

PESTICIDE USAGE IN SCOTLAND

***OUTDOOR BULBS
AND FLOWERS 1993***



Scottish Agricultural Science Agency

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This report presents information from a survey of pesticide usage on outdoor bulbs and flowers grown in Scotland in 1993. The last survey was carried out in 1981 when surveys of this type were carried out on an ad hoc basis and was confined to bulbs only. All agricultural and horticultural surveys are now carried out in a programme in which the major areas of pesticide use are surveyed every 2 years and others every 4 years. The area of bulbs grown had doubled since the previous survey to 380 hectares, whilst the area of flowers was relatively small at 17 hectares only.

No insecticides were recorded on bulbs, although a wide range was used on flowers, mainly for aphid control.

There were large increases in the use of both fungicides and herbicides since 1981.

Benomyl was extensively used on narcissi bulbs, both to control smoulder and to keep the crop green, whilst chlorothalonil was the principal fungicide recorded on flowers for the control of rust.

Cyanazine was the most popular herbicide for general weed control and sulphuric acid was widely used for desiccation on narcissi bulbs in their final year.

INTRODUCTION

This was the third survey of pesticides on outdoor bulbs but the first on outdoor flowers for cutting. The previous two surveys on bulbs were carried out in 1977 and 1981 (References 1 & 2). Data in the former survey had been based on 2 growers only and the estimates of pesticide usage in that report should therefore be treated with caution. In 1993, the crops surveyed were predominantly narcissi; small areas of other bulbs (mainly tulips and crocuses), chrysanthemums and other flowers were also encountered.

DEFINITIONS AND NOTES

Basic area (or basic ha) is the planted area of crop which was treated with a given pesticide, irrespective of the number of times it was applied to that area.

Spray area (or spray ha) is the basic area of a crop treated with a given pesticide multiplied by the number of treatments that area received.

The reasons reported for the uses of pesticides are those given by growers and may sometimes be inappropriate.

In this report, the term 'formulation(s)' is used to denote the pesticide active ingredient or mixture of active ingredient in a product (s).

Due to rounding, there may be slight differences in totals both within and between tables.

Data from the 1981 survey are provided for comparison purposes in some of the tables, although it should be borne in mind that there may be minor differences in the range of crops surveyed, together with changes in areas of each of the crops grown.

The quantities of active ingredients recorded for the seed/hot water treatments of the bulbs are the total used in the process. No attempt has been made to estimate the amount of active ingredient remaining on the bulbs after the treatment.

Using the 1992 Agricultural Census (Reference 3), two samples were drawn representing the whole of Scotland: the first was selected from holdings growing bulbs, and the second from those growing other flowers. Two samples were necessary to ensure the inclusion of holdings growing other flowers such as chrysanthemums which represented relatively small areas.

The country was divided into 11 land-use regions (Fig 1, Reference 4). Holdings were stratified by land-use region and by size group. Sampling fractions within size groups were based on the areas of the relevant crops grown rather than number of holdings, so that smaller size groups would not dominate the sample.

The survey period was the 12 months from September 1992 to September 1993. Details of the numbers of holdings visited and their distribution are given in Table 2 and the areas of crops surveyed are shown in Tables 19 and 20.

For all crops, sample data were raised to give estimates of national pesticide usage using raising factors (Tables 23 & 24). These were based on the areas of bulbs and flowers in the 1993 Agricultural Census (Reference 5) within regions and size groups (Tables 21 & 22). Land-use regions 1, 2, 3 and 4 were amalgamated (Northern Scotland), as were regions 5 & 6 (Angus & East Fife), and regions 7, 9, 10 and 11 (South & South-East Scotland). Adjustments (Table 25) were made for bulbs within each region by applying the raising factors to the sample area of each crop grown and comparing this with the area from the 1993 Agricultural Census.

In 1993, narcissi were the predominant bulb crop grown in Scotland, estimated to cover almost all of the total bulb area of 380 hectares. Accurate comparisons of the areas grown between the present and previous surveys are not possible, as the relevant data were not available in the 1981 report; overall, the area of bulb crops had doubled.

● ***Insecticides***

As in 1981, no insecticides were recorded.

● ***Fungicides (Table 4)***

Seventy three percent of the crop was treated with fungicide, compared with only small areas in the previous surveys. By far the most commonly used fungicide was benomyl, applied to 53% of the crop, used mainly against smoulder and to keep the crop green.

● ***Herbicides and desiccants (Table 5)***

An estimated 86% of the crop was treated with a herbicide. Cyanazine was the principal formulation used, applied to 304 spray hectares, 80% of the crop, followed by paraquat on 194 spray hectares (32%). By comparison, chlorpropham and linuron had been the most popular in 1981.

Sulphuric acid was used predominantly as a desiccant on 115 spray hectares but also for weed control on 10 hectares. Although the proportion of the area of all bulbs treated with this chemical was only 32%, this was equivalent to 84% of the area of crops in their final year.

● ***Seed/hot water treatments (Table 4)***

Nearly all (100%) of bulbs in their first year had been hot-water treated, all with formaldehyde.

Only very small areas of bulbs other than narcissi were grown. It was estimated that only 0.7 hectares of tulips, crocus, iris and snow drop were planted. In 1981, at least 9 hectares of tulips had been recorded.

● ***Insecticides and fungicides***

Neither insecticides nor fungicides were used on these crops. In the previous survey (1981), several fungicides had been recorded, mainly vinclozolin, iprodione and benomyl.

● ***Herbicides (Table 6)***

Forty percent of the crops were treated with herbicide. Cyanazine and diphenamid were the main ones recorded, each applied to 35% of the crop.

● ***Seed/hot water treatments (Table 6)***

Benomyl, applied to 35% of the crop, was the only specified pesticide used, applied to the bulbs as a hot water treatment.

An estimated 6 hectares of chrysanthemums were grown in Scotland in 1993.

● ***Insecticides and molluscicides (Table 7)***

Nearly all (96%) of the crop area was treated with insecticide. Cypermethrin, applied to 9 spray hectares, (70% of the crop), and nicotine to 8 spray hectares (5% of the crop area) were the principal insecticides recorded, both for aphid control.

Twenty seven percent of the crop received molluscicide. Metaldehyde and methiocarb were each applied to 1 spray hectare, 19% and 8% of the crop area respectively.

● ***Fungicides and soil sterilants (Table 8)***

Sixty two percent of the area of the crop was treated with fungicide. The main formulation recorded was chlorothalonil, applied to 7 spray hectares, 57% of the crop, for rust control.

The soil sterilant, dazomet, was used on 8% of the crop.

● ***Herbicides (Table 8)***

Only 7% of the area of the crop was treated with herbicide for general weed control. Glyphosate and paraquat were the only formulations recorded.

An estimated 10 hectares of flowers for cutting, other than chrysanthemums, were grown in 1993. Dahlias, sweet pea and polyanthus were the only crops specified.

● ***Insecticides and molluscicides (Table 9)***

Twenty six percent of the area of the crops was treated with insecticide. Pirimicarb, applied to 4 spray hectares, (7% of the crop area) and pirimiphos-methyl to 3 spray hectares (18% of the crop area) for aphid control, and resmethrin to 3 spray hectares (2% of the crop area) against caterpillars were the most commonly used insecticides.

Roughly one fifth of the area of the crops received molluscicide. Both methiocarb and metaldehyde were recorded.

● ***Fungicides and soil sterilants (Table 9)***

No fungicide use was recorded on any of these crops.

The soil sterilant, dazomet, was used on 5% of the area of the crops.

● ***Herbicides (Table 9)***

Only 10% of the area of the crops was treated with herbicide for general weed control. Paraquat, both alone and in a formulated mixture with diquat, was the principal herbicide employed.

COMPARISONS WITH PREVIOUS SURVEYS

Complete comparisons between the data reported in the last survey conducted on the 1981 crops and present survey are not possible because the earlier survey did not include flowers other than bulbs. The comparisons are therefore restricted to bulbs only. However, the crop area in 1993 for bulbs alone accounted for 97% of the total area of bulbs and flowers grown in Scotland, indicating the relatively small area of flowers.

Comparisons in the usage of pesticides in terms of weight and spray hectares of formulations applied between the current and last survey are presented in Table 18.

Since the previous survey the area of outdoor bulbs had doubled to 380 hectares.

As in 1981, no insecticides were recorded on bulbs.

Even accounting for the doubling of area grown, the use of fungicides increased considerably: 9-fold as measured by the spray area of active ingredients and 5-fold by their weight.

There was also a real increase in the use of herbicides and desiccants. The massive increase in weight applied was due to the increased use of sulphuric acid, mainly as a desiccant, but also for weed control on small areas.

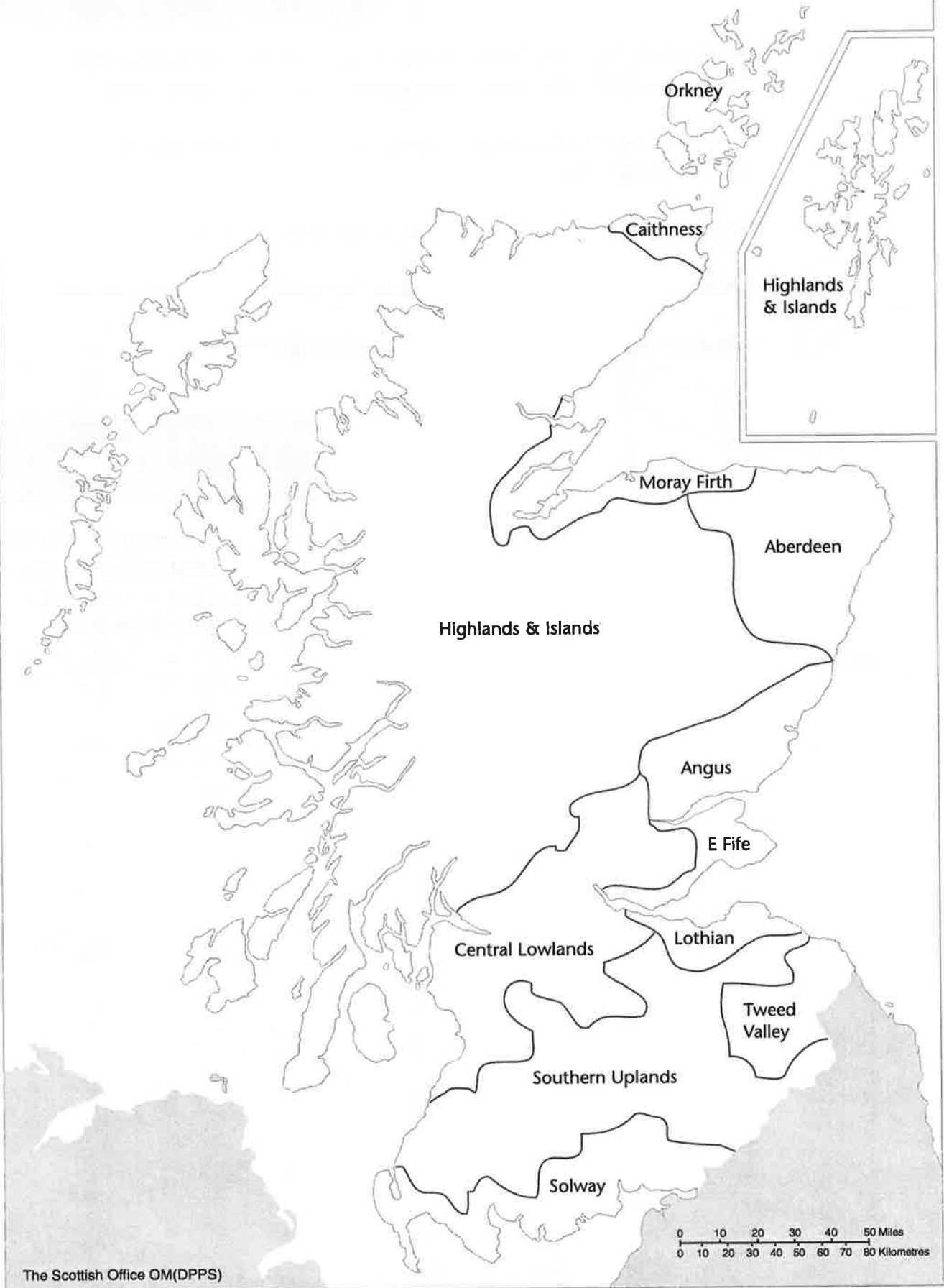
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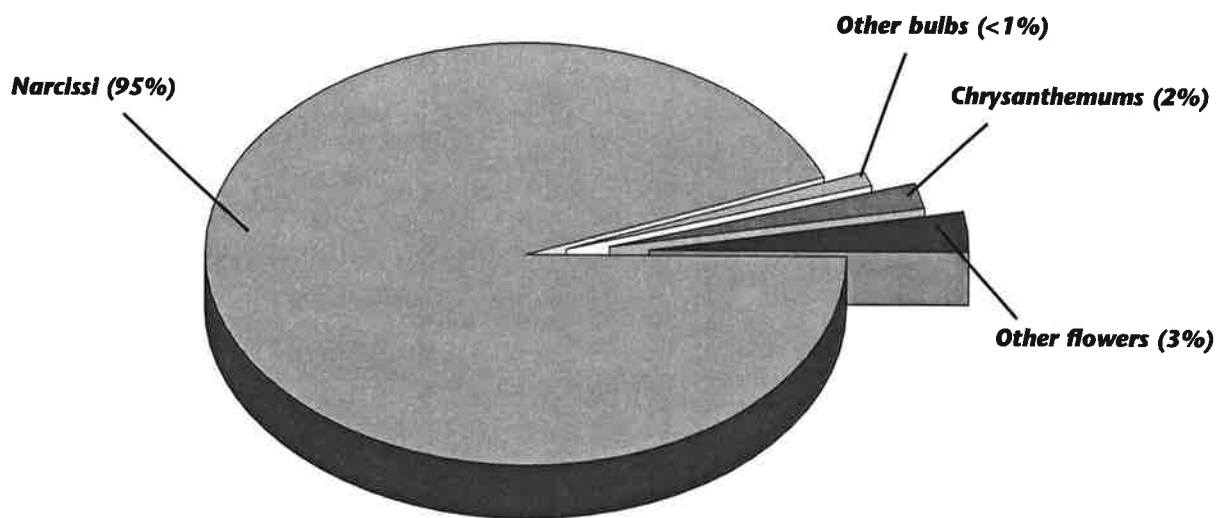
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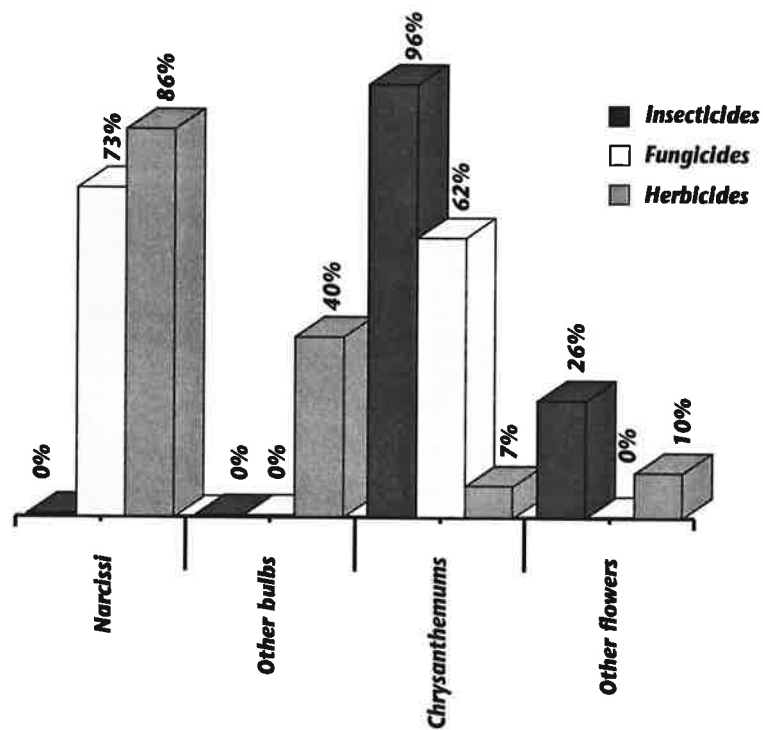
● **Figure 1 Land-Use Regions of Scotland**



● **Figure 2 Outdoor bulbs and flower crop areas (%) in 1993**



● **Figure 3 Percentages of crop areas treated with pesticide**



● **TABLE 1** *Crop Areas 1993 (hectares)*

	Northern Scotland	Angus & East Fife	South & South-East Scotland	Central Scotland	Scotland 1981
Bulbs	38.8	335.9	1.2	4.3	189.7
Flowers	1.4	7.1	5.7	2.3	35.1
All crops	40.2	343	6.9	6.6	224.8

● **TABLE 2** *Distribution of sample*

Size (ha)	Northern Scotland	Angus & East Fife	South & South-East Scotland	Central Scotland	Scotland
0.1 - 1.9	2	8	6	3	19
2 - 5.9		6			6
6 - 19.9		6			6
20 - 29.9	1	8			9
All sizes	3	28	6	3	40

TABLE 3 Proportions (%) of crops treated with pesticides

	Narcissus	Other bulbs	Chrysanthemums	Other cut flowers	All crops
Insecticide			96	26	2
Molluscicide			27	21	1
Fungicide	73		62		71
Soil sterilant			8	5	+
Herbicide	86	40	7	10	83
Desiccant	*32				30
Any pesticide	86	40	98	36	85

'+' = <0.5%

'**' = equivalent to 76% of area of crops in their final year

TABLE 4 Narcissi

Fungicides and seed/hot water treatments, the reasons for their use (spray hectares of formulations) and percentage of crop treated

Fungicides	Smoulder	Keep green	Smoulder & keep green	White rot	Rust	Disease precaution	No reason given	Total spray area	% crop treated
Benomyl	126	105	103	12		29	26	401	53
Carbendazim	37							37	5
Chlorothalomid				12				12	3
Iprodione							61	61	16
Mancozeb	11			39			77	127	15
Maneb						13		13	3
Prochloraz							77	77	10
Propiconazole					37			37	5
All fungicides	175	105	103	62	37	42	240	764	73
Seed/hot water treatments									
Formaldehyde							137	137	*36
Seed/hot water treatment - no information							+	+	+
All seed/hot water treatments							137	137	*36
Area planted (ha)									380

*+ = <0.5 ha or <0.5%

**+ = equivalent to 100% of the area of crops in their first year

TABLE 5 Narcissi
 Herbicides and desiccants, the reasons for their use (spray hectares of formulations) and percentage of crop treated

Herbicides	Annual grass weeds & couch	Annual grass weeds & docks	Thistles	Volunteer potatoes	General weed control	Desiccation	Total spray area	% crop treated
Chlorpropham					10		10	3
Cyanazine					304		304	80
Diquat/paraquat					61		61	16
Glyphosate	3			17	44		64	17
Linuron					24		24	6
Monolinuron					9		9	2
Paraquat		4			190		194	41
All herbicides	3	4		17	642		667	86
Desiccants								
Sulphuric acid			5		5	115	125	*32
All desiccants			5		5	115	125	*32
Area planted (ha)								380

*32 = equivalent to 84% of the area of crops in their final year

TABLE 6 Other bulbs
Herbicides and seed/hot water treatments, the reasons for their use (spray hectares of formulations) and the percentage of crop treated

Herbicides	General weed control	No reason given	Total spray area	% crop treated
Cyanazine	+		+	35
Diphenamid	+		+	35
Diquat/paraquat	+		+	1
Glyphosate	+		+	4
All herbicides	1		1	40
Seed/hot water treatments				
Benomyl		+	+	35
Seed/hot water treatment - no information		+	+	60
All seed/hot water treatments		+	+	
Area planted (ha)				1

'+' = <0.5 ha

TABLE 7 Chrysanthemums

Insecticides and molluscicides, the reasons for their use (spray hectares of formulations) and the percentage of crop treated

Insecticides	Aphids	Leaf miner	Midge	Whitefly	No reason given	Slugs	Total spray area	% crop treated
Aldicarb	+						+	5
Buprofezin				1			1	5
Cypermethrin	8	1					9	70
Deltamethrin	1	1					2	13
Fatty acids					+		+	5
Gamma-HCH			1				1	8
Nicotine	8						8	5
Pirimicarb	4						4	16
Pirimiphos-methyl	1				2		3	26
Pyrethrins/resmethrin	1						1	5
Teflubenzuron				+			+	5
All insecticides	23	2	1	1	2		28	96
Molluscicides								
Metaldelyde						1	1	19
Methiocarb						1	1	8
All molluscicides						2	2	27
Area planted (ha)								6

'+' = <0.5 ha or <0.5%

TABLE 8 *Chrysanthemums*
Fungicides, soil sterilants and herbicides, the reasons for their use (spray hectares of formulations) and the percentage of crop treated

Fungicides	Rust	Disease precaution	Soil sterilisation	General weed control	Total spray area	% crop treated
Benomyl		+			+	5
Chlorothalonil	7				7	57
Iprodione		1			1	5
Vinclozolin		1			1	5
All fungicides	7	2			9	62
Soil sterilants						
Dazomet			+		+	8
All soil sterilants			+		+	8
Herbicides						
Glyphosate				+	+	5
Paraquat				+	+	2
All herbicides				1	1	7
Area planted (ha)						6

'+' = <0.5 ha

TABLE 9 Other flowers

Insecticides, molluscicides, soil sterilants and herbicides, the reasons for their use (spray hectares of formulations) and percentage of crop treated

Insecticides	Aphids	Aphids & caterpillars	Blackfly	Earwigs	No reason given	Slugs	Soil sterilisation	Annual bi weeds	General weed control	Total spray area	% crop treated
Cypermethrin			+							+	5
Malathion				+						+	2
Pirimicarb	4									4	7
Pririmiphos-methyl	1				2					3	18
Resmethrin		3								3	2
All Insecticides	5	3	+	+	2					11	26
Molluscicides											
Metaldelyde						1				1	11
Methiocarb						2				2	10
All molluscicides						3				3	21
Soil sterilants											
Dazomet							+			+	5
All soil sterilants							+			+	5
Herbicides											
Diquat/paraquat									+	+	3
Paraquat									1	1	6
Propachlor								+		+	1
All herbicides								+	1	1	10
Area planted (ha)											10

'+' = <0.5 ha

TABLE 10 All bulbs and flowers

Usage of insecticides and molluscicides (spray hectares of active ingredients)

Insecticides	Narcissi	Other bulbs	Chrysanthemums	Other cut flowers	Total spray area	Spray area 1981
Pyrethroids						
Cypermethrin			9	+	9	
Deltamethrin			2		2	
Pyrethrins			1		1	
Resmethrin			1	3	4	
Carbamates						
Aldicarb			+		+	
Pirimicarb			4	4	7	
Organophosphates						
Malathion				+	+	
Pirimiphos-methyl			3	3	6	
Organochlorines						
Gamma-HCH			1		1	
Other Insecticides						
Buprofezin			1		1	
Fatty acids			+		+	
Nicotine			8		8	
Teflubenzuron			+		+	
All insecticides			29	10	40	
Molluscicides						
Metalddehyde			1	1	3	
Methiocarb			1	2	3	
All molluscicides			2	3	6	

'+' = <0.5 ha

TABLE 11 All bulbs and flowers

Usage of fungicides, soil sterilants and seed/hot water treatments (spray hectares of active ingredients)

Fungicides	Narcissi	Other bulbs	Chrysanthemums	Other cut flowers	Total spray area	Spray area 1981
Benomyl	401		+		401	9
Carbendazim	37				37	
Chlorothalonil	12		7		19	
Iprodione	61		1		62	5
Mancozeb	127				127	43
Maneb	13				13	
Prochloraz	77				77	
Propiconazole	37				37	
Vinclozolin			1		1	24
All fungicides	764		9		773	
Soil sterilants						
Dazomet			+	+	+	
All soil sterilants			+	+	+	
Seed/hot water treatments						
Benomyl		+			+	•
Formaldehyde	137				137	92
Seed/hot water treatment - no information	+	+			+	
All seed/hot water treatments	137	+			137	

'+' = <0.5 ha

'*' = not recorded in 1981 report

TABLE 12 All bulbs and flowers

Usage of herbicides and desiccants (spray hectares of active ingredients)

Herbicides and desiccants	Narcissi	Other bulbs	Chrysanthemums	Other cut flowers	Total spray area	Spray area 1981
Chlorpropham	10				10	107
Cyanazine	304	+			304	
Diphenamid		+			+	
Diquat	61	+		+	61	*
Glyphosate	64	+	+		64	8
Linuron	24				24	107
Monolinuron	9				9	
Paraquat	255	+	+	1	256	115
Propachlor				+	+	
Sulphuric acid	125				125	15
All herbicides and desiccants	853	+	+	1	854	

'+' = <0.5 ha

'*' = not recorded in 1981 report

TABLE 13 All bulbs and flowers

Quantities (kg) of insecticides and molluscicides used

Insecticides	Narcissi	Other bulbs	Chrysanth- -emums	Other cut flowers	Total kg	Total kg 1981
Pyrethroids						
Cypermethrin			+	+	+	
Deltamethrin			+		+	
Pyrethrins			1		1	
Resmethrin			4	+	4	
Carbamates						
Aldicarb			2		2	
Pirimicarb			1	1	1	
Organophosphates						
Malathion				+	+	
Pirimiphos-methyl			2	2	3	
Organochlorines						
Gamma-HCH			+		+	
Other insecticides						
Buprofezin			+		+	
Fatty acids			2		2	
Nicotine			4		4	
Teflubenzuron			+		+	
All insecticides			14	2	16	
Molluscicides						
Metalddehyde			7	9	16	
Methiocarb			+	+	+	
All molluscicides			7	9	16	

'+' = <0.5 kg

TABLE 14 All bulbs and flowers

Quantities (kg) of fungicides, soil sterilants and seed/hot water treatments used

Fungicides	Narcissi	Other bulbs	Chrysanthemums	Other cut flowers	Total kg	Total kg 1981
Benomyl	215		+		215	12
Carbendazim	20				20	
Chlorothalonil	4		8		12	
Iprodione	31		+		31	4
Mancozeb	217				217	
Maneb	23				23	76
Prochloraz	43				43	
Propiconazole	9				9	
Vinclozolin			1		1	18
All fungicides	562		9		571	
Soil sterilants						
Dazomet			104	104	208	
All soil sterilants			104	104	208	
Seed/hot water treatments						
Benomyl		5			5	*
Formaldehyde	1,197				1,197	*
All seed/hot water treatments	1,197	5			1,202	

*+ = <0.5 kg

** = not recorded in 1981 report

TABLE 15 All bulbs and flowers
Quantities (kg) of herbicides and desiccants used

Herbicides and desiccants	Narcisst	Other bulbs	Chrysanth- -emums	Other cut flowers	Total kg	Total kg 1981
Chlorpropham	22				22	180
Cyanazine	689	1			690	
Diphenamid		2			2	
Diquat	14	+		+	14	*
Glyphosate	79	+	+		79	15
Linuron	24				24	115
Monolinuron	5				5	
Paraquat	135	+	+	1	135	55
Propachlor				+	+	
Sulphuric acid	30,950				30,950	2,010
All herbicides and desiccants	31,918	3	+	1	31,921	

'+' = <0.5 kg

'*' = not recorded in 1981 report

TABLE 16 Principal active ingredients
Area (spray hectares) treated with the 20 most used active ingredients on all bulbs and flower crops

	1993	1981
1 Benomyl	401	9
2 Cyanazine	305	
3 Paraquat	257	115
4 Formaldehyde	137	92
5 Mancozeb	127	
6 Sulphuric acid	125	15
7 Prochloraz	77	
8 Glyphosate	64	8
9 Iprodione	62	5
10 Diquat	62	*
11 Carbendazim	37	
12 Propiconazole	37	
13 Linuron	24	107
14 Chlorothalonil	19	
15 Maneb	13	43
16 Chlorpropham	10	107
17 Cypermethrin	9	
18 Monolinuron	9	
19 Nicotine	8	
20 Pirimicarb	7	

* = details not recorded in 1981 report

TABLE 17 Principal active ingredients
Quantity (kg) of the 20 most used ingredients on all bulbs and flower crops

	1993	1981
1 Sulphuric acid	30,950	2,010
2 Formaldehyde	1,197	*
3 Cyanazine	690	
4 Benomyl	220	*
5 Mancozeb	217	
6 Dazomet	208	
7 Paraquat	135	55
8 Glyphosate	79	15
9 Prochloraz	43	
10 Iprodione	31	4
11 Linuron	24	115
12 Maneb	23	76
13 Chlorpropham	22	180
14 Carbendazim	20	
15 Metaldehyde	16	
16 Diquat	14	*
17 Chlorothalonil	12	
18 Propiconazole	9	
19 Monolinuron	5	
20 Nicotine	4	

TABLE 18 All bulbs and flowers

Comparison of pesticide usage 1981 - 1993, spray hectares of formulations, active ingredients and quantities (kg) used

	1981*			1993		
	sp ha of a.i.'s	kg		sp ha of formulations	sp ha of a.i.'s	kg
Insecticides						
Pyrethroids				15	16	5
Organophosphates				6	6	3
Organochlorines				1	1	+
Carbamates				7	7	3
Other insecticides				9	9	6
All insecticides				39	40	16
Molluscicides				6	6	16
Fungicides	81	110		773	773	571
Soil sterilants				+	+	208
Herbicides and desiccants	188	2,385		791	854	31,921
Seed/hot water treatments	92	**		137	137	1,202
Total pesticides	361	2,495**		1,746	1,810	33,934
Area grown (ha)	190*			397		

* = <0.5 ha or <0.5 kg

** = flowers not surveyed in 1981, area grown refers to bulbs only

*** = weight of seed/hot water treatments not recorded in 1981 report

TABLE 19 Sample areas
Area (ha) of bulbs grown in sample

Size (ha)	Northern Scotland	Angus & East Fife	South & South-East Scotland	Central Scotland	Scotland
0.1 - 1.9	0.1	2.4	0.4	0.4	3.3
2 - 5.9		29.1			29.1
6 - 19.9		57.6			57.6
20 - 29.9	16.8	178.4			195.2
All sizes	16.9	267.5	0.4	0.4	285.2

TABLE 21 Census areas
Area (ha) of bulbs grown in Scotland

Size (ha)	Northern Scotland	Angus & East Fife	South & South-East Scotland	Central Scotland	Scotland
0.1 - 1.9	0.2	3.6	1.2	4.3	9.3
2 - 5.9	21.8	66.4			88.2
6 - 19.9		72.0			72.0
20 - 29.9	16.8	193.9			210.7
All sizes	38.8	335.9	1.2	4.3	380.2

TABLE 20 Sample areas
Area (ha) of flowers grown in sample

Size (ha)	Northern Scotland	Angus & East Fife	South & South-East Scotland	Central Scotland	Scotland
0.1 - 1.9	0.04	0.65	0.65	0.8	2.1

TABLE 22 Census areas
Area (ha) of flowers grown in Scotland

Size (ha)	Northern Scotland	Angus & East Fife	South & South-East Scotland	Central Scotland	Scotland
0.1 - 1.9	1.4	7.1	5.7	2.3	16.5

TABLE 23 Raising factors
Bulbs

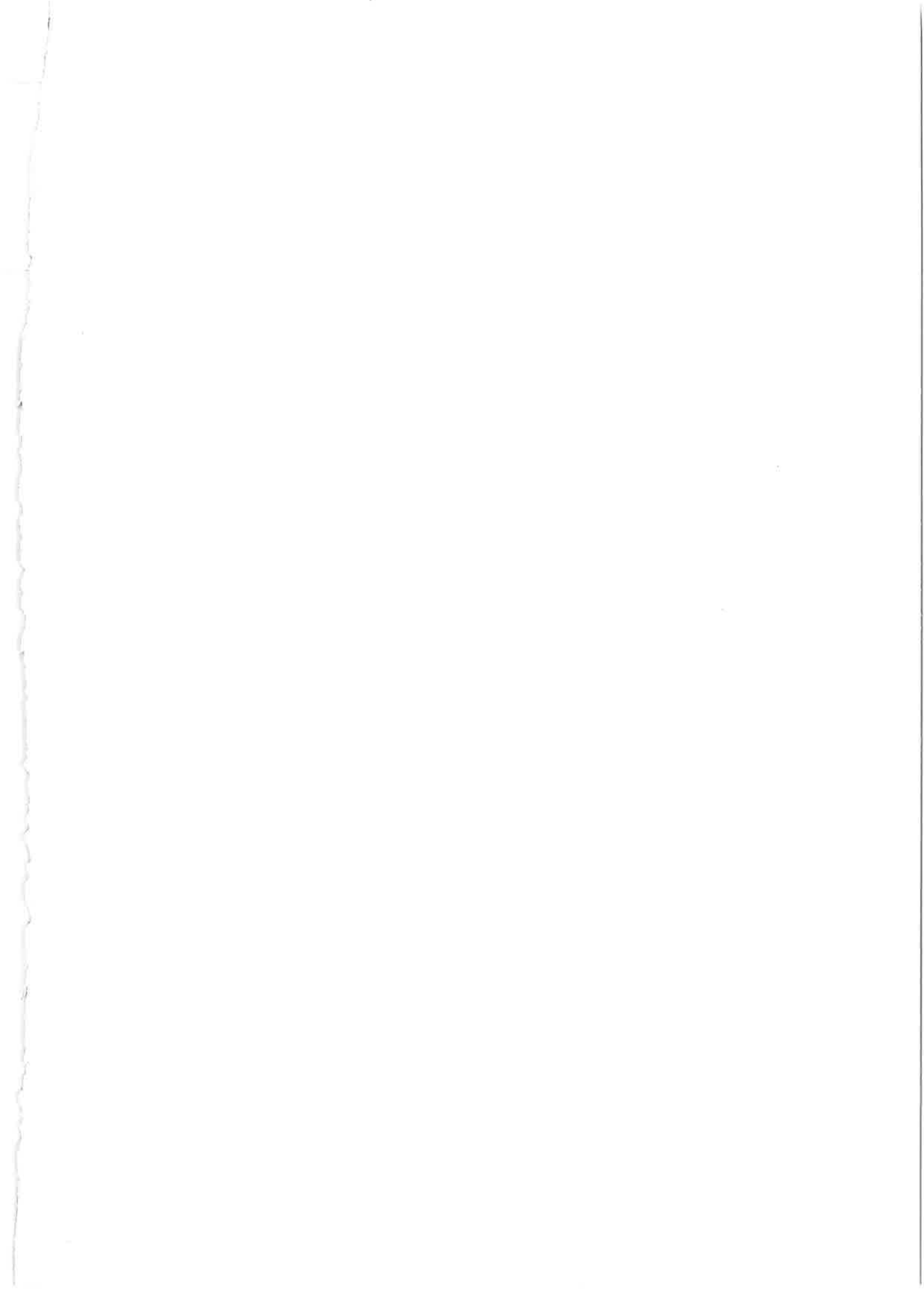
Size (ha)	Northern Scotland	Angus & East Fife	South & South-East Scotland	Central Scotland
0.1 - 1.9	2.00	1.49	3.24	10.75
2 - 5.9		2.28		
6 - 19.9		1.25		
20 - 29.9	1.00	1.09		

TABLE 24 Raising factors
Flowers

Size (ha)	Northern Scotland	Angus & East Fife	South & South-East Scotland	Central Scotland
0.1 - 1.9	35.00	10.92	2.88	7.71

TABLE 25 Adjustment factors

Size (ha)	Northern Scotland	Angus & East Fife	South & South-East Scotland	Central Scotland
Bulbs	2.28	1.00	1.00	1.00
Flowers	1.00	1.00	1.00	1.00





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