

**PESTICIDE USAGE IN SCOTLAND**

***OUTDOOR BULBS AND  
FLOWERS 2005***

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	● <i>Page</i>
Summary .....	1
Introduction .....	2
Definitions and notes .....	2
Method.....	3
Narcissus .....	4
Other bulbs .....	4
Flowers for cutting .....	5
Bedding plants.....	5
References .....	6
Acknowledgements .....	6
Figure 1 Agricultural land-use regions .....	7
Table 1 Regional distribution of bulbs and flowers in 2005 (hectares).....	8
Table 2 Distribution of sample .....	8
Table 3 Proportion (%) of crops treated with pesticides .....	8
Table 4 Insecticide and molluscicide formulations .....	9
Table 5 Fungicide and seed/hot water treatment formulations.....	10
Table 6 Herbicide and desiccant formulations .....	11
Table 7 Insecticide and molluscicide active ingredients .....	12
Table 8 Fungicide and seed/hot water treatment active ingredients.....	13
Table 9 Herbicide and desiccant active ingredients.....	14
Table 10 Insecticide and molluscicide weights .....	15
Table 11 Fungicide and seed/hot water treatment weights.....	16
Table 12 Herbicide and desiccant weights .....	17
Table 13 Principal active ingredients by treated area.....	18
Table 14 Principal active ingredients by weights applied .....	18
Table 15 Comparisons with previous surveys.....	19
Table 16 Raising factors.....	20
Table 17 Adjustment factors .....	20





This report presents information from a survey of pesticide usage on outdoor bulbs, flowers for cutting and bedding plants in Scotland during the 2004/2005 growing season. The data, collected by personal interview, have been raised to give estimates of national pesticide usage.

When compared with the previous survey in 2001 the total area of all crops increased by 12%. Bulbs, the main crop surveyed, increased as did bedding plants. The area of flowers for cutting had fallen since the last survey.

As in previous surveys, no insecticide use was recorded for bulbs. Tebuconazole and azoxystrobin were the most used fungicides. All Narcissus in their first year were hot water treated before planting. Formaldehyde and prochloraz were always used in the hot water treatment tank and carbendazim was sometimes also added. Cyanazine and glyphosate were the most commonly used herbicides on bulbs, whilst sulphuric acid was the only desiccant recorded on Narcissus in their final year.

Pesticide usage on flowers for cutting and bedding plants was relatively low due to the small areas grown.

## ***INTRODUCTION***

This was the sixth survey of pesticides on outdoor bulbs and flowers, the previous surveys being in 1977, 1981, 1993, 1997 and 2001<sup>1-5</sup>. As in the 2001 survey, the crops surveyed were predominantly Narcissus, whilst small areas of other bulbs and flowers plus bedding plants grown in the open were also included.

## ***DEFINITIONS AND NOTES***

Basic area is the planted area of crop which was treated with a given pesticide or pesticide group, irrespective of the number of times the pesticide (group) was applied to that area. Basic areas are not presented anywhere in the report, but their values are used to calculate the percentage of crop treated with a given pesticide or pesticide group.

Area treated (or hectares treated) is the basic area of a crop treated with a given pesticide multiplied by the number of treatments that area received. These terms are synonymous with "spray area" and "spray hectare" which have appeared in previous reports. The new terms are believed to be more appropriate where pelleted or granular treatments are applied.

Flowers for cutting and bedding plants recorded in this report are those grown outside. Pesticide usage on flowers and bedding plants grown in glasshouses or plastic structures are covered in the Protected Crop Survey reports.

The reasons for the uses of pesticides reported in the text are those given by growers and may at times be inappropriate.

It should be borne in mind that some of the herbicides may not have been applied directly to the crop itself but either as land preparation treatments prior to sowing/planting the crop, to control weeds at the field margins or to destroy the crop.

In this report the term 'formulation(s)' is used to describe 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.

Data from the 2001 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.

Using the 2005 Agricultural Census<sup>6</sup> three samples were taken, representing the whole of Scotland: the first was selected from holdings growing bulbs, the second from those growing other flowers and the third from those growing bedding plants. Three samples were necessary to ensure the inclusion of holdings growing flowers and bedding plants, which represented a relatively small area.

The country was divided into 11 land-use regions<sup>7</sup> (Fig 1). 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 2004 to September 2005. The areas of crops grown in Scotland are shown in Table 1 and the number of holdings sampled in Table 2.

For all crops, sample data were raised to give estimates of national pesticide usage using raising factors (Table 16). These factors were based on the areas growing all crops covered in this survey and recorded in the 2005 Agricultural Census<sup>6</sup> within regions and size groups. Adjustments (Table 17) were made for each crop, within each region by applying the raising factors to the sample area of each crop grown and comparing this with the area from the 2005 Agricultural Census. A second adjustment factor was applied to crops where no holdings were sampled in one or more regions (Table 17). Due to small sample populations land-use regions were amalgamated: Highlands & Islands, Caithness & Orkney, Moray Firth and Aberdeen to form Northern Scotland, Angus with East Fife to form East Central, and Lothian, Tweed Valley, Southern Uplands and Solway to form Southern Scotland.

## ***NARCISSUS***

The estimated area of Narcissus grown in Scotland in 2005 was 544 hectares, a 10% increase on the area in the previous survey. In 2005, it was estimated that 177 hectares of Narcissus were in their first year, 216 hectares in their final year, and the remaining 151 hectares in years in between.

### ● ***Insecticides (Tables 4,7)***

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As in previous surveys, no insecticides or molluscicides were recorded.

### ● ***Fungicides (Tables 5,8)***

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The proportion of crop area treated with fungicide was 85%, compared with 90% in 2001. Tebuconazole, applied to 77% of the crop, and azoxystrobin to 71% were the dominant fungicides on Narcissus. Both of these actives were not encountered in the 2001 survey. Carbendazim applied in the field to 52% of the crop in this survey was the most used fungicide in 2001 (89%).

### ● ***Seed/hot water treatments (Tables 5,8)***

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All Narcissus in their first year received a hot water treatment. Formaldehyde and prochloraz were applied to all first year bulbs. Seventy-eight percent also had an application of carbendazim during hot water treatment.

### ● ***Herbicides and desiccants (Tables 6,9)***

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Ninety-seven percent of the crop area received a herbicide treatment. Cyanazine and glyphosate were applied to 77% of the crop. Sulphuric acid, used as a desiccant, was applied to 69% of the bulbs in their final year.

## ***OTHER BULBS***

It was estimated that approximately 4 hectares of bulbs, other than Narcissus, were grown in Scotland in 2005. No pesticide use was recorded.



Only 5.7 hectares of flowers for cutting were grown in 2005, a 33% decline compared with 2001. It should be noted that a small area was not grown for commercial purposes although they were entered on the Census.

- ***Insecticides and molluscicides (Tables 4,7)***

The proportion of the crop area treated with insecticides was 60%, with pirimicarb the only insecticide encountered in the survey. The previous survey had recorded cypermethrin as the predominant insecticide with a small usage of the organophosphate heptenophos. Molluscicides were applied to 60% of the crop, with metaldehyde the only molluscicide encountered.

- ***Fungicides (Tables 5,8)***

Sixty percent of the crop was treated with a fungicide. Oxycarboxin was the only fungicide recorded, compared with 2001 when the main active ingredient, chlorothalonil, was applied to 26% of the crop.

- ***Herbicides and growth regulators (Tables 6,9)***

Paraquat applied to sixty percent of the crop area was the only herbicide encountered.

The estimated area of bedding plants grown in the open in 2005 was 9 hectares, compared with 3 hectares in 2001.

- ***Insecticides and molluscicides (Tables 4,7)***

As in the last survey no insecticides were recorded. Sixteen percent of the crop area was treated with the molluscicide metaldehyde. No molluscicide was found in the last survey.

- ***Fungicides (Tables 5,8)***

No fungicides were recorded.

- ***Herbicides (Tables 6,9)***

Forty-five percent of the crop area was treated with the herbicide active propachlor. In 2001 the only herbicide recorded was glyphosate (18%).

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



**TABLE 1 Regional distribution of bulbs and flowers in 2005 (hectares)**

<i>Crop</i>	<i>North Scotland</i>	<i>East Central</i>	<i>West Central</i>	<i>South Scotland</i>	<i>Scotland 2005</i>	<i>Scotland 2001</i>	<i>% change</i>
Bedding plants	1.6		6.3	1.1	<b>9.0</b>	3.0	200
Bulbs	12.7	528.1	1.1	6.1	<b>548.0</b>	492.8	11
Flowers	1.9	0.4	0.7	2.7	<b>5.7</b>	8.5	-33
<b>Total</b>	<b>16.1</b>	<b>528.5</b>	<b>8.1</b>	<b>9.9</b>	<b>562.7</b>	<b>504.3</b>	<b>12</b>

**TABLE 2 Distribution of sample**

<i>Size(ha)</i>	<i>North Scotland</i>	<i>East Central</i>	<i>West Central</i>	<i>South Scotland</i>	<i>Scotland</i>
0.01-2.49	10	1	1	2	<b>14</b>
2.50-4.99		1	1		<b>2</b>
5.00-9.99		1			<b>1</b>
10.00-19.99		5			<b>5</b>
20.00+		5			<b>5</b>
<i>All sizes</i>	<b>10</b>	<b>13</b>	<b>2</b>	<b>2</b>	<b>27</b>

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

	<i>Narcissus</i>	<i>Cut flowers</i>	<i>Bedding plants</i>
Insecticides		60	
Molluscicides		60	16
Fungicides	85	60	
Herbicides	97	60	45
Any pesticide	97	60	61

**TABLE 4 Insecticide and molluscicide formulations**  
 Area treated (ha) and percentage of crop treated.

<i><b>Insecticides</b></i>	<i>Narcissus</i>		<i>Cut flowers</i>		<i>Bedding plants</i>		<i>All crops</i>	<i>2001</i>
	(ha)	(%)	(ha)	(%)	(ha)	(%)	<b>(ha)</b>	(ha)
Pirimicarb			3	60			<b>3</b>	
<i>All insecticides</i>			<b>3</b>	<b>60</b>			<b>3</b>	<b>13</b>
<i><b>Molluscicides</b></i>								
Metaldehyde			3	60	1	16	<b>5</b>	1
<i>All molluscicides</i>			<b>3</b>	<b>60</b>	<b>1</b>	<b>16</b>	<b>5</b>	<b>1</b>
Area planted (ha)	544		6		9			

**TABLE 5 Fungicide and seed/hot water treatment formulations***Area treated (ha) and percentage of crop treated*

<b>Fungicides</b>	<b>Narcissus</b>		<b>Cut flowers</b>		<b>Bedding plants</b>		<b>All crops</b>	<b>2001</b>
	(ha)	(%)	(ha)	(%)	(ha)	(%)	(ha)	(ha)
Azoxystrobin	651	71					<b>651</b>	
Carbendazim	486	52					<b>486</b>	1,386
Chlorothalonil	38	7					<b>38</b>	9
Mancozeb	168	16					<b>168</b>	19
Maneb	61	11					<b>61</b>	401
Oxycarboxin			3	60			<b>3</b>	
Prochloraz	46	8					<b>46</b>	974
Tebuconazole	862	77					<b>862</b>	
<b>All fungicides</b>	<b>2,311</b>	<b>85</b>	<b>3</b>	<b>60</b>			<b>2,314</b>	<b>4,385</b>
<b>Seed/hot water treatments</b>								
Carbendazim	139	25					<b>139</b>	24
Formaldehyde	177	*32					<b>177</b>	184
Prochloraz	177	*32					<b>177</b>	138
<b>All seed/hot water treatments</b>	<b>493</b>	<b>*32</b>					<b>493</b>	<b>523</b>
Area planted	544		6		9			

\*\* = equivalent to 100% of the crops in their first year.

**TABLE 6 Herbicide and desiccant formulations***Area treated (ha) and percentage of crop treated*

<b>Herbicides &amp; desiccants</b>	<b>Narcissus</b>		<b>Cut flowers</b>		<b>Bedding plants</b>		<b>All crops</b>	<b>2001</b>
	(ha)	(%)	(ha)	(%)	(ha)	(%)	(ha)	(ha)
Bentazone	25	5					<b>25</b>	14
Cyanazine	447	77					<b>447</b>	440
Cycloxydim	4	1					<b>4</b>	
Diquat/paraquat	21	4					<b>21</b>	14
Glyphosate	433	77					<b>433</b>	472
Metamitron	25	5					<b>25</b>	14
Paraquat	62	11	3	60			<b>65</b>	36
Propachlor					4	45	<b>4</b>	
Sulphuric acid	236	*27					<b>236</b>	160
<b>All herbicides &amp; desiccants</b>	<b>1,252</b>	<b>97</b>	<b>3</b>	<b>60</b>	<b>4</b>	<b>45</b>	<b>1,260</b>	<b>1,122</b>
<b>Growth regulators</b>								
Chlormequat/imazaquin	42	8					<b>42</b>	
<b>All growth regulators</b>	<b>42</b>	<b>8</b>					<b>42</b>	
Area planted	544		6		9			

\*\* = equivalent to 69% of the crops in final year

**TABLE 7 Insecticide and molluscicide active ingredients***Area treated (ha) and percentage of crop treated*

<i><b>Insecticides</b></i>	<i>Narcissus</i>		<i>Cut flowers</i>		<i>Bedding plants</i>		<i>All crops</i>	<i>2001</i>
	(ha)	(%)	(ha)	(%)	(ha)	(%)	<b>(ha)</b>	(ha)
<b><u>Carbamate</u></b>								
Pirimicarb			3	60			<b>3</b>	
<b><i>All insecticides</i></b>			<b>3</b>	<b>60</b>			<b>3</b>	<b>13</b>
<b><u>Molluscicides</u></b>								
Metaldehyde			3	60	1	16	<b>5</b>	1
<b><i>All molluscicides</i></b>			<b>3</b>	<b>60</b>	<b>1</b>	<b>16</b>	<b>5</b>	<b>1</b>



**TABLE 8 Fungicide and seed/hot water treatment active ingredients**  
 Area treated (ha) and percentage of crop treated

<i>Fungicides</i>	<i>Narcissus</i>		<i>Cut flowers</i>		<i>Bedding plants</i>		<i>All crops</i>	<i>2001</i>
	(ha)	(%)	(ha)	(%)	(ha)	(%)	(ha)	(ha)
Azoxystrobin	651	71					<b>651</b>	
Carbendazim	486	52					<b>486</b>	1,458
Chlorothalonil	38	7					<b>38</b>	9
Mancozeb	168	16					<b>168</b>	19
Maneb	61	11					<b>61</b>	401
Oxycarboxin			3	60			<b>3</b>	
Prochloraz	46	8					<b>46</b>	1,158
Tebuconazole	862	77					<b>862</b>	
<b>All fungicides</b>	<b>2,311</b>	<b>85</b>	<b>3</b>	<b>60</b>			<b>2,314</b>	<b>4,569</b>
<i>Seed/hot water treatments</i>								
Carbendazim	139	25					<b>139</b>	24
Formaldehyde	177	*32					<b>177</b>	184
Prochloraz	177	*32					<b>177</b>	175
<b>All seed/hot water treatments</b>	<b>493</b>	<b>90</b>					<b>493</b>	<b>559</b>
Area planted	548		6		9			

\* = equivalent to 100% of the crops in first year

**TABLE 9 Herbicide and desiccant active ingredients***Area treated (ha) and percentage of crop treated*

<b>Herbicides &amp; desiccants</b>	<i>Narcissus</i>		<i>Cut flowers</i>		<i>Bedding plants</i>		<i>All crops</i>	<i>2001</i>
	(ha)	(%)	(ha)	(%)	(ha)	(%)	<b>(ha)</b>	(ha)
Bentazone	25	5					<b>25</b>	12
Cyanazine	447	78					<b>447</b>	365
Cycloxydim	4	1					<b>4</b>	
Diquat	21	4					<b>21</b>	38
Glyphosate	433	78					<b>433</b>	390
Metamitron	25	5					<b>25</b>	12
Paraquat	83	15	3	60			<b>87</b>	36
Propachlor					4	45	<b>4</b>	
Sulphuric acid	236	*27					<b>236</b>	133
<b>All herbicides &amp; desiccants</b>	<b>1,273</b>	<b>97</b>	<b>3</b>	<b>60</b>	<b>4</b>	<b>45</b>	<b>1,281</b>	<b>1,025</b>
<b>Growth regulators</b>								
Chlormequat	42	8					<b>42</b>	
Imazaquin	42	8					<b>42</b>	
<b>All growth regulators</b>	<b>84</b>	<b>16</b>					<b>84</b>	
Area planted	548		6		9			

\*\* = equivalent to 69% of the crops in final year

**TABLE 10 Insecticides and molluscicides**  
Weights (kg) of active ingredients

<i><b>Insecticides</b></i>	<i>Narcissus</i>	<i>Cut flowers</i>	<i>Bedding plant</i>	<i>All crops</i>	<i>2001</i>
<b><u>Carbamate</u></b>					
Pirimicarb		+		+	
<i>All insecticides</i>		+		+	<b>1</b>
<b><u>Molluscicides</u></b>					
Metaldehyde		1	1	2	1
<i>All molluscicides</i>		<b>1</b>	<b>1</b>	<b>2</b>	<b>1</b>

'+' =< 0.5 kg

**TABLE 11 Fungicides and seed/hot water treatments**  
Weights (kg) of active ingredients

<i>Fungicides</i>	<i>Narcissus</i>	<i>Cut flowers</i>	<i>Bedding plants</i>	<i>All crops</i>	<i>2001</i>
Azoxystrobin	81			<b>81</b>	
Carbendazim	116			<b>116</b>	324
Chlorothalonil	38			<b>38</b>	13
Mancozeb	145			<b>145</b>	19
Maneb	73			<b>73</b>	437
Oxycarboxin		1		<b>1</b>	
Prochloraz	5			<b>5</b>	362
Tebuconazole	105			<b>105</b>	
<b>All fungicides</b>	<b>563</b>	<b>1</b>		<b>564</b>	<b>1,376</b>
<b>Seed/hot water treatments</b>					
Carbendazim	164			<b>164</b>	25
Formaldehyde	1,471			<b>1,471</b>	1,530
Prochloraz	243			<b>243</b>	161
<b>All seed/hot water treatments</b>	<b>1,878</b>			<b>1,878</b>	<b>1,850</b>

**TABLE 12 Herbicides and desiccants**  
Weights (kg) of active ingredients

<i>Herbicides &amp; desiccants</i>	<i>Narcissus</i>	<i>Cut flowers</i>	<i>Bedding plants</i>	<i>All crops</i>	<i>2001</i>
Bentazone	24			<b>24</b>	10
Cyanazine	953			<b>953</b>	805
Cycloxydim	1			<b>1</b>	
Diquat	9			<b>9</b>	16
Glyphosate	631			<b>631</b>	467
Metamitron	22			<b>22</b>	8
Paraquat	39	1		<b>40</b>	21
Propachlor			3	<b>3</b>	
Sulphuric acid	29,139			<b>29,139</b>	26,565
<b>All herbicides &amp; desiccants</b>	<b>30,817</b>	<b>1</b>	<b>3</b>	<b>30,821</b>	<b>27,925</b>
<b>Growth regulators</b>					
Chlormequat	15			<b>15</b>	
Imazaquin	+			<b>+</b>	
<b>All growth regulators</b>	<b>16</b>			<b>16</b>	

'+' =< 0.5 ha

**TABLE 13 Principal active ingredients**

Area treated with the 15 most used active ingredients on all bulbs, flower and bedding plant crops

		Type	2005	2001
1	Tebuconazole	F	862	
2	Azoxystrobin	F	651	
3	Carbendazim	F/S	625	1,482
4	Cyanazine	H	447	365
5	Glyphosate	H	433	390
6	Sulphuric acid	H	236	133
7	Prochloraz	F/S	223	1,333
8	Formaldehyde	S	177	184
9	Mancozeb	F	168	19
10	Paraquat	H	87	36
11	Maneb	F	61	401
12	Chlormequat	G	42	
12	Imazaquin	G	42	
13	Chlorothalonil	F	38	9
14	Bentazone	H	25	12
15	Metamitron	H	25	12

**TABLE 14 Principal active ingredients**

Quantity (kg) of the 15 most used active ingredients on all bulbs, flower and bedding plant crops

		Type	2005	2001
1	Sulphuric Acid	H	29,139	26,565
2	Formaldehyde	S	1,471	1,530
3	Cyanazine	H	953	805
4	Glyphosate	H	631	467
5	Carbendazim	F/S	280	349
6	Prochloraz	F/S	248	523
7	Mancozeb	F	145	19
8	Tebuconazole	F	105	
9	Azoxystrobin	F	81	
10	Maneb	F	73	437
11	Paraquat	H	40	21
12	Chlorothalonil	F	38	13
13	Bentazone	H	24	10
14	Metamitron	H	22	8
15	Chlormequat	G	15	

For tables 13 and 14 the pesticide type is shown (H: herbicide, F: fungicide, S: seed treatment, G: growth regulator)

**TABLE 15 All bulbs and flowers, comparison with previous years**

Pesticide usage 1997 – 2005, area treated with formulations, active ingredients and quantities (kg) used

	1997			2001			2005		
	Formulations (ha)	a.i. (ha)	kg	Formulations (ha)	a.i. (ha)	kg	Formulations (ha)	a.i. (ha)	kg
<i>Insecticides</i>									
Pyrethroids	+	1	+	12	12	+			
Organophosphates	1	2	1	1	1	+			
Organochlorines	3	3	+						
Carbamates	+	1	+				3	3	+
Unspecified or mixed formulation	1								
<i>All insecticides</i>	5	7	1	13	13	+	3	3	+
<i>Molluscicides</i>	4	4	1	1	1	1	5	5	2
<i>Fungicides</i>	2,802	2,826	1,065	4,385	4,569	1,376	2,314	2,314	564
<i>Herbicides/desiccants</i>	1,010	1,012	41,619	1,012	1,025	27,925	1,260	1,281	30,821
<i>Growth regulators</i>	2	2	+				42	84	16
<i>Seed/hot water treatments</i>	532	532	1,574	523	559	1,850	493	493	1,878
<b><i>All pesticides</i></b>	<b>4,355</b>	<b>4,383</b>	<b>44,260</b>	<b>5,934</b>	<b>6,168</b>	<b>31,152</b>	<b>4,116</b>	<b>4,186</b>	<b>33,280</b>
Area planted (ha)	455			504			563		

‘+’ =&lt; 0.5 ha or kg

**TABLE 16 Raising factors**

<i>Size (ha)</i>	<i>North Scotland</i>	<i>East Central</i>	<i>West Central</i>	<i>South Scotland</i>
0.01-2.49	8.02	2.50	5.45	8.18
2.50-4.99		3.01	1.00	
5.00-9.99		4.76		
10.00-19.99		3.28		
20.00+		2.08		

**TABLE 17 Adjustment factors**

<i>Crop</i>	<i>North Scotland</i>	<i>East Central</i>	<i>West Central</i>	<i>South Scotland</i>	<i>2<sup>nd</sup> adjustment factor</i>
Bedding plants	0.35		1.66	0.28	1.00
Bulbs	2.33	1.00	0.25		1.01
Flowers	5.77			0.83	1.24