Project title:	**Larkspur: evaluation of weed control systems in *Delphinium ajacis* and *D. consolida* grown for flower production outdoors.**
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AUTHENTICATION

I declare that this work was done under my supervision according to the procedures described herein and that this report represents a true and accurate record of the results obtained.

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For precise reporting, herbicides have been referred to by their product names. No endorsement is intended of products mentioned, nor criticism of those not mentioned.

Report prepared for the
Horticultural Development Council

Larkspur: evaluation of weed control systems in *Delphinium ajacis* and *D.consolida* grown for flower production outdoors.

December 1997

(BOF 40)

PRACTICAL SECTION FOR GROWERS

Objective and background

The Horticultural Development Council's Bulb and Outdoor Flower Panel commissioned "Review of Outdoor Flower Production and Scope for R & D" (BOF 18) identified weed control and use of crop covers and mulches as priority items of research and development. This project is therefore the third in an on-going series of herbicide trials in outdoor flower crops. It is designed to give information on weed control in the family *Ranunculaceae* which includes larkspur (*Delphinium ajacis* and *D. consolida);* love-in-a-mist (*Nigella damescena*); perennial delphinium (*D. elatum*); peony (*Paeonia* spp) and *Ranunculus* spp. All are increasingly important flower crops outdoors, identified by HDC levy payers as a major group for which safe, reliable and long-term weed control systems are needed. Larkspur has been used because of its importance as both a fresh cut and dried flower. However, extrapolation of the results for the other flower crops in the family *Ranunculaceae* should be possible.

Traditionally larkspur is grown as either a biennial or annual flower crop direct-drilled to flower <u>in situ</u>. Sown in the autumn in suitable soils and sites, and over-wintered as young plants, larkspur will flower from June some weeks before early spring drilled crops.

Successional cropping can be achieved both for the fresh and dried flower market by this approach. Discussions with major growers indicated a preference for the trial to be done on an early spring-drilled crop where weed control was considered more of a problem resulting from dry soil conditions which often occur in the early part of the year.

The HDC's "Review of outdoor flower production and scope for R & D" identified a number of 'candidate' herbicides; others were chosen through industry consultation.

The objective of this project was to test a range of herbicides and chemical soil fumigants applied at various stages to determine safe and efficient weed control strategies.

Pre-sowing, pre and early post-emergence treatments were devised using herbicides alone, and in combination, with one complementing the other, to achieve as wide a spectrum of weed control as possible. Pre-sowing low-rate applications of two chemical soil fumigants were also evaluated as they were considered to have potential for long-term weed control, especially for over-wintered crops.

Summary of results

A trial was set-up in February 1997 in a spring-sown, direct-drilled commercial crop of larkspur grown on a flower enterprise in Hertfordshire. The trial aimed to test 2 chemical soil fumigants, and a range of herbicides, applied at various stages to determine safe and efficient weed control strategies. Pre-sowing applications of the two soil fumigants, and pre and early post-emergence (young plant stage) treatments using herbicides alone, and in combination, were devised to achieve as wide a spectrum of weed control as possible.

Given the lack of herbicides with label recommendations a wide range of herbicides were selected based on wide-ranging discussions in the Industry.

Abnormally high rainfall fell in June following 3 months in which much less than average was recorded. The onset of wet weather coincided with the application of the early post-emergence treatments on 29 May. There was too much weed growth present (approximately 30%) for the mainly residual-acting herbicides to work effectively at the young plant stage. This showed clearly the need for herbicide treatments to be applied before crop emergence given that larkspur tends to grow slowly to the young plant stage (9 weeks between sowing and 2-3 leaf stage in this trial).

In terms of plant stand, effective weed control to harvest, and numbers of marketable flower stems the best results were achieved with the soil fumigant dazomet incorporated into the soil to a depth of 2.5 cm only, then covered with polythene, 6 weeks before sowing. Only the 100 kg/ha rate had significantly more marketable flowers than the unweeded control whereas at 50 kg/ha flower stem number was not significantly better.

Of the herbicides treatments, only some of those applied pre-emergence achieved good weed control, and some reduced plant stand significantly. The following herbicides were far too phytotoxic - oxydiazon, chlorpropham + fenuron, trifluralin + propachlor, metamitron, isoxaben and lenacil.

Chlorthal-dimethyl applied pre-emergence achieved good weed control. However, it significantly reduced the mean plant number, but only just.

The soil fumigant metam-sodium, and the 2 herbicides pentanochlor and asulam, applied pre-emergence, although safe to the crop, did not achieve good weed control.

Action points for growers

1. The soil fumigant dazomet was safe and effective when used at a low rate as a soil surface treatment 6 weeks before the crop was drilled. However, it is an expensive treatment compared with residual herbicides and must be applied according to manufacturers instructions.

2. On the basis of this trial care should be exercised in the use of the herbicide chlorthal-dimethyl applied pre-emergence as it significantly reduced the mean plant stand, although good weed control was achieved.

3. Larkspur tends to germinate and grow slowly to the young plant stage. Treatments prior to crop germination are therefore essential to achieve effective weed control; early post-emergence treatments alone cannot be relied upon.

4. The above findings are based on a single trial, subjected to abnormally wet weather in June, and apply to herbicides only when used at the rates etc, stated in the body of this report.

Practical and financial benefits from the study

A limited range of safe and effective treatments for use in direct-drilled larkspur crops has been usefully identified. The soil fumigant dazomet was the safest and most effective when used pre-drilling at a low rate as a soil surface treatment. However, at the highest rate evaluated the material cost was £500/ha against an average cost for the residual herbicides of £100/ha.

A number of herbicides which damaged the crop were also identified.

SCIENCE SECTION

Introduction

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 withdrawal in the 1990s of the widely used herbicides chloroxuron ("Tenoran") and diphenamid ("Enide 50W") only served to highlight a major problem faced by the outdoor flower sector. Furthermore, as for many other horticultural crops, agrochemical companies have not been able to justify field trials with newer products. Alternative herbicides, alone and in combination, have, of course, been tried by growers on an 'own risk' basis.

Whilst the original Review included a world-wide literature search of 15 genera encompassing 22 species of flowers, the most economically important outdoor flowers are contained in the 3 families *Caryophyllaceae, Compositae* and *Ranunculaceae*. During the 1990s the HDC has funded projects on weed control in the first two, respectively BOF 29 "Evaluation of systems of weed control in *Dianthus barbatus* (sweet william) grown for flower production outdoors", and BOF 30 "Evaluation of systems of weed control in chrysanthemums grown for flower production outdoors".

With both these projects growers have also been able to apply the results to other economically important flower crops in the respective families e.g. hybrid pinks and asters.

The third family to be chosen, that of the buttercup family *Ranunculacea*, likewise contains a number of economically important outdoor flower crops grown as annual, biennial or longer-term perennial crops.

The HDC trial was set up to test herbicide programmes, with particular reference to applications before drilling, and pre and early post-crop emergence.

Mostly residual herbicides were chosen, used either alone or in a sequence with another complementary herbicide. However, the mainly contact herbicide pentanochlor ("Atlas Solan 40", "Croptex Bronze") was included as it has a label recommendation for use in larkspur and is used commercially in the crop.

Two chemical soil fumigants were used, dazomet ("Basamid") and metam-sodium ("Campbell's Metam Sodium") both at low rates, with the aim of achieving complete weed control in the surface soil only. It was recognised that the use of soil fumigation techniques presented specific problems for the industry apart from the obvious one of cost. There is a need for adequate soil moisture after application; the time between application and sowing/planting is often lengthy and there is a risk of re-contamination of the site after treatment by wind-borne weed seed. Even so, renewed interest in the technique after a number of years of limited use prompted a reassessment.

The effects of treatments on the following parameters were recorded: total weed cover at 2-3 week intervals between the young plant stage and the start of flowering; individual weed species present; plant stand at young plant stage; flowering date, marketable stems and stem length.

Materials and methods

Plant material

Seed of larkspur *Delphinium consolida* Imperialis "Salmon Beauty", "Blue Spire" and "White Spire" was direct-drilled on 27 March 1997. A commercial seed rate of 0.09 gm/running metre was used.

Crop husbandry

The site, formerly a long-established top fruit orchard with a typical weed population, had only been used for outdoor flower production from 1994.

The soil, a brick earth, was sampled on 13 November 1996; fertility was good with pH 7.9, phosphorus 30 mg/l (index 3), potassium 311 mg/l (index 3) and magnesium 61 mg/l (index 2). Fertilisers did not need to be applied.

The land was cultivated and beds formed [on 1.53 m wheel centres] on 6 February 1997. Husbandry followed good commercial practice; irrigation was applied according to crop requirements.

Following discussion with the Statistician the translocated non-residual herbicide glyphosate was applied on 9 April 1997 to control emerged weed seedlings before crop emergence. It was not however applied to the two chemical soil fumigant treatments [treatments 6, 7 and 8] which were covered with polythene sheets to prevent herbicide contact.

To prevent weed spread from the untreated roadways and pathways into the plots, these were rotovated/hand hoed as necessary.

Chemical soil fumigant and herbicide treatments

Details of chemical soil fumigants and herbicides used and application rates (commercial product/ha) were as listed below, rates being either those recommended in the case of herbicides with label recommendations for use on flower crops outdoors, or extrapolated from other recommended rates where there was no such label recommendation. Given the lack of recommendations, a 'broad brush' approach was adopted with a wide range of herbicides, used alone, and in combination to complement one another, to establish safety and efficacy. However, to meet the needs of statistical analysis compromises were necessary.

The fumigant and herbicide programmes tested were:

1. Handweeded control.

2. Unweeded control.

3. Unweeded control.

4. Unweeded control.

5. Unweeded control.

6. Dazomet ('Basamid') at 50 kg/ha raked into soil surface to a depth of 2.5 cm 6 weeks before drilling the crop.

7. Dazomet ('Basamid') at 100 kg/ha raked into the soil surface to a depth of 2.5 cm 6 weeks before drilling the crop.

8. Metam-sodium ('Campbell's Metam Sodium') at 200 l/ha watered into the soil 5 days before drilling, with 5.0 mm of irrigation.

9. Chlorthal-dimethyl ('Dacthal W-75') at 9.0 kg/ha applied pre-emergence.

10. Chlorthal-dimethyl ('Dacthal W-75') at 9.0 kg/ha applied at young plant stage.

11. Pentanochlor ('Atlas Solan 40') at 5.61/ha applied pre-emergence.

12. Oxydiazon ('Ronstar Liquid') at 4.0 l/ha applied pre-emergence followed by metazachlor ('Butisan S') at 1.5 l/ha at young plant stage.

13. Asulam ('Asulox') at 6.0 l/ha applied pre-emergence.

14. Asulam ('Asulox') at 2.8 l/ha applied at young plant stage.

15. Chlorpropham + fenuron ('Croptex Chrome') at 11.0 l/ha applied pre-weed and pre-crop emergence.

16. Trifluralin ('Treflan') at 2.3 l/ha incorporated prior to drilling followed by propachlor ('Ramrod Flowable') at 9.0 kg/ha applied pre-emergence.

17. Metamitron ('Goltix WG') at 5.0 kg/ha applied pre-emergence.

18. Chlorthal-dimethyl ('Dacthal W-75') at 9.0 kg/ha and propachlor ('Ramrod Flowable') at 9.0 kg/ha applied at young plant stage.

19. Isoxaben ('Flexidor 125') at 1.0 l/ha applied pre-emergence.

20. Isoxaben ('Flexidor 125') at 1.0 l/ha applied at young plant stage.

21. Lenacil ('Clayton Lenacil 80W') at 4.0 l/ha applied pre-emergence.

All herbicides were applied in 450 litres of water/ha using a medium quality spray. Treatments were applied via an Oxford Precision Sprayer.

The chemical soil fumigant dazomet (treatments 6 and 7) was carefully raked into the soil surface to a depth of 2.5 cm under good soil conditions on 14 February 1997. The plots were immediately covered with polythene to seal the surface. The polythene was removed on 18 March 1997 when a 'cress' test confirmed the soil was free of the fumigant.

The soil sterilant metam-sodium was watered into the soil with 5.0 mm of irrigation on 22 March 1997 5 days before the crop was drilled. The plots were left uncovered.

The soil incorporated herbicide trifluralin was also applied on 22 March 1997 and worked to a depth of 5.0-7.5 cm.

All the pre-emergence herbicide treatments were applied on 9 April 1997; irrigation was applied the same day.

The early post-emergence treatments were applied on 29 May 1997 when the larkspur was actively growing and had 2-3 pairs of leaves. This was at a similar stage to the application of herbicides to commercial crops. The weed cover was approximately 30% on the unweeded control plots.

During crop establishment the experimental site was irrigated at the same time as the surrounding commercial crop.

The trial was superimposed across a commercial crop of three flower colours, pink, white and blue and to meet the demands of the Statistician there were 4 unweeded control treatments together with a hand-weeded control; in the former weeds were allowed to grow unchecked, and in the latter weeds were removed by hand (on 9 May and 10 June). The unweeded controls allows the weed population and any resultant competition with the crop to be assessed, while the hand-weeded control allows any phytotoxicity of the fumigants and herbicides to be checked.

Rainfall recorded at Ickleton Grange, an official meteorological station nearest to the trial site, showed marked fluctuations in the 6 month period February to July 1997. March, April, May and July had much lower rainfall than the 30 year average at 15.9, 28.8, 62.9 and 74.8% respectively. February was slightly wetter at 121.2% of average, whilst in June 146.1 mm of rainfall was recorded, 332% more than the 30 year average. This encouraged an explosion of lush weed growth some 6-8 weeks after the pre-emergence herbicide treatments were applied.

<u>Assessments</u>

Plant counts were done on 9 May 1997 when the stage of growth of the young plants ranged between the cotyledon stage and two true expanded leaves. Symptoms of leaf scorch were recorded at the same time.

Plots were checked for weed growth on 5 occasions, at 2-3 week intervals, between 9 May and 23 July. The total percentage weed cover and the weed species present were recorded.

The number of stems with open flowers were recorded on 6 occasions at 1-4 day intervals between 14 and 28 July to identify any treatments which advanced flowering. Whilst no formal statistical analysis could be made due to sparseness of the data, graphs were produced to determine trends - Figures 1-6.

The number of marketable flower stems and stem length were recorded at the point of harvest.

Design and statistical analysis

Treatments were arranged in a randomised block design with 3 replicates (1 each of 3 colours). Plot size was a 5.0 metre length of bed (1.53 m) with a recorded area of a 2.0 metre length of the 2 centre rows.

Where appropriate, least significant differences (LSD) at P = 0.05 are given in the results. A difference exceeding the LSD value is significant at the 5% level. This means that, even without a real treatment effect, such a difference could occur one time in twenty.

Results

Number of plants

The number of plants recorded on 9 May 1997 is summarised in Table 1. Given the 'broad brush' approach that was adopted inevitably some treatments applied pre-crop emergence proved to be phytotoxic. The following herbicides applied pre-emergence significantly reduced plant numbers compared to the unweeded control - chlorthal-dimethyl, oxydiazon, chlorpropham + fenuron, trifluralin + propacholor, metamitron, isoxaben and lenacil (treatments 9, 12, 15, 16, 17, 19 and 21 respectively). As well as reducing plant numbers leaf scorch was recorded on two or more replicates of the following treatments - oxydiazon, metamitron and lenacil (treatments 12, 17 and 21 respectively)

Only two treatments showed significantly better results compared with the unweeded control - dazomet at 100 kg/ha and pentanochlor (treatments 7 and 11).

Compared to the hand weeded control none of the treatments was significantly better.

Weed control

Weed cover recorded between 9 May and 23 July is summarised in Table 2. A full list of the weed species found in plots of each treatment is given in Table 3.

In the untreated plots, the weed population reached 28% cover by 23 May, then in the next 5 week period it developed rapidly with 81.4% recorded on 30 June. This was a reaction to the abnormally wet June in which 332% more rainfall was recorded than the 30 year average.

Overall, only treatments applied either before drilling or pre-crop emergence successfully controlled weeds and even then significant differences were recorded. Applications only at the young plant stage were too late to prevent excessive weed growth (treatments 10, 14, 18 and 20).

By the last assessment on 23 July, when harvesting was well advanced, the following treatments had maintained significantly better weed control throughout compared with the unweeded control - dazomet (both rates), chlorthal-dimethyl, oxydiazon + metazachlor, metamitron and lenacil (treatments 6, 7, 9, 12, 17 and 21 respectively). Chlorpropham + fenuron and trifluralin +

propachlor (treatments 15 and 16) also performed satisfactorily although weed control tended to breakdown at the end of June.

All of the remaining pre-drilling and pre-emergence treatments performed poorly - metam-sodium, pentanochlor, asulam, and isoxaben (treatments 8, 11, 13, and 19).

Crop performance

Plants with open flowers were recorded on 6 occasions between 14 and 28 July, shown in Figures 1-6. Whilst the data was unsuitable for statistical analysis trends were noted. Dazomet soil fumigation (treatments 6 and 7) consistently advanced the start of flowering compared with the other treatment.

The number of marketable flower stems and stem length are given in Table 4.

Only dazomet at 100 kg/ha (treatment 7) had a significantly greater number of marketable flowers than the unweeded control.

Oxydiazon + metazachlor, asulam post-emergence, trifluralin + propachlor, metamitron, isoxaben pre-emergence and lenacil (treatments 12, 14, 16, 17, 19 and 21) had significantly shorter flower stems than the unweeded control.

Discussion

In this trial a wide range of treatments were evaluated to identify those with potential for safe and efficient weed control in larkspur in particular, and in the family *Ranunculaceae* in general. Given the lack of herbicides with label recommendations, and the dearth of information on the safety and efficacy of others based on growers' experience, it was to be expected that the 'broad brush' approach adopted would result in widely varying results. And so it proved.

The results of trials of this type are dependent on weather and other conditions, unless the work can be repeated over a number of years. The site was atypical in that the weed species present were, in part, a carry-over from previous use of the land for top fruit production; black bindweed, cleavers, fat hen, sowthistle and woody nightshade were predominant. Furthermore, the abnormally high rainfall in June following 3 months in which much less rainfall than average was recorded, encouraged lush weed growth which tended to overwhelm the crop as it grew beyond the young plant stage.

The trial provided very clear evidence of herbicides applied pre-crop emergence that significantly reduced plant numbers; these were chlorthal-dimethyl, oxydiazon, chlorpropham + fenuron, trifluralin + propachlor, metamitron, isoxaben and lenacil. In all the other treatments dazomet, metam-sodium, pentanochlor, asulam, chlorthal-dimethyl + propachlor, and isoxaben post-emergence there were no significant reductions in plant stands compared with the two control treatments.

Time of application, and also treatment, determined efficacy of weed control over the 4 month period April to July. Only treatments applied either before drilling or pre-crop emergence achieved significantly better weed control through to harvest compared with the unweeded control, and even then significant differences were recorded. The extremely wet weather in June provided a real test of efficacy for all treatments. On the basis of this single trial, only the following treatments were shown to be fully effective - dazomet (both rates), chlorthal-dimethyl, oxydiazon + metazachlor, metamitron and lenacil. Chlorpropham + fenuron and trifluralin + propachlor also performed satisfactorily although weed control tended to breakdown at the end of June.

Larkspur tends to germinate and grow slowly to the young plant stage. Even with irrigation, there was a 9 week interval between sowing and the post-emergence application of herbicides. During this period weeds developed rapidly. Clearly, where treatments were restricted to application at the young plant stage (2-3 pairs of leaves) with approximately 30% weed cover on the unweeded control plot on 29 May, this was much too late to achieve good commercial control given that the herbicides were mainly residual in action.

As well as weed control, the number of marketable flower stems, and to a lesser degree, stem length, are the main criteria in determining suitability of treatments for use in larkspur. Compared with the unweeded control, only dazomet at 100 kg/ha had significantly more marketable flowers. There was also a trend towards earlier flowering in plots treated with dazomet although this was not subject to statistical analysis.

Conclusions

1. Of 2 chemical soil fumigants, and 12 herbicides evaluated either alone or in combination, only the soil fumigant dazomet, incorporated into the soil surface, 6 weeks before the crop was drilled, at 100 kg/ha, was fully safe and effective. Dazomet at 50 kg/ha incorporated into the soil surface 6 weeks before drilling also performed satisfactorily although flower stem number was not significantly different from the unweeded control.

2. Chlorthal-dimethyl applied pre-emergence significantly reduced the mean plant number (95% certainty), but only just, and flower yield was not significantly better than the unweeded control. However, good weed control was achieved.

3. None of the herbicides applied early post-emergence at the young plant stage were effective. There were two main reasons for this. Too much weed growth was present (approximately 30%) for the mainly residual acting herbicides to work. Furthermore, the abnormally wet June encouraged lush weed growth immediately after the post-emergence treatments were applied.

4. Dazomet was very effective in maintaining weed free conditions through to harvest and met the objective of achieving good weed control in the surface soil. Recontamination of the plots by wind-blown weed seed did not occur.

References

Papers consulted include:-

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Table 1 Mean number of plants, 9 May 1997

Treatment	Number of plants
Unweeded Control	63.58
Handweeded Control	67.33
Dazomet, 50 kg/ha	64.33
Dazomet, 100 kg/ha	68.67
Metam-sodium	66.00
Chlorthal-dimethyl pre-emergence	58.00
Chlorthal-dimethyl post-emergence	57.00
Pentanochlor pre-emergence	68.67
Oxydiazon pre-emergence, metazachlor post-emergence	26.33
Asulam pre-emergence	62.00
Asulam post-emergence	62.33
Chlorpropham + fenuron pre-emergence	49.67
Trifluralin pre-drilling + propachlor pre-emergence	25.33
Metamitron pre-emergence	17.33
Chlorthal-dimethyl + propachlor post-emergence	64.33
Isoxaben pre-emergence	5.00
Isoxaben post-emergence	65.67
Lenacil pre-emergence	4.00
SED	2.493
LSD (5.0%)	5.038
Residual DF	43

Table 2 **Mean weed cover (percentage) for the various treatments from 9 May to 23 July**

Treatment	9 May 1997	23 May 1997	13 June 1997	30 June 1997	23 July 1997
Unweeded Control	9.87	28.3	64.8	81.4	62.2
Handweeded Control	0.00	0.0	0.0	0.0	0.0
Dazomet, 50 kg/ha	1.91	8.1	14.6	14.8	9.7
Dazomet, 100 kg/ha	3.83	8.1	8.9	9.7	4.6
Metam-sodium	9.27	28.9	44.9	68.1	51.8
Chlorthal-dimethyl pre-emergence	5.74	9.7	16.2	32.2	17.9
Chlorthal-dimethyl post-emergence	8.74	23.7	42.0	57.7	53.2
Pentanochlor pre-emergence	9.96	31.1	60.0	76.8	58.1
Oxydiazon pre-emergence, metazachlor post-emergence	0.00	2.7	4.6	7.0	13.2
Asulam pre-emergence	6.54	19.7	47.2	57.6	48.8
Asulam post-emergence	6.56	37.6	70.7	75.0	60.0
Chlorpropham + fenuron pre-emergence	1.91	15.1	15.9	30.3	36.9
Trifluralin pre-drilling + propachlor pre-emergence	3.83	6.6	14.2	34.3	55.1
Metamitron pre-emergence	1.91	6.2	15.1	31.6	39.8
Chlorthal-dimethyl + propachlor post-emergence	9.88	28.7	45.0	63.8	45.0
Isoxaben pre-emergence	7.02	15.9	40.3	49.3	57.8
Isoxaben post-emergence	10.76	31.3	65.8	90.0	68.9
Lenacil pre-emergence	1.91	3.8	6.1	16.9	26.6
SED	1.908	8.08	10.96	9.83	11.32
LSD (5.0%)	3.86	16.33	22.15	19.87	22.88
Residual DF	43	43	43	43	43

Table 3 Weed species in the experimental plots on 23 July 1997. See text for treatment details

Treatment	Black bindweed	Cleavers	Clover	Fat hen	Groundsel	Knotgrass	Mayweed	Plantain
1	✓							
2				✓			✓	✓
3	✓			✓				
4	✓	✓		✓			✓	
5				✓				
6		✓	✓	✓	✓			
7	✓		✓	✓				
8	✓			✓				
9	✓	✓	✓	✓	✓		✓	
10				✓				
11	✓	✓		✓				
12	✓	✓				✓		
13		✓		✓				
14	✓	✓		✓				
15				✓	✓		✓	
16			✓	✓	✓			✓
17	✓	✓		✓	✓			
18				✓			✓	
19	✓	✓		✓	✓		✓	✓
20		✓		✓			✓	
21	✓	✓	✓	✓				

Table 3 continued

Treatment	Shepherds purse	Small nettle	Speedwell	Sow-thistle	Woody nightshade
1				✓	✓
2				✓	✓
3				✓	✓
4				✓	✓
5				✓	✓
6					
7				✓	
8		✓		✓	✓
9	✓				
10				✓	✓
11		✓		✓	✓
12	✓		✓		
13				✓	✓
14				✓	✓
15				✓	✓
16				✓	✓
17	✓		✓	✓	✓
18				✓	
19				✓	✓
20				✓	✓
21	✓		✓		✓

Table 4 Mean number of marketable flower stems and stem length at harvest

Treatment	Flower Stem Number	Stem Length cm
Unweeded Control	18.1	110.6
Handweeded Control	30.5	115.0
Dazomet, 50 kg/ha	26.0	125.0
Dazomet, 100 kg/ha	48.0	147.5
Metam-sodium	29.5	127.5
Chlorthal-dimethyl pre-emergence	32.0	115.0
Chlorthal-dimethyl post-emergence	19.0	117.5
Pentanochlor pre-emergence	15.5	112.5
Oxydiazon pre-emergence, metazachlor post-emergence	8.5	55.0
Asulam pre-emergence	23.0	122.5
Asulam post-emergence	2.5	55.0
Chlorpropham + fenuron pre-emergence	14.0	107.5
Trifluralin pre-drilling + propachlor pre-emergence	0.0	0.0
Metamitron pre-emergence	1.0	52.5
Chlorthal-dimethyl + propachlor post-emergence	26.0	115.0
Isoxaben pre-emergence	0.0	0.0
Isoxaben post-emergence	27.0	125.0
Lenacil pre-emergence	0.0	0.0
SED	9.02	23.77
LSD (5.0%)	18.66	49.18
Residual DF	23	23

Fig 1 Number of open flowers versus treatment, 14 July 1997

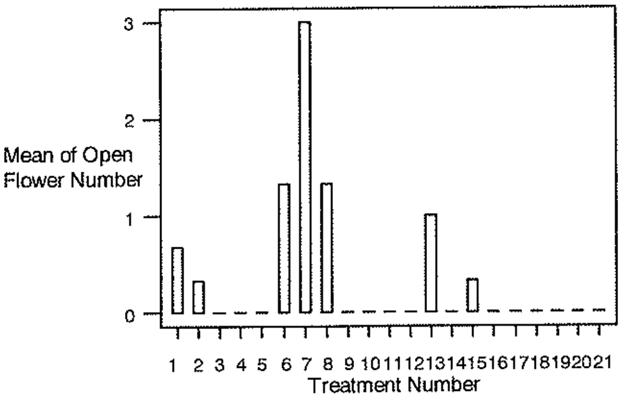


Fig 2 Number of open flowers versus treatment, 18 July 1997

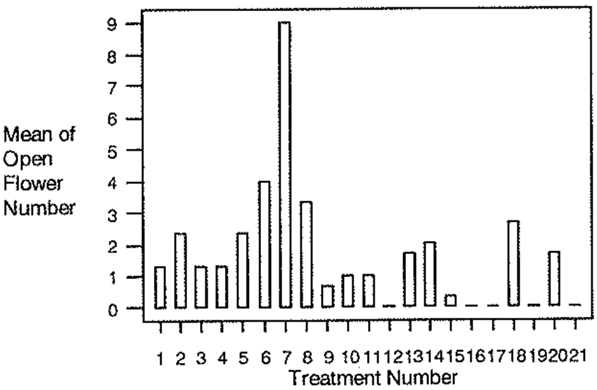


Fig 3 Number of open flowers versus treatment, 22 July 1997

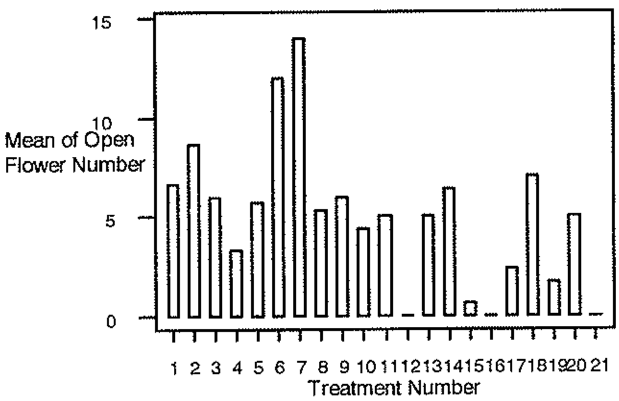


Fig 4 Number of open flowers versus treatment, 23 July 1997

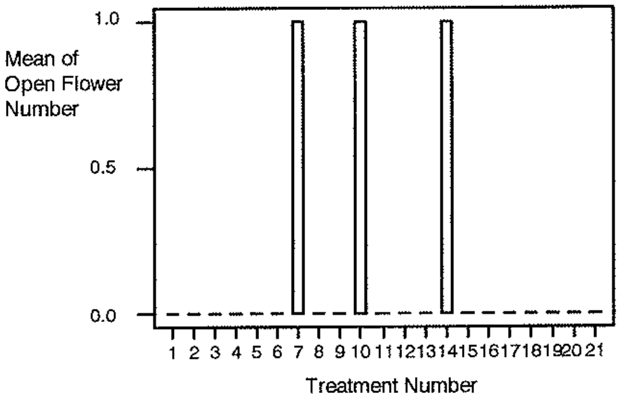


Fig 5 Number of open flowers versus treatment, 25 July 1997 number.

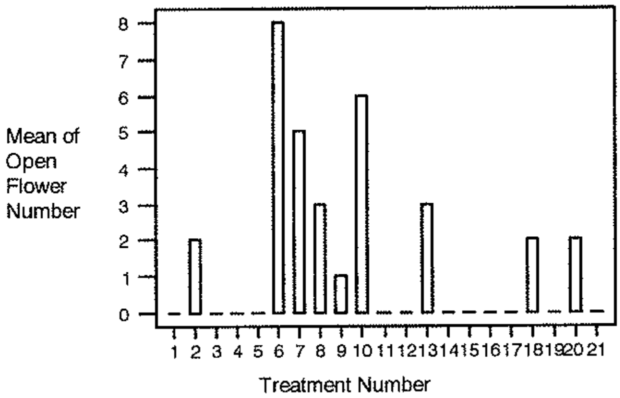
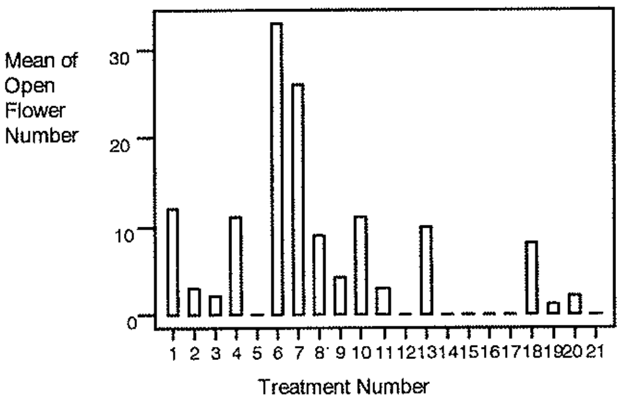


Fig 6 Number of open flowers versus treatment, 28 July 1997



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