIDENCE

RELEVANCE TO GROWERS AND PRACTICAL APPLICATION.

APPLICATION

* The objective of the project

To identify safe and efficient weed control strategies for sweet williams, a member of the economically important 'pink' family, when grown as an outdoor flower crop.

* The key results

Three applications of the herbicide oxadiazon ("Ronstar Liquid") in a 7 month period will give acceptable weed control combined with good crop vigour in the absence of *Stellaria media* (common chickweed) and *Poa annua* (annual meadowgrass). If these weed species are present an initial application of "Ronstar Liquid" pre-crop emergence should be followed by either metazachlor ("Butisan S") or propachlor ("Ramrod Flowable") post-crop emergence at the young plant stage (at least 3 pairs of leaves) and again the following spring.

* The opportunity for application

The annual weed *Stellaria media* (common chickweed), a member of the 'pink' family, is a reoccurring problem in the economically important flower crops gypsophila, hybrid pinks and sweet williams which are members of the same family. Herbicides that control *Stellaria media* are also likely to adversely affect these flower crops, especially up to the young plant stage. For this reason neither metazachlor ("Butisan S") nor propachlor ("Ramrod Flowable") must be applied before the crop is at the young plant stage (with at least 3 pairs of leaves).

Summary

* Scope and objective

Outdoor flowers include a very wide range of species from different botanical families and genera. Although one of the smaller sectors of UK horticulture, these crops can give a high financial return. However it is not surprising to find there are few pesticides with label recommendations, especially for weed control, for use in these crops. Not only is the grower's choice limited, but the recent withdrawal of the widely used herbicide chloroxuron ("Tenoran") only serves to highlight a major problem faced by the outdoor flower sector.

The family *Caryophyllaceae* was chosen as it contains a number of economically important outdoor flower crops including *Dianthus* x *allwoodii* (hybrid show pink), *D. barbatus* (sweet william) and *Gypsophila paniculata* (biennial gypsophila). Most are grown as biennial or longer-term crops for which safe, reliable and long-lasting weed control systems need to be identified. *Dianthus barbatus* (sweet william) was chosen for the project as it is grown outdoors as a biennial crop, direct-drilled or transplanted in the summer months when satisfactory weed control can be difficult to achieve especially, in the absence of irrigation.

Furthermore in a long-term crop such as sweet williams the absence of a herbicide with good contact action means the grower is solely reliant on an efficient residual herbicide programme starting just pre-crop emergence.

The report covers two years' work on direct-drilled crops and one years' work on a transplanted crop.

***Results**

Herbicides were identified which were considered to have potential, but not all with label recommendations. Most were soil-acting residual herbicides, but the contact/residual herbicide pentachlor ("Croptex Bronze") was also included, as was a black non-woven mulch in the transplanted crop (first year) as an alternative strategy to herbicides.

The first years' experiment - July 1991 to May 1992

Exceptionally dry soil conditions in the summer resulted in very poor germination and establishment in both the drilled and transplanted crops (in 1991 July and August rainfall was 72% and 25% of normal respectively).

- (a) Direct-drilled: the herbicides "Ronstar Liquid" and "Devrinol" applied pre-crop emergence gave good weed control with acceptable plant vigour compared with the hand weeded and control treatments.
- (b) Transplanted: 4.0 l/ha "Ronstar Liquid" and 5.0 l/ha "Devrinol" gave good weed control combined with minimal crop damage. The transplants failed to establish satisfactorily when planted through the black non-woven mulch and plant losses were great, possibly because plants were too small when planted.

Because soil conditions throughout the summer and autumn were so dry, affecting not only crop establishment and growth, but also herbicide performance, it was agreed that a further year's evaluation was needed before sound recommendations could be made.

The second years' experiment - July 1992 to June 1993

The experiment progressed with evaluation of systems of weed control in a direct-drilled crop only. Results in year 1 had highlighted the problem that no one herbicide had the capability to control the wide range of weed species present; for instance the herbicide "Ronstar Liquid" did not control common chickweed (*Stellaria media*) and "Flexidor" did not control grass weeds. For this reason changes were made with herbicides used in sequence on 3 occasions following direct-drilling on 7 July 1992.

In the second year establishment was excellent in marked contrast to 1991. The cool wet weather throughout July and August 1992 ensured 100% establishment and rapid growth.

Evaluation of herbicides in various combinations showed that oxadiazon ("Ronstar Liquid") at 4.0 l/ha product, applied pre, early post-emergence (young plant stage) and a third time in early March 1993, gave the best results in terms of crop growth and vigour. However it did not control *Poa annua* (annual meadowgrass) and *Stellaria media* (common chickweed) which were abundant on the trial site and had to be removed by hand weeding. Where these weed species were present a combination of oxadiazon ("Ronstar Liquid") applied at 4.0 l/ha product pre-emergence followed by either metazachlor ("Butisan S") at 1.5 l/ha product or propachlor ("Ramrod Flowable") at 9.0 l/ha product at the young plant stage and again in early spring were the most effective treatments in terms of weed control, although crop growth and vigour was significantly poorer than where a sequential treatment with "Ronstar Liquid" was used.

The combination of "Ronstar Liquid" followed by diphenamid ("Enide 50 W") performed well both in terms of crop vigour and weed control. However "Enide 50W" is no longer available commercially.

All other treatments either caused unacceptable crop damage or resulted in unacceptable weed control. Isoxaben ("Flexidor") killed seedlings at emergence; napropamide ("Devrinol") pre-emergence and lenacil ("Venzar Weed Killer") post-emergence significantly reduced crop growth and vigour.

* **ACTION POINTS FOR GROWERS**

- Pre-crop emergence apply the herbicide oxadiazon ("Ronstar Liquid") at 4.0 l/ha product
- Two further applications of oxadiazon ("Ronstar Liquid") can be made from the young plant stage to maintain weed free conditions throughout the life of the crop.
- Where the annual weeds *Stellaria media* (common chickweed) and *Poa annua* (annual meadow grass) are known to be a problem the following herbicides, as appropriate for the weed present, should be used when the young plants have at least 3 pairs of leaves - metazachlor ("Butisan S") at 1.5 l/ha product or propachlor ("Ramrod Flowable") at 9.0 l/ha product. Application of either of these products before the young plant stage is likely to result in poorer plant stands and reduced vigour.

Note

- i None of the herbicides referred to above have a specific label recommendation for use on sweet williams and therefore under the Control of Pesticides Regulations 1986 off-label arrangements for non-edible crops and plants apply.
- ii Annual Weed Species not controlled pre-emergence by specific herbicides

"Butisan S"	Charlock, fumitory, knotgrass, field penny cress.
"Devrinol"	Black nightshade, charlock, field penny cress, hairy bittercress, scarlet pimpernel, (shepherds purse)*.
"Enide 50 W"	Black bindweed, annual dead nettle, fumitory, black nightshade, (charlock, cleavers)*.
"Flexidor"	Cleavers, annual meadow grass, and all grasses.
"Ramrod Flowable"	Black bindweed, charlock fumitory, field penny cress, knotgrass, volunteer cereals, red shank (fat hen)*.
"Ronstar Liquid"	Annual meadow grass, chickweed, black nightshade.

"Venzar Weed Killer" Black nightshade, cleavers, ivy leafed speedwell and common speedwell, field pansy.

* annual weeds in brackets are moderately resistant to the specific herbicide.

* **Practical and financial anticipated benefits.**

- The ability to maintain long-term weed free conditions with the control of a wide range of annual weed species, especially *Poa annua* and *Stellaria media* with the use of a comprehensive herbicide programme, instead of costly hand labour for weeding, will be a considerable benefit.

EXPERIMENTAL SECTION

INTRODUCTION

In recent years there has been an expansion in the area of production of a wide range of flower crops grown outdoors across the whole of the UK.

Cut flowers such as natural season chrysanthemums, hybrid pinks and annual crops from seed both for the fresh and dried flower markets are now widely grown and provide attractive alternatives to higher cost protected production.

The UK Farm Gate value (at current prices) of flowers in the open, excluding flower bulbs, has increased from £9.4 m in 1985 to £21.9 m in 1992 (ADAS and MAFF)^①. The area of production in England and Wales of flowers grown in the open including dahlias and chrysanthemums, has also increased from 547 ha in 1986 to approximately 1,000 ha (1991 = 1,120 ha; 1992 = 1016 ha) (MAFF)^②

With renewed grower interest in outdoor flower production in the late 1980s the HDC's Bulbs and Outdoor Flowers Panel's commissioned Review was timely. The Review, summarised in HDC Project News No 14,(BRIGGS 1992)^③ made full use of the limited statistics on outdoor flower production; of World databases; of seed and plant sources and knowledge and experience of specialist ADAS consultants and HRI colleagues. It also identified major limitations to crop production and priorities for R&D.

Outdoor flower crops are one of the smallest of the minor crops sectors in UK horticulture. It is not surprising to find that there are few pesticides with specific label recommendations, especially for weed control, for use in these crops. The Review identified weed control and use of crop covers and mulches as one of the priority items for R&D.

MATERIALS AND METHODS

First Year Experiment

Crop Diary

i. Sowing/transplanting

Direct-drilled Crop

Seed of *Dianthus barbatus* (sweet william) was direct-drilled on 24 July 1991.

Transplanted Crop

Module-raised transplants were planted on 20 September 1991.

ii. Bed System

A standard 3 row bed, 1.83 m wide was used. The direct-drilled crop was drilled to a stand. An in-row spacing of 0.31 m was used for the transplanted modules.

iii. Application of Treatments

Direct-drilled Crop

Treatments were applied on 31 July 1991 pre-crop emergence.

Transplanted Crop

The black non-woven mulch was laid on 21 August 1991.

Treatments were applied on 25 September 1991.

iv. Assessments

10 September 1991:	Plant stand counts and weed cover assessments for direct-drilled treatments.
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- 26 September 1991: Weed assessments for direct-drilled crop only.
- 28 November 1991: Weed assessments of all treatments.
- 4 December 1991: Plant stand counts, crop damage and weed assessments of all treatments.
- 2 January 1992: Height and width measurements taken, crop damage and weed assessments of drilled crop.
- 29 April 1992: Crop vigour, weed cover and weed species assessments for all treatments.

v. Treatments - Direct-drilled Crop

1. Control - weeds not removed
2. Control-cultivated
3. Oxadiazon ("Ronstar Liquid"), 4.0 l/ha product in 600 l/ha water
4. Napropamide ("Devrinol"), 5.0 l/ha product in 300 l/ha water
5. Pentanochlor ("Croptex Bronze"), 5.6 l/ha product in a minimum of 220 l/ha water
6. Isoxaben ("Flexidor"), 0.3 l/ha product in 300 l/ha water

DESIGN: Treatments were fully replicated in 3 randomised blocks.

vi. Treatments - Transplanted Crop

1. Control-weeds not removed
2. Control - cultivated
3. Black non-woven mulch

4. Oxadiazon ("Ronstar Liquid"), 4.0 l/ha product in 600 l water/ha
5. Oxadiazon ("Ronstar Liquid"), 8.0 l/ha product in 600 l water/ha
6. Napropamide ("Devrinol"), 5.0 l/ha product in 300 l water/ha
7. Napropamide ("Devrinol"), 7.0 l/ha product in 300 l water/ha
8. Metazachlor ("Butisan S"), 1.5 l/ha product in 600 l water/ha
9. Isoxaben ("Flexidor"), 0.3 l/ha product in 300 l water/ha

DESIGN: Treatments were fully replicated in 4 randomised blocks

Second Year Experiment

Crop Diary

i. Sowing

Seed of *Dianthus barbatus* (sweet william) was direct-drilled on 7 July 1992; varieties Messenger and Electron.

ii. Bed System

A standard 3 row bed, 1.83 m wide was used. The crop was drilled to a stand and no further inter-row spacing was done.

iii. Application of Treatments

Treatments were applied as follows:-

Pre-crop emergence: 11 July 1992

Early post-emergence: 19 August 1992
(young plant stage:
at least 3 pairs of leaves)

Early spring: 4 March 1993
(a continuous in-row band
of growth)

iv. Assessments

28 July 1992: Plant stand counts.

18 August 1992: Weed assessments all treatments, followed by removal of *Stellaria media* from treatments 2, 5-10.

7 September 1992: Percentage weed cover and weed species records; crop damage assessments.

- 11 September 1992: All weeds removed from treatment 3.
- 19 October 1992: Plant cover, weed cover and weed species assessments.
- 8 February 1993: Plant cover, weed cover and weed species assessments.

v. Treatments

1. Control - hand weeded.
2. Oxadiazon ("Ronstar Liquid"), 4.0 l/ha product pre-emergence, and post-emergence in August and early March.
3. Napropamide ("Devrinol"), 5.0 l/ha product pre-emergence, and post-emergence in August and early March.
4. Isoxaben ("Flexidor"), 0.3 l/ha product pre-emergence, and post-emergence in August and early March.
5. Oxadiazon ("Ronstar Liquid"), 4.0 l/ha product pre-emergence, lenacil ("Venzar Weed Killer"), 1.5 kg/ha product post-emergence in August and 2.2 kg/ha product early March.
6. Oxadiazon ("Ronstar Liquid"), 4.0 l/ha product pre-emergence, napropamide ("Devrinol"), 5.0 l/ha product post-emergence in August and early March.
7. Oxadiazon ("Ronstar Liquid"), 4.0 l/ha product pre-emergence, isoxaben ("Flexidor"), 0.3 l/ha product post-emergence in August and early March.
8. Oxadiazon ("Ronstar Liquid"), 4.0 l/ha product pre-emergence, diphenamid ("Enide 50W"), 9.0 kg/ha product post-emergence in August and early March.
9. Oxadiazon ("Ronstar Liquid"), 9.0 l/ha product pre-emergence, propachlor ("Ramrod Flowable"), 9.0 l/ha product post-emergence in August and early March.
10. Oxadiazon ("Ronstar Liquid"), 4.0 l/ha product pre-emergence, metazachlor ("Butisan S"), 1.5 l/ha product post-emergence in August and early March.

All herbicides were applied in 450 l water/ha.

DESIGN: Treatments were fully replicated in 4 randomised blocks.

The data were transformed using the square root transformation, adding a constant of 0.5, to satisfy the analysis of variants assumptions.

RESULTS

Year One

Direct-drilled Crop

The herbicides oxadiazon ("Ronstar Liquid") and napropamide ("Devrionol") applied pre-emergence gave good weed control and acceptable plant vigour compared with the hand weeded and control treatments. However, "Ronstar Liquid" did not control common chickweed (*Stellaria media*).

Transplanted Crop

Oxadiazon ("Ronstar Liquid") at 4.0 l/ha product and napropamide ("Devrionol") at 5.0 l/ha product gave good weed control combined with minimal crop damage. The transplants failed to establish satisfactorily when planted through the black non-woven mulch and plant losses were great, possibly because plants were too small when planted.

Soil conditions throughout the summer and autumn were exceptionally dry affecting not only crop establishment and growth, but also herbicide performance. A further year's evaluation was needed before sound recommendations could be given.

Year Two

Plant stand count - 28 July 1992 [Appendix I]

Pre-emergence application of isoxaben ("Flexidor") prevented seedling emergence and the treatment was not statistically analysed. Differences between the other treatments were not statistically significant.

Crop growth and vigour [Appendix I and II]

The application of oxadiazon ("Ronstar Liquid") at 4.0 l/ha product alone to the direct-drilled crop on 3 occasions gave significantly better crop growth and vigour than the other treatments, including the hand weeded control.

Sequential treatments (6, 7, 8, 9 and 10) of oxadiazon ("Ronstar Liquid") applied pre-emergence with other herbicides applied early post-emergence and in early March 1993, gave results which were not significantly different from the hand weeded control.

Napropamide ("Devrinol") applied on 3 occasions, and oxadiazon ("Ronstar Liquid"), 4.0 l/ha product pre-emergence and lenacil ("Venzar Weed Killer") at 1.5 kg/ha product post-emergence in August and 2.2 kg/ha product early March gave significantly poorer crop growth compared with all other treatments.

Treatment 4 isoxaben ("Flexidor") applied at 0.3 l/ha product prevented seedling emergence so that the plant stand count at 28 July 1992 was so low as to render the treatment unacceptable. It was not therefore included in the statistical analysis.

Weed Control [Appendix I and III]

On 18 August 1992 *Stellaria media* (chickweed) was removed from all treatments which included oxadiazon ("Ronstar Liquid").

The treatment of napropamide ("Devrinol") applied on 3 occasions, was handweeded on 11 September 1992 as weed growth was excessive.

Sequential treatments of oxadiazon ("Ronstar Liquid") followed by napropamide ("Devrinol") or isoxaben ("Flexidor") gave significantly poorer weed control than the other treatments.

CONCLUSIONS

Three applications of the herbicide oxadiazon ("Ronstar Liquid") in a 7 month period will give acceptable weed control, providing no *Stellaria media* (chickweed) or *Poa annua* (annual meadow grass) is present, combined with good crop vigour.

If *Stellaria media* or *Poa annua* are known to be present, an initial application of "Ronstar Liquid" pre crop emergence should be followed by either metazachlor ("Butisan S") or propachlor ("Ramrod Flowable") post-crop emergence at the young plant stage (at least 3 pairs of leaves) and again the following spring.

All other treatments evaluated resulted in poor weed control, damage to crop growth or in the case of diphenamid ("Enide 50W") are no longer commercially available.

ACKNOWLEDGEMENTS

The author acknowledges the co-operation and unstinting help of ME and ML Louis Ltd, Sun King Flowers, Shrove House, Moulton Chapel, Spalding, Lincs PE12 0XQ in the provision of the trial sites and full facilities in both years. Thanks are also due to Mr P W Bingham, Kingfisher Nursery, Gedney Hill, Spalding, Lincs PE12 0PP for the provision without charge of the module transplants for the first years' trial.

The author thanks Mr W M R Lawes, ADAS Kirton for skillfully carrying out the trials and Ms F M O'Donnell, ADAS Biometrics Unit, Cheltenham, for statistical services, and Mr P A Johnson, ADAS Kirton, for advice on preparation of the report.

REFERENCES

1. ADAS, and MAFF Statistics (Agricultural Commodities) Division. 1993.
2. MAFF Agricultural Census Branch. 1993.
3. BRIGGS, J. B., 1992. Outdoor flowers (excluding bulb flowers): a review of outdoor flower production including problems and scope for R&D. BOF18; Horticultural Development Council, Petersfield.

APPENDIX I STATISTICAL ANALYSIS

"Evaluation of systems of weed control in *Dianthus barbatus* (sweet william) grown for flower production out-doors".

TREATMENT	PLANT STAND COUNT	% GROUND COVERED BY SWEET WILLIAMS	
	28 July 1992	19 October 1992	8 February 1993
1	18.3	55.0 b	67.5 b
2	20.6	71.2 c	86.2 c
3	16.9	46.2 a	58.7 a
5	14.8	47.5 a	55.0 a
6	15.6	56.2 b	70.0 b
7	18.1	55.0 b	67.5 b
8	18.1	61.2 b	71.2 b
9	16.4	55.0 b	67.5 b
10	15.4	58.7 b	65.0 b
p	NS	< 0.001	= 0.002
SED	3.55	2.63	4.23
df	69	15	15

Means followed by different letters are significantly different.
NS - no significant difference between treatments

TREATMENT	% WEED AREA*				OVERALL
	19 October 1992				
VARIETY	VARIETY	VARIETY	VARIETY		
Messenger	Electron	Electron	Electron		
1	0.71 a	(0.0)	0.71 a	(0.0)	(0.0)
2	2.09 a	(0.0)	7.11 b	(50.0)	(10.7)
3	1.40 a	(1.5)	2.79 a	(7.3)	(3.9)
5	1.58 a	(2.0)	3.73 a	(13.4)	(9.7)
6	7.67 b	(58.3)	5.35 b	(28.1)	(41.8)
7	7.78b	(60.0)	2.79 a	(7.3)	(27.4)
8	2.35 a	(5.0)	2.62 a	(6.4)	(6.0)
9	3.24 a	(10.0)	2.64 a	(6.5)	(7.3)
10	2.35 a	(5.0)	1.22 a	(1.0)	(1.8)

p = 0.014

df = 69

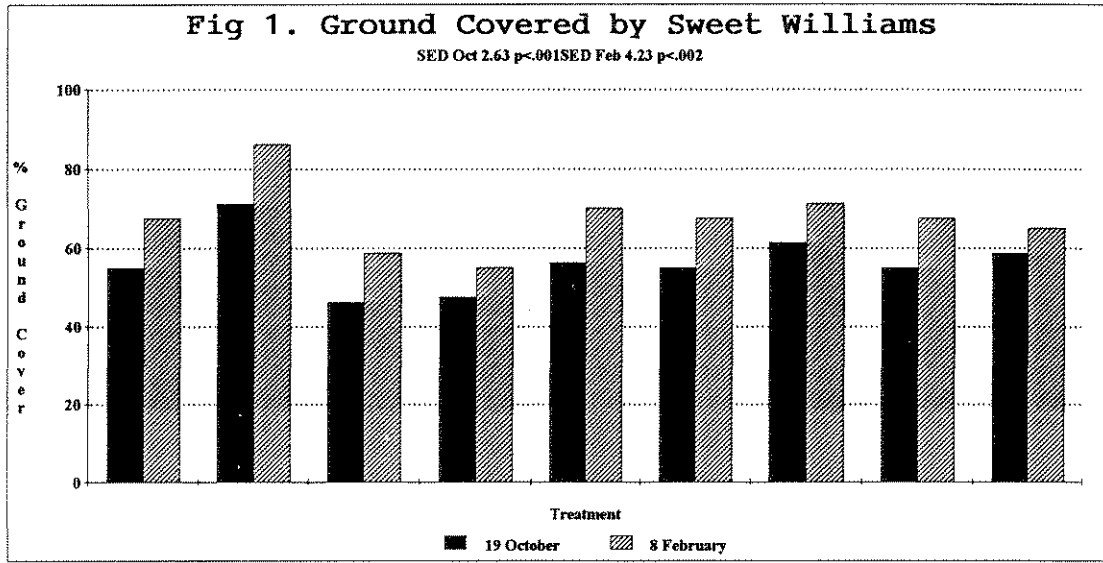
SED = 1.89 to compare means with 1 value

= 1.34 to compare means with 2 values

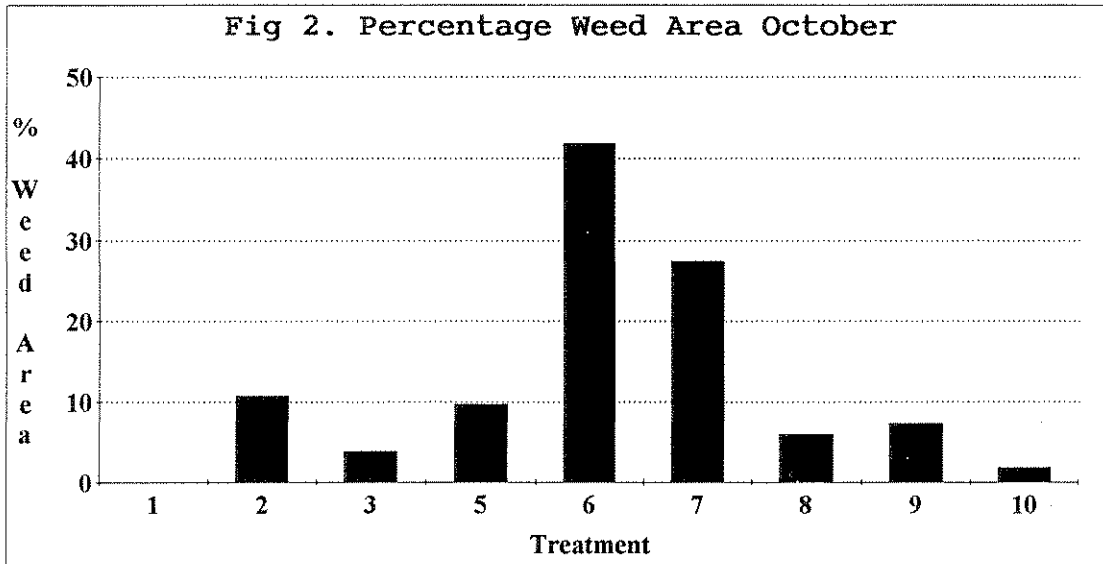
= 1.09 to compare means with 3 values

* Data were transformed using a square root transformation, adding a constant of 0.5 first. Back-transformed mean values are quoted in brackets. Transformed data are quoted with SED, df and means comparisons.

APPENDIX II



APPENDIX III



CONTRACT

1. TITLE OF PROJECT

Contract No: BOF 29

EVALUATION OF SYSTEMS OF WEED CONTROL IN *DIANTHUS BARBATUS* (SWEET WILLIAM) GROWN FOR FLOWER PRODUCTION OUTDOORS

2. BACKGROUND AND COMMERCIAL OBJECTIVE

The Horticultural Development Council's Bulb and Outdoor Flower Panel commissioned "Review of Outdoor Flower Production and Scope for R & D" identified weed control and use of crop covers and mulches as priority items of research and development. The family *Caryophylleacea* includes a number of important outdoor flower crops including *Dianthus x allwoodii* (Hybrid Show Pink), *Dianthus barbatus* (Sweet William) and *Gypsophila panniculata* (biennial Gypsophila) for which safe, reliable and long-term weed control systems need to be identified.

3. POTENTIAL FINANCIAL BENEFIT TO THE INDUSTRY

Results would enable optimum weed control systems, and particularly those with environmental advantages, to be identified.

4. SCIENTIFIC/TECHNICAL TARGET OF THE WORK

To record:

- (a) Total weed cover at monthly intervals between emergence/planting and start of flowering.
- (b) Individual weed species present.
- (c) Effects on crop emergence/plant stand.
- (d) Effects on flower yield and quality.
- (e) Degradation of the plastic mulches.

5. CLOSELY RELATED WORK - COMPLETED OR IN PROGRESS

The HDC "Review of Outdoor Flowers Production and Scope for R & D" did not identify any work done in the United Kingdom, although research, development and review reports and articles were identified world-wide, which included:-

- i. Lamont, G P; O'Connell, M A; 'An evaluation of pre-emergent herbicides in field-grown cut flowers'. NSW Dep Agric, Gosford, NSW 2250, Australia. Plant Protection Quarterly 1986. I (3): 95-100 (14 ref).
- ii. Penningsfeld, F; Kurzmann, P; Kalthoff, F; 'Cut-flower perennials under plastic sheeting (I)'; Institut für Bodenkunde und Pflanzenernährung, Weihenstephan, German Federal Republic. Deutscher Gartenbau 1980. 34 (16): 714-720.
- iii. Penningsfel, F; Kurzmann, P; Kalthoff, F; 'Cut-flower perennials under plastic sheeting (11)'. (As at ii).

6. DESCRIPTION OF THE WORK

The following treatments are proposed on direct-drilled seed and transplanted (plug) plants:-

Direct-drilled crop. Herbicides applied pre-crop emergence

- (a) Control - weeds not removed.
- (b) Cultivated control.
- (c) Oxadiazon ("Ronstar Liquid" at 4 l/ha in 300-1000 l/ha water.
- (d) Napropamide ("Devrinol") at 5 l/ha.
- (e) Alachlor ("Lasso") at 4.0 l/ha in a minimum of 225 l/ha of water.
- (f) Isoxaben ("Flexidor") at 0.3 l/ha in 100-400 l/ha of water.

Transplanted crop. Herbicides applied post-planting.

- (a) Control - weeds not removed.
- (b) Cultivated control.
- (c) Black non-woven mulch, eg "Black Agryl".
- (d) Oxadiazon ("Ronstar Liquid") at 4 l/ha in 300-1000 l/ha water.
- (e) Oxadiazon ("Ronstar Liquid") at 8 l/ha in 300-1000 l/ha water.

- (f) Napropamide ("Devrinol") at 5 l/ha.
- (g) Napropamide ("Devrinol") at 7 l/ha.
- (h) Alachlor ("Lasso") at 4.0 l/ha in a minimum of 225 l/ha of water.
- (i) Isoxaben ("Flexidor") at 0.3 l/ha in 100-400 l/ha of water.

Notes

- 1. The bed system to be used.
- 2. If possible, pelleted seed to be used.
- 3. Direct-drilled trial; 6 treatments x 4 replications. Transplanted trial; 9 treatments x 3 replications.

7. COMMENCEMENT DATE AND DURATION

July 1991 - one year, with final report by August 1992.

8. STAFF RESPONSIBILITIES

Project Leader: J B Briggs, Horticultural Adviser, ADAS, Government Buildings, Willington Road, Kirton, Boston, Lincs. PE20 1EJ

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

Other staff: A J Greenfield, ADAS Horticultural Herbicide Liaison Officer, Oxford Divisional Office.

D H Gilbert, ADAS National Adviser, Ornamental Crops, Cambridge Regional Office.

9. LOCATION

Commercial unit in South Lincolnshire: M E & M L Louis Ltd, Sun King Flowers, Shrove House, Moulton Chapel, Spalding, Lincs. PE12 0XQ.

PROPOSAL

1. **TITLE OF PROJECT**

Contract No: BOF 29
(Extension for a second year)

EVALUATION OF SYSTEMS OF WEED CONTROL IN *DIANTHUS BARBATUS*
(SWEET WILLIAM) GROWN FOR FLOWER PRODUCTION OUTDOORS
(SECOND YEAR)

2. **BACKGROUND AND COMMERCIAL OBJECTIVE**

As for BOF 29

3. **POTENTIAL FINANCIAL BENEFIT TO THE INDUSTRY**

As for BOF 29

4. **SCIENTIFIC/TECHNICAL TARGET OF THE WORK**

As for BOF 29

5. **CLOSELY RELATED WORK - COMPLETED OR IN PROGRESS**

As for BOF 29

6. **DESCRIPTION OF THE WORK FOR YEAR 2**

The following treatments are proposed on direct-drilled seed, applied pre-emergence, and post-crop emergence in September and February.

- (a) Handweeded control.
- (b) Oxadiazon ("Ronstar Liquid") 4.0 l/ha product pre-emergence, and post-emergence in September and February.
- (c) Napropamide ("Devrinol") 5.0 l/ha product pre-emergence, and post-emergence in September and February.
- (d) Isoxaben ("Flexidor") 0.3 l/ha product pre-emergence, and post-emergence in September and February.

- (e) Oxadiazon ("Ronstar Liquid") 4.0 l/ha product pre-emergence, lenacil ("Venzar") 1.5 kg/ha product post-emergence in September and 2.2 kg/ha product February.
- (f) Oxadiazon ("Ronstar Liquid") 4.0 l/ha product pre-emergence, napropamide ("Devrinol") 5.0 l/ha product post-emergence in September and February.
- (g) Oxadiazon ("Ronstar Liquid") 4.0 l/ha product pre-emergence, isoxaben ("Flexidor") 0.3 l/ha product post-emergence in September and February.
- (h) Oxadiazon ("Ronstar Liquid") 4.0 l/ha product pre-emergence, diphenamid ("Enide 50W") 9.0 kg/ha product post-emergence in September and February.
- (j) Oxadiazon ("Ronstar Liquid") 4.0 l/ha product pre-emergence, propachlor ("Ramrod Flowable"), 9.0 l/ha product post-emergence in September and February.
- (k) Oxadiazon ("Ronstar Liquid") 4.0 l/ha product pre-emergence, metazachlor ("Butisan S"), 1.5 l/ha product post-emergence in September and February.

Notes

- i Replication: 10 treatments x 4 replications.
- ii. Records: Effects on crop emergence/plant stand
Total weed cover assessments
Individual weed species present
Effects on plant vigour and quality

7. COMMENCEMENT DATE AND DURATION

Start date 1 July 1991; duration 2 years.

8. STAFF RESPONSIBILITIES

As for BOF 29

9. LOCATION

As for BOF 29

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