

**PESTICIDE USAGE IN SCOTLAND**

***OUTDOOR BULBS AND  
FLOWERS 1997***

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This report presents information from a survey of pesticide usage on outdoor bulbs and flowers grown in Scotland in 1997. The area of bulbs grown had increased from 380 hectares in 1993 to 445 hectares in 1997, whilst the area of flowers fell from 17 hectares to only 10 hectares.

No insecticides were recorded on bulbs. The most commonly used fungicides were carbendazim and vinclozolin. Nearly all narcissi bulbs in their first year had been hot water treated. Unlike the previous survey where only formaldehyde had been used, the 1997 hot water treatment also included benomyl and prochloraz. 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.

Because of the relatively small area (10 ha) of flowers, total pesticide usage was relatively small.

## ● ***INTRODUCTION***

This is the latest in a series of surveys on outdoor bulbs and flowers, previous reports covered surveys carried out in 1977<sup>1</sup>, 1981<sup>2</sup> and 1993<sup>3</sup>. As in the 1993 survey, the crops surveyed were predominantly narcissi, whilst small areas of other bulbs (mainly tulips), chrysanthemums and other flowers (mainly dahlias) were also encountered.

## ● ***DEFINITIONS AND NOTES***

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

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

The flowers for cutting recorded in this report are those grown outside. Flowers grown in glasshouses or plastic structures are reported on in the Protected Crop Survey reports.

Tables containing reasons for use of pesticides have not been published because most of the applications were as a routine preventative measure, rather than in response to specific problems.

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

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

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 1996 Agricultural Census<sup>4</sup> two samples were taken, 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 flowers such as chrysanthemums, which represented a relatively small area.

The country was divided into 11 land-use regions<sup>6</sup>. 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 for 12 months from September 1996 to September 1997. The areas of crops grown are shown in Table [1](#), and the number of holdings sampled in Table [2](#).

For all crops, sample data were raised (Tables [13](#)-[15](#)) to give estimates of national pesticide usage based on the areas of bulbs and flowers in the 1997 Agricultural Census<sup>5</sup>. Due to small sample populations, some land-use regions were amalgamated: Caithness & Orkney, Highlands & Islands, Moray Firth and Aberdeen to form Northern Scotland, East Lothian, Tweed Valley, Southern Uplands and Solway to form South & Southeast Scotland, and Angus with East Fife.

## ● ***NARCISSI***

In 1997, narcissi were the predominant bulbs grown in Scotland, estimated to cover almost all of the total bulb area of 445 hectares. The area of bulbs had increased by 17% compared with the 1993 survey (380 hectares).

### ● ***Insecticides (Table 4)***

As in previous surveys, no insecticides were recorded.

### ● ***Fungicides (Table 5)***

Ninety-five percent of the crop was treated with fungicide, compared with only 73% in 1993. The most commonly used fungicides were carbendazim, applied to 83% of the crop area, and vinclozolin (78%). All fungicides were applied as a routine preventative measure.

### ● ***Herbicides and desiccants (Table 6)***

An estimated 99% of the crop was treated with a herbicide mainly for annual weed control. As in 1993, cyanazine was the principal formulation used, applied to 91% of the crop, followed by paraquat to 57%.

Sulphuric acid was used predominantly as a desiccant on crops in their final year, but was also used on 7 hectares for weed control in the late summer. Although the proportion of the total crop area treated with acid was 36%, this was equivalent to 95% of the area of crops in their final year.

### ● ***Seed/hot water treatment (Table 5)***

Nearly all (99%) of the bulbs in their first year had been hot water treated, but unlike the previous survey when they had been treated with formaldehyde only, those in the present survey were treated with a mixture of benomyl, prochloraz and formaldehyde.

## ● ***OTHER BULBS***

The estimated area of bulbs other than narcissi encountered in the survey was so small (<0.5 ha) that it was felt it would not be appropriate to raise the data to national level. The only pesticide encountered was the fungicide, propiconazole.





An estimated 4 hectares of chrysanthemums were grown in Scotland in 1997, approximately a third less than in 1993.

### ● ***Insecticides and molluscicides (Table 4)***

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Seventy-nine percent of the crop area was treated with insecticide. The principal insecticide recorded was gamma-HCH applied to 43% of the crop area against capsids. In the 1993 survey, cypermethrin had been the main insecticide, used on 70% of the crop area, but in 1997 none was recorded.

Eight percent of the crop received molluscicide. Metaldehyde was the only active ingredient encountered.

### ● ***Fungicides (Table 5)***

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Fifteen percent of the crop was treated with fungicide. The only formulations recorded were propiconazole and carbendazim, applied to 8% and 6% of the crop area respectively. Chlorothalonil had been the principal formulation in 1993, applied to 57% of the crop.

### ● ***Herbicides and growth regulators (Table 6)***

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Only 3% of the crop was treated with a herbicide, for annual weed control. Paraquat was the only herbicide recorded.

Forty-three percent of the crop area was treated with the growth regulator 4-indol-3-ylbutyric acid.



An estimated 6 hectares of flowers for cutting, other than chrysanthemums, was grown in 1997.

### ● ***Insecticides and molluscicides (Table 4)***

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Only 8% of the crop was treated with an insecticide, compared with 28% in the previous survey. As in 1993, pirimicarb was the most commonly used insecticide.

Eighteen percent of the crop was treated with a molluscicide, similar to usage in 1993. Only metaldehyde was encountered in the present survey.

### ● ***Fungicides (Tables 4 & 5)***

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The only fungicides recorded were bupirimate and triforine, applied in a mixed formulation with the insecticide pirimicarb, to 4% of the crop area.

### ● ***Herbicides (Table 6)***

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Only 2% of the crop area was treated with the herbicide paraquat. In 1993, 10% had been treated with paraquat both alone and in formulation with diquat.

## 6 *COMPARISON WITH PREVIOUS SURVEYS*

Compared with the previous survey in 1993, the total area of bulbs and flowers grown in 1997 increased by 15% to 455 hectares: bulbs increased by 17% to 445 hectares, whilst the area of flowers for cutting fell by 41% to only 10 hectares.

Comparisons in the usage of pesticides, in terms of spray area and weight applied, with previous surveys are presented in Table [12](#).

As in the previous two surveys, no insecticides were recorded on bulbs, whilst usage on flowers for cutting was much reduced.

The total area treated with fungicides increased over 3-fold compared with 1993, even when the increase in area grown is taken into account. This increase was due to both a higher proportion of the crop treated and to greater repeated use of fungicide applications.

As in the previous survey, sulphuric acid, which accounted for 97% of the total weight of herbicides and desiccants in 1997, dominated these data, as it is applied at very high dosage rates. When the data for sulphuric acid are discounted, there was little change in the areas treated and weights applied with herbicide active ingredients when the increase in area grown is taken into account.

Compared with 1993, there was more than a 3-fold increase in hot water treatment active ingredients applied to first year bulbs, due to the application of a mixture containing 3 active ingredients, as opposed to only one, formaldehyde, in the previous survey. Only a small increase in weight was recorded.

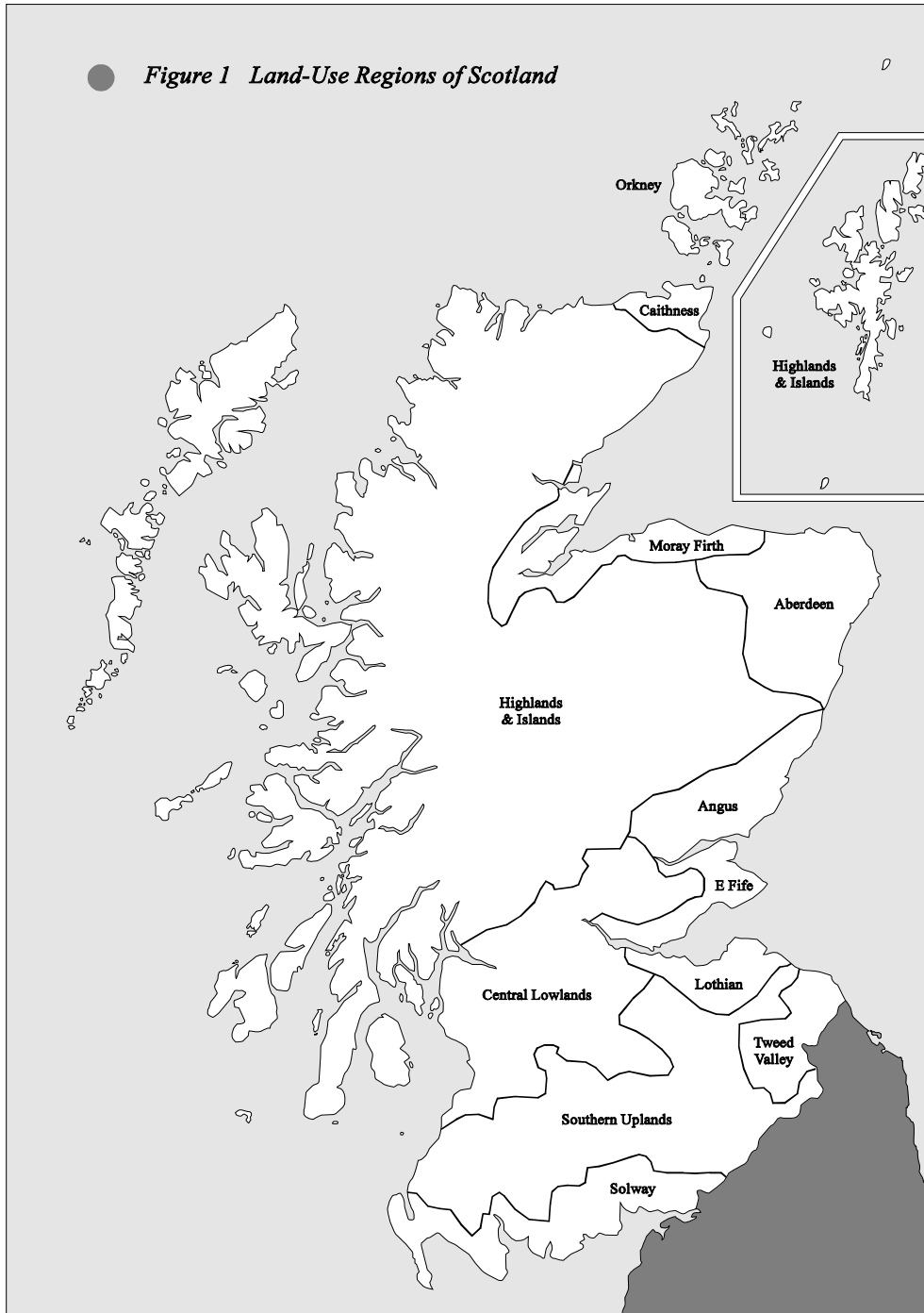
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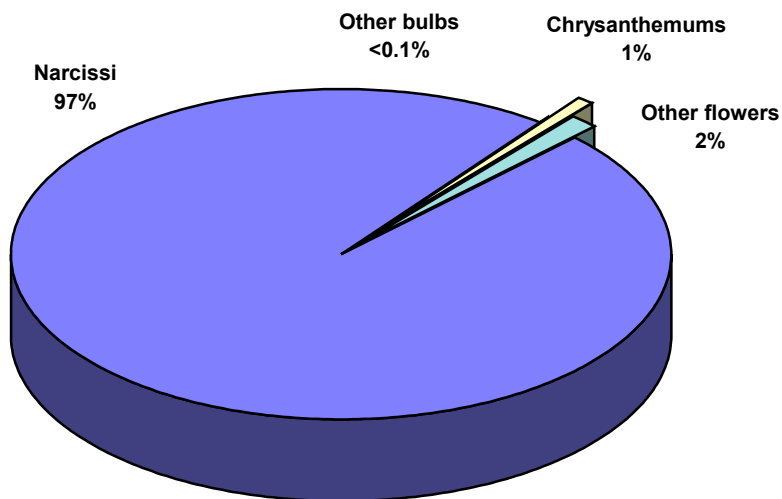
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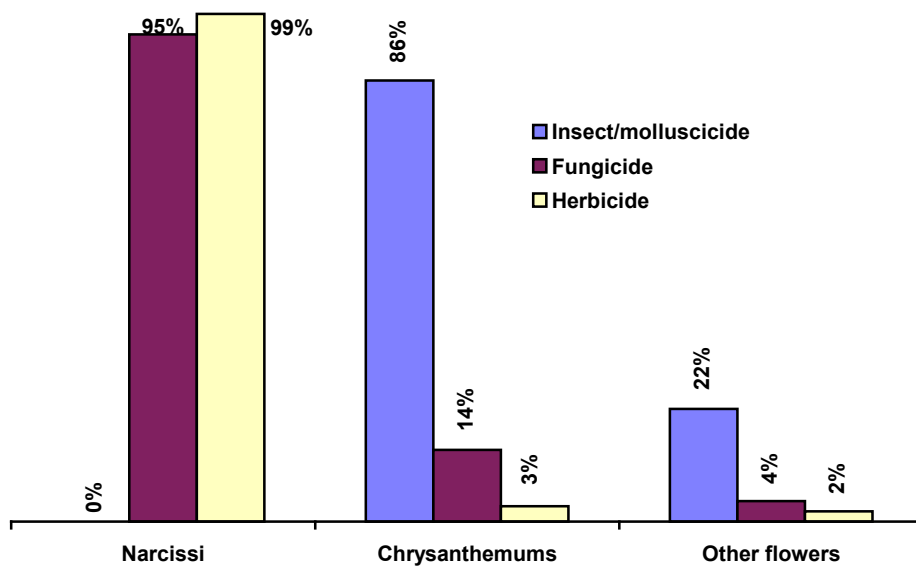
● **Figure 1 Land-Use Regions of Scotland**



● *Figure 2 Outdoor bulbs and flower crop areas (%) in 1997*



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



**TABLE 1 Regional distribution of bulbs and flowers in 1997 (hectares)**

	<i>Angus &amp; East Fife</i>	<i>Rest of Scotland*</i>	<i>Scotland</i>	<i>Scotland 1993</i>	<i>% change</i>
Bulbs	428.7	16.3	<b>445.0</b>	380.2	17
Flowers	2.8	7.0	<b>9.8</b>	16.5	-41
<b>All crops</b>	<b>431.5</b>	<b>23.3</b>	<b>454.8</b>	<b>396.7</b>	<b>15</b>

\* = regions have been amalgamated to prevent disclosure of information where there are fewer than 5 holdings

**TABLE 2 Number of holdings sampled**

<i>Size (ha)</i>	<i>Number of holdings</i>
0.1-1.9	11
2-4.9	1
5-19.9	11
20.0+	7
<i>All sizes</i>	<b>30</b>

**TABLE 3 Proportions (%) of crops treated with pesticides**

	<i>Narcissi</i>	<i>Chrysanthemums</i>	<i>Other cut flowers</i>
Insecticides		79	4
Molluscicides		8	18
Fungicides	95	15	4
Herbicides	99	3	2
Desiccants	36*		
Growth regulators		58	
Any pesticide	99	82	25

\* = equivalent to 95% of the area of crops in their final year

**TABLE 4 Bulbs and flowers**

*Insecticides and molluscicides (spray hectares of formulations) and % of crop treated in parentheses*

<b><i>Insecticides</i></b>	<b><i>Narcissi</i></b>	<b><i>Chrysanthemums</i></b>	<b><i>Other cut flowers</i></b>	<b><i>Total spray area</i></b>
<b><i>Pyrethroids</i></b>				
Cypermethrin			+ (2)	+
<b><i>Carbamates</i></b>				
Pirimicarb		+ (6)	+ (1)	+
<b><i>Organophosphates</i></b>				
Heptenophos		+ (8)		+
Malathion		+ (7)	+ (1)	1
Pirimiphos-methyl			+ (1)	+
<b><i>Organochlorines</i></b>				
Gamma-HCH		3 (43)		3
<b><i>Others</i></b>				
Heptenophos/permethrin		1 (15)		1
<b><i>All insecticides</i></b>		<b>5 (79)</b>	<b>+ (4)</b>	<b>5</b>
<b><i>Mixed formulations</i></b>				
Pirimicarb/bupirimate/triforine			+ (4)	+
<b><i>Molluscicides</i></b>				
Metaldehyde		+ (8)	3 (18)	4
Area planted (ha)	445.0	3.5	6.3	

'+' = < 0.5 ha

**TABLE 5 Bulbs and flowers***Fungicides (spray hectares of formulations) and % of crop treated in parentheses*

<b>Fungicides</b>	<b>Narcissi</b>	<b>Chrysan- themums</b>	<b>Other cut flowers</b>	<b>Total spray area</b>
Carbendazim	1,028 (83)	1 (6)		<b>1,029</b>
Carbendazim/prochloraz	23 (5)			<b>23</b>
Iprodione	311 (26)			<b>311</b>
Maneb	272 (27)			<b>272</b>
Prochloraz	254 (32)			<b>254</b>
Propiconazole		+ (8)		<b>+</b>
Vinclozolin	914 (78)			<b>914</b>
<b>All fungicides</b>	<b>2,802 (95)</b>	<b>1 (15)</b>		<b>2,803</b>
<b>Seed/hot water treatments</b>				
Benomyl	174 (39)			<b>174</b>
Formaldehyde	184 (41)			<b>184</b>
Prochloraz	174 (39)			<b>174</b>
<b>All seed/hot water treatments</b>	<b>532 (41)*</b>			<b>532</b>
Area planted (ha)	445.0	3.5	6.3	

‘+’ = &lt; 0.5 ha

‘\*’ = equivalent to 99% of the area of crops in their first year

**TABLE 6 Bulbs and flowers***Herbicides, desiccants and growth regulators (spray hectares of formulations) and % of crop treated in parentheses*

<b>Herbicides</b>	<b>Narcissi</b>	<b>Chrysan- themums</b>	<b>Other cut flowers</b>	<b>Total spray area</b>
Cyanazine	407 (91)			<b>407</b>
Diquat/paraquat	3 (1)			<b>3</b>
Glyphosate	145 (33)			<b>145</b>
Paraquat	253 (57)	+ (3)	+ (2)	<b>253</b>
<b>All herbicides</b>	<b>808 (99)</b>	<b>+ (3)</b>	<b>+ (2)</b>	<b>808</b>
<b>Desiccants</b>				
Sulphuric acid	202 (36)			<b>202</b>
<b>Growth regulators</b>				
Captan/1-naphthylacetic acid		1 (15)		<b>1</b>
4-indol-3-ylbutyric acid		2 (43)		<b>2</b>
<b>All growth regulators</b>		<b>2 (58)</b>		<b>2</b>
Area planted (ha)	445.0	3.5	6.3	

‘+’ = &lt; 0.5 ha



**TABLE 7 Bulbs and flowers***Quantities (kg) of insecticides and molluscicides used*

<i>Insecticides</i>	<i>Narcissi</i>	<i>Chrysanth- emums</i>	<i>Other cut flowers</i>	<i>Total kg</i>	<i>Total kg 1993</i>
<b><i>Pyrethroids</i></b>					
Cypermethrin			+	+	+
Permethrin		+		+	
<b><i>Carbamates</i></b>					
Pirimicarb		+	+	+	1
<b><i>Organophosphates</i></b>					
Heptenophos		+		+	
Malathion		+	+	+	+
Pirimiphos-methyl			+	+	3
<b><i>Organochlorines</i></b>					
Gamma-HCH		+		+	+
<b><i>All insecticides</i></b>		+	+	<b>1</b>	<b>16</b>
<b><i>Molluscicides</i></b>					
Metaldehyde		+	1	<b>1</b>	16

‘+’ = &lt; 0.5 kg

**TABLE 8 All bulbs and flowers***Quantities (kg) of fungicides and seed/hot water treatments used*

<i>Fungicides</i>	<i>Narcissi</i>	<i>Chrysanth- emums</i>	<i>Other cut flowers</i>	<i>Total kg</i>	<i>Total kg 1993</i>
Bupirimate			+	+	
Captan		+		+	
Carbendazim	259	1		<b>260</b>	20
Iprodione	39			<b>39</b>	31
Maneb	478			<b>478</b>	23
Prochloraz	77			<b>77</b>	43
Propiconazole		+		+	9
Triforine			+	+	
Vinclozolin	211			<b>211</b>	1
<b><i>All fungicides</i></b>	<b>1,065</b>	<b>1</b>		<b>1,065</b>	<b>562</b>
<b><i>Seed/hot water treatments</i></b>					
Benomyl	154			<b>154</b>	5
Formaldehyde	1,297			<b>1,297</b>	1,197
Prochloraz	123			<b>123</b>	
<b><i>All seed/hot water treatments</i></b>	<b>1,574</b>			<b>1,574</b>	<b>1,202</b>

**TABLE 9 Bulbs and flowers**  
*Quantities (kg) of herbicides, desiccants and growth regulators*

<i>Herbicides</i>	<i>Narcissi</i>	<i>Chrysan- themums</i>	<i>Other cut flowers</i>	<i>Total kg</i>	<i>Total kg 1993</i>
Cyanazine	804			<b>804</b>	690
Diquat	+			+	14
Glyphosate	167			<b>167</b>	79
Paraquat	156	+	1	<b>157</b>	135
<b>All herbicides</b>	<b>1,127</b>	<b>+</b>	<b>1</b>	<b>1,128</b>	<b>971</b>
<b>Desiccants</b>					
Sulphuric acid	40,491			<b>40,491</b>	30,950
<b>Growth regulators</b>					
1-naphthylacetic acid		+		+	
4-indol-3-ylbutyric acid		+		+	
<b>All growth regulators</b>		<b>+</b>		<b>+</b>	

'+' = 0.5 kg

**TABLE 10 Principal active ingredients***Area (spray hectares) treated with the 15 most used active ingredients on all bulb and flower crops*

	1997	1993
1 Carbendazim	1,051	37
2 Vinclozolin	914	
3 Prochloraz	451	77
4 Cyanazine	407	305
5 Iprodione	311	62
6 Maneb	272	13
7 Paraquat	256	257
8 Sulphuric acid	202	125
9 Formaldehyde	184	137
10 Benomyl	174	401
11 Glyphosate	145	64
12 Metaldehyde	4	
13 Gamma-HCH	3	
14 Diquat	3	62
15 4-indol-3-ylbutyric acid	2	

‘+’ = 0.5 kg

**TABLE 11 Principal active ingredients***Quantity (kg) of the 15 most used active ingredients on all bulb and flower crops*

	1997	1993
1 Sulphuric acid	40,491	30,950
2 Formaldehyde	1,297	1,197
3 Cyanazine	804	690
4 Maneb	478	23
5 Carbendazim	260	20
6 Vinclozolin	211	1
7 Prochloraz	201	43
8 Glyphosate	167	79
9 Paraquat	157	135
10 Iprodione	39	31
11 Metaldehyde	1	16
12 Diquat	+	14
13 Malathion	+	+
14 Heptenophos	+	
15 Gamma-HCH	+	+

**TABLE 12 All bulbs and flowers**

Comparison of pesticide usage 1981 – 1997, spray hectares of formulations, active ingredients and quantities (kg) used

	1981*		1993			1997		
	<i>Sp ha of a.i.'s</i>	<i>Kg</i>	<i>Sp ha of formulations</i>	<i>Sp ha of a.i.'s</i>	<i>Kg</i>	<i>Sp ha of formulations</i>	<i>Sp ha of a.i.'s</i>	<i>Kg</i>
<b><i>Insecticides</i></b>								
Pyrethroids			15	16	5	+	1	+
Organophosphates			6	6	3	1	2	1
Organochlorines			1	1	+	3	3	+
Carbamates			7	7	3	+	1	+
Mixed formulations			9	9	6	1		
<b><i>All insecticides</i></b>			<b>39</b>	<b>40</b>	<b>16</b>	<b>5</b>	<b>7</b>	<b>1</b>
<b><i>Molluscicides</i></b>			6	6	16	4	4	1
<b><i>Fungicides</i></b>	81	110	773	773	571	2,802	2,826	1,065
<b><i>Herbicides and desiccants</i></b>	188	2,385	791	854	31,921	1,010	1,012	41,619
<b><i>Growth regulators</i></b>						2	2	+
<b><i>Seed/hot water treatments</i></b>	92	**	137	137	1,202	532	532	1,574
<b><i>All pesticides</i></b>	<b>361</b>	<b>2,495**</b>	<b>1,746</b>	<b>1,810</b>	<b>33,934</b>	<b>4,355</b>	<b>4,383</b>	<b>44,260</b>
Area grown (ha)	190*		397			455		

‘+’ = &lt; 0.5ha or &lt; 0.5 kg

‘\*’ = flowers not surveyed in 1981, area grown refers to bulbs only.

‘\*\*’ = weight of seed/hot water treatments not recorded in 1981 survey.

**TABLE 13 Raising factors**  
*Bulbs*

<i>Size (ha)</i>	<i>Northern Scotland</i>	<i>Angus &amp; East Fife</i>	<i>South &amp; South-East Scotland</i>	<i>Central Scotland</i>
0.1-1.9		2.01	12.27	
2-5.9		3.60		
6-19.9		1.35		
20.0-29.9		0.96		

**TABLE 14 Raising factors**  
*Flowers*

<i>Size (ha)</i>	<i>Northern Scotland</i>	<i>Angus &amp; East Fife</i>	<i>South &amp; South-East Scotland</i>	<i>Central Scotland</i>
0.1-1.9	28.00	7.37	7.50	2.17

**TABLE 15 Adjustment factors**

<i>Size (ha)</i>	<i>Northern Scotland</i>	<i>Angus &amp; East Fife</i>	<i>South &amp; South-East Scotland</i>	<i>Central Scotland</i>
Bulbs	1.00	1.03	1.03	1.00
Flowers	1.00	1.00	1.00	1.00