PESTICIDE USAGE SURVEY REPORT 212

OUTDOOR BULBS AND FLOWERS IN GREAT BRITAIN 2005

D. G. Garthwaite, H. M. Anderson & M. R. Thomas

Pesticide Usage Survey Team

Central Science Laboratory

Sand Hutton

York UK

YO41 1LZ

Department for Environment, Food & Rural Affairs
&
Scottish Executive Environment & Rural Affairs Department

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ROUNDING

Due to rounding of figures, the sum of constituent items in the tables may not agree exactly with the totals shown.

DEFINITIONS

a) 'Pesticide' is used throughout this report to include commercial formulations containing active substances used as acaricides, biological control agents, defoliants, fungicides, growth regulators, herbicides, insecticides, molluscicides or nematicides.

b) 'Treated area' is the gross area treated with a pesticide, including all repeated applications.

c) 'Reason for application' shown in tables is the grower's stated reason for use of that particular pesticide and may not always seem entirely appropriate.

d) Where individual active substances are mentioned in the text, they are listed in descending order of use by hectares treated.

e) 'Hot water treatment' (HWT) refers to the treatment of plant material after lifting or prior to planting, for example, hot water treatment of bulbs.

f) 'At lifting treatment' refers to any treatment applied to material after lifting or prior to planting by immersion in hot water. This is commonly applied to bulbs. Some pesticides may be included in the HWT tank.

g) Throughout all tables, "Other" refers to chemicals grouped together because they were applied to less than 0.1% of the total area treated with pesticides.

h) The term "formulation(s)" used within the text is used here to describe either single active substances or mixtures of active substances contained within an individual **product**. It does not refer to any of the solvents, pH modifiers or adjuvants also contained within a product that contribute to its efficacy.

i) The term "bulb crops" used within the text includes all those crops grown from bulbs, corms, tubers, scales and rhizomes.

j) The term "other flowers for cutting" includes crops grown both for flowers and those grown as decorative foliage used for floristry, but excludes any flowers produced from bulbs.

QUALITY CONTROL OF DATA

All data are collected by personal interview using fully qualified staff working to standard operating procedures. Paper records are held at Central Science Laboratory but individual holdings cannot be identified. Data are entered onto a computer database which has extensive error checking routines associated with the input program. Each item of data is then checked after entry and subsequently all forms are re-checked by someone other than the original operator. Prior to compilation of the tables, the data are further subjected to a range of computer checks to detect, amongst other things, any values, which, on agronomic grounds, appear suspect. Any thus revealed are further scrutinised, and, if necessary, referred back to the original source. All the tables are prepared by computer once the data set is considered correct, thus eliminating transcription and typographical errors.

SUMMARY

This report presents information concerning all aspects of pesticide usage on outdoor bulbs and cut flowers in Great Britain during the 2004/5 cropping season. Information was collected from 102 holdings and the data on the area of pesticide treatments and the amount of active substances applied have been raised to give national estimates of pesticide usage.

There was very little change in the total area of outdoor bulbs and other flowers for cutting grown in Great Britain between the four most recent surveys. The area grown in 2005 was less than one percent lower than in 2001, 5% greater than in 1997 and one percent lower than in 1993. In terms of the area treated in 2005, there were decreases of 35% and 7% respectively compared with 2001 and 1997, but an increase of 32% since 1993. By contrast, the weight applied has decreased by 8% since 2001, and 12% since 1997 and by 37% since 1993.

Fungicides accounted for 56% of the total pesticide-treated area of outdoor bulb and flower crops grown in Great Britain in 2005, herbicides 29%, insecticides 8%, pesticides applied to seed or bulbs (including in hot water treatments) 6%, desiccants one percent, with soil sterilants, growth regulators, molluscicides and repellents, acaricides, sulphur and tar oils/acids all accounting for less than one percent of the area. In contrast, desiccants accounted for 51% of the total weight of pesticide active substances applied, soil sterilants 18%, herbicides 12%, fungicides 11%, pesticides applied to seed or bulbs (including in hot water treatments) 7% and insecticides/nematicides, sulphur, tar oils/acids, molluscicides and repellents, growth regulators and acaricides all accounting for less than one percent of the weight

On average bulb and flower crops received five separate spray applications, nine products and nine active substances (including repeat applications of the same product/active substance, but excluding pesticides applied to seed or bulbs). Most of these were accounted for by the routine application of fungicides.

The most extensively-used foliar applied fungicide formulations were carbendazim (19% of the fungicide-treated area), chlorothalonil (19%), azoxystrobin (15%), tebuconazole (15%) and mancozeb (13%). In terms of weight applied, the most-used fungicide was chlorothalonil (34% of fungicide use), followed by mancozeb (30%) and carbendazim (13%).

The most extensively-used herbicide formulations were glyphosate, accounting for 28% of the herbicide-treated area, cyanazine (13%), chlorpropham (12%), diuron (8%), linuron (8%), diquat/paraquat (7%) and paraquat (6%). By weight, glyphosate alone accounted for 32% of herbicide use, followed by cyanazine (23%) and chlorpropham (15%).

Pyrethroids were the most extensively-used insecticides, accounting for 44% of the total insecticide-treated area (excluding pesticides applied to seed or bulbs) but for only 3% of the usage by weight reflecting their relatively low rates of application. Organophosphates comprised 35% of the insecticide-treated area but 84% of the weight applied. The organophosphate dimethoate accounted for 28% of the total insecticide-treated area but 64% of the weight of all insecticides applied. The neonicotinoids, thiacloprid and imidacloprid accounted for a further 7% by area, carbamates (3%), benzoylureas, (3%), spinosyns, (3%), azomethines, (3%) and pyrethroid/carbamates (2%). In terms of weight applied, the neonicotinoid active substances accounted for 5% of the total.

Since 2001, the area treated with insecticides has decreased by 37%, with the weight applied falling by 57%, in line with an increased use of pyrethroids applied at a much lower rate of application than the organophosphates they are replacing. The average rate of insecticide application fell from 0.63 kg/ha in 2001 to 0.43 kg/ha in 2005. Between 1993 and 2005 the area treated with insecticides decreased by 16%, but had increased by 23% in 2005 compared with 1997. Average rates of application were similar in 1993, 1997 and 2005.

Whilst use of organophosphates in 2005 (1,849 kg) was less than half that of 2001 (4,438 kg) it is still greater than in 1997 (1,641 kg) or 1993 (1,690 kg). However, usage is likely to decline further in future as pyrethroids replace organophosphates for the control of large narcissus fly (*Merodon equestris*). Use of pyrethroids in 2005 was 23 kg, almost doubling that of 2001 (13 kg). Organophosphates are used at much higher dose rates than pyrethroids which accounts for the apparent mis-match in quantities used.

INTRODUCTION

The Advisory Committee on Pesticides advises government on all aspects of pesticide use. In order to discharge this function the Committee must regularly monitor the usage of all pesticides. It needs accurate data on the usage of individual pesticides.

As part of the ongoing process for obtaining data, the Pesticide Usage Survey Teams of the Central Science Laboratory, an executive agency of the Department for Environment, Food & Rural Affairs and the Scottish Agricultural Science Agency, an agency of the Scottish Executive Environment and Rural Affairs Department, conducted a survey of pesticide usage on outdoor bulb & flower crops in 2004/05 by visiting holdings throughout Great Britain during the winter of 2005/06.

This was the eighth survey of pesticide usage on outdoor bulbs in England & Wales, and the third to include flowers for cutting. In 1993, chrysanthemums were treated as a separate crop group. However, in 1997, 2001 and 2005 the area of chrysanthemums grown was found to have declined to one percent or less of the total area of bulbs and flowers, and because of this they are now grouped together with other flowers for cutting.

Prior to 1993, bulbs were surveyed with vegetables for human consumption. Previous surveys have been reported by Sly, (1972); Umpelby & Sly (1977); Umpelby, Sly, Cutler & Symonds (1982); Williams (1986); Thomas, Garthwaite & Thomas (1995), Crawford, Garthwaite & Thomas (1999) and Stoddart, Garthwaite & Thomas (2002). Data relating to pesticide usage on bulbs in Scotland has been reported by Umpelby *et al.* (1982) and Hosie & Bowen (1990). In 1988, a survey of narcissus only was conducted in three Eastern region counties, the results of which were not published or suitable for comparison because of the restricted nature of the survey.

Information on all aspects of pesticide usage in Great Britain plus the old Defra regions of England & Wales may be obtained from the Pesticide Usage Survey Team at the Central Science Laboratory, Sand Hutton. Further data related specifically to Scotland may be obtained from the Pesticide Usage Survey Team at the Scottish Agricultural Science Agency, Edinburgh.

A list of the most recently published survey reports is shown in the Appendix. Copies of reports on pesticide usage may be purchased from DEFRA Publications, London SE99 7TP (01645 556000).

REPORT FORMAT

In order to improve the presentation of data within this report summary charts and tables for each crop have been incorporated. These include:

1. Data are presented which outline the percentage of monthly applications made for each of the main pesticide groups, in particular insecticides, fungicides, herbicides and growth regulators. Within a pesticide group each individual monthly figure is expressed as a proportion of the total annual application of that pesticide group. Figures are expressed proportionately in order to remove any bias caused by one pesticide group dominating all usage on an individual crop.
2. For each major pesticide group, detailed data are presented on the five principal active substances used on an individual crop. These data include the area treated with each formulation in 2005, the weight applied in 2005, the proportion of the total area treated within each pesticide group, the proportion of the census area grown treated with each formulation, the number of applications of each formulation made to an individual crop where treated with that formulation and the proportion of its full label rate used on that crop.

METHODS

The Sample

The samples of holdings to be surveyed were selected using data from the Agricultural Census Returns, June 2004, based on the distribution of farms growing outdoor bulbs and flowers in England and Wales (Anon., 2005a) and in Scotland (Anon., 2005b).

The samples were drawn from the census returns to represent the area of all outdoor bulb and flower crops grown throughout Great Britain. The samples were stratified according to the total area of outdoor bulb and flower crops grown in each region and by farm size group based on the total area of outdoor bulb and flower crops grown on each farm. The area of outdoor bulb and flower crops sampled in each size group and each region was proportional to the total area of outdoor bulb and flower crops grown on holdings of each size group in each region.

An introductory letter was sent to the occupiers of the selected holdings explaining the purpose of the survey. A total of 102 holdings were visited during the winter of 2005/6 and data collected during a personal interview with the grower conducted by an experienced pesticide usage surveyor. Where a holding listed in the original sample was not able to provide data it was replaced with another from the same size group and region, held on a reserve list.

The pesticide usage data collected from each holding were raised by two factors to give an estimate of regional usage; the first factor being dependent on farm size group and region and the second dependent on crop area and region (Thomas, 2001). The data were further adjusted by a third factor to give estimates of total pesticide usage related to the national cropping areas in Great Britain.

The raising factors were based on the areas of outdoor bulb and flower crops grown and harvested in 2005 as recorded in the June 2005 Agricultural Census Returns (Anon., 2006a & 2006b).

The Questionnaire

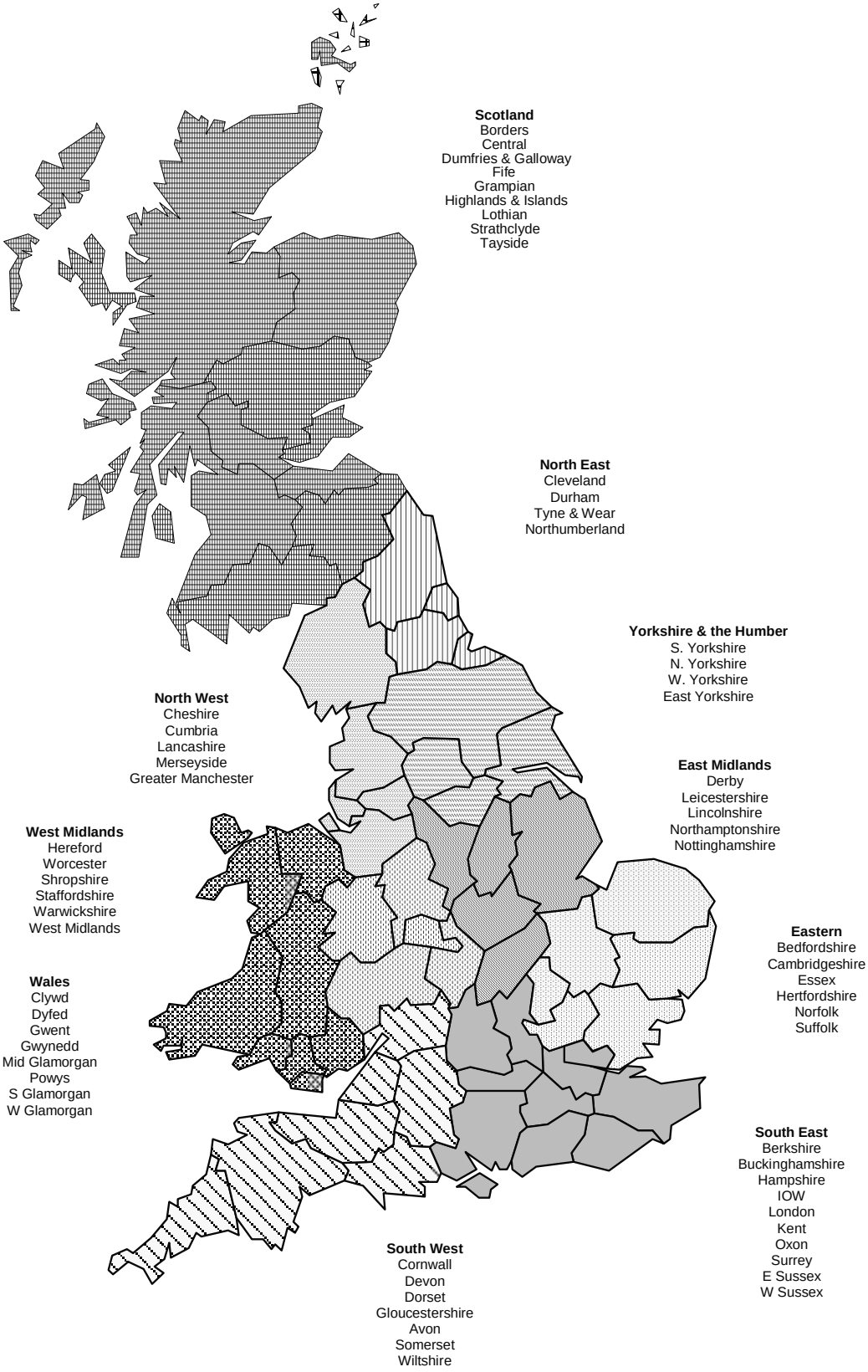
The questionnaire for the main part of the survey consisted of two forms, which were completed by a surveyor during an interview with the farmer.

Form 1 summarised the cropping on the holding during the 2005 growing season.

Form 2 dealt with all aspects of pesticide usage and any additional data, which may have influenced pesticide applications. Bulbs and flowers grown in different fields and receiving the same spray programme were grouped together and treated as one “field”. A separate form 2 was used where different spray programmes occurred, even if this was within a field.

A further form was used to collect information on hot water treatment applied to bulbs before planting. A rate per unit area was calculated for each pesticide applied in this way, and the information included in form 2.

Fig. 1 Counties in Government Office Regions of England & Wales and regions covered by SEERAD in Scotland



RESULTS AND DISCUSSION

CROPS AND CROPPING

Information concerning outdoor bulb and flower crops and data on pesticide usage were collected from 646 fields/part fields grown on 102 holdings throughout Great Britain. The sample accounted for 37% of the total area of outdoor bulb and flower crops grown in Great Britain during the 2005 season.

Bulb crops included narcissi, gladioli, lilies, *Agapanthus*, dahlia, tulip and *Brodea*. Narcissi accounted for 88% of the total area of bulb crops grown, gladioli for 7%, lilies for 3% and other bulb crops each less than one percent. The very large proportion of narcissus bulbs grown has a great bearing on the information gathered on the total use of pesticides on all outdoor bulb and flower crops. Most crops encountered were grown on an annual basis, with the exception of narcissi, which were normally left in the ground for two or three years or sometimes more. Thirty-nine percent of narcissi sampled were in their first year, 39% in their second year with the remainder being three years or older. Flowers were picked from 79% of first year narcissi, from 95% of second year crops and from all crops three years and older. Flowers were picked from 44% of the tulip area, 99% of the gladioli area, and from all other bulb crops excluding bluebells. Overall, 45% of the narcissi grown in 2005 were harvested as bulbs for replanting, as were 56% of tulips and one percent of gladioli.

Twenty-nine specific crops included in the category "Other flowers for cutting" were encountered in this survey. However, it is likely that some other, more minor, crops would have been grouped by the grower to ensure compatibility with the June Census returns. Major crops included in this category were sunflower, accounting for 24% of the area grown where a crop was specified, chrysanthemum 14%, *Eucalyptus* 14%, peony 10%, sweet william 6%, *Gypsophila* 6%, aster 6%, larkspur 5% and *Pittosporum* 5%. All crops were grown for cut flowers/foliage but the length of time that a crop was grown varied both between and within crops. Over half (54%) of all crops were grown on an annual basis, 14% as biennials and 32% as perennials or for more than two years.

The areas of the outdoor bulb and flower crops grown in Great Britain are shown in Table 1. Bulbs accounted for 86% of the total area of all outdoor bulb and flower crops grown, with other flowers for cutting (14%) making up the rest. Approximately 39% of the total area of outdoor bulb and flower crops were grown in South West Region, 34% in East Midlands Region, 10% in Eastern Region and Scotland, 3% in London & South Eastern Region, 2% in North West and West Midlands Regions, and less than one percent in Yorkshire & the Humber Region, Wales and North East Region.

The distribution of the outdoor bulbs was similar to the overall distribution of all the crops surveyed. The area of flowers for cutting grown in each region varied from the overall distribution with 24% of the area being grown in East Midlands Region, 23% in South West Region, 19% in Eastern region and less than one percent in Scotland. Comparisons of use at a regional level are not included because of the potentially small sample size in some regions.

Table 1 *Area of bulb and flower crops grown in Great Britain 2005 (hectares)*

Crop group	**Great Britain**
Outdoor bulbs	4,914
Other flowers for cutting	826
All outdoor bulb and flower crops	**5,740**

OVERALL USAGE OF PESTICIDES

Pesticide usage on crops

The extent of total pesticide usage was closely related to the total area grown (Table 2). For example, bulbs accounted for 86% of the total area of outdoor bulb and flower crops grown in Great Britain and for 94% of the total pesticide-treated area. However, this relationship varied within each chemical group. All the desiccants and all of the treatments applied directly to bulbs or via hot water treatment were applied to bulbs, as well as bulbs accounting for 95% of fungicide usage and 96% of herbicide usage. By contrast, bulbs accounted for 78% of the insecticide-treated area.

By weight, use of pesticides on bulbs comprised 81% of the total weight of all active substances applied to both bulbs and flower crops. The discrepancy between area treated and weight applied is due to a small area, 61 hectares, of flowers for cutting being treated with the soil sterilant dazomet, an active substance applied at a relatively high recommended rate. The use of dazomet on this small area of flowers for cutting accounted for 18% of the weight of all active substances applied.

Proportion of crops treated

The percentage areas of each crop treated with the different pesticide groups are shown in Table 3, whilst the mean number of spray rounds, mean number of products and mean number of active substances applied are shown in Tables 4a, b and c respectively.

Approximately 8% of all outdoor bulb and flower crops received no pesticides at all, but this varied between crop groups. Four percent of all bulbs and 30% of other flowers for cutting remained untreated (Table 3).

Since 1997, applications to bulbs have changed only slightly, from an average of 5 pesticide spray rounds, 8 products and 9 active substances (Crawford *et al.*, 1999) to 5 pesticide sprays (Table 4a), 9 products (Table 4b) and 9 active substances (Table 4c) in 2005. By contrast, the number of applications made to other flowers for cutting has decreased from an average of 5 pesticide spray rounds, 6 products and 7 active substances in 1997 (Crawford *et al.*, 1999) to 4 pesticide spray rounds, 4 products and 4 active substances in 2005.

Fungicides were applied to 89% of bulb crops, but to only 52% of other flowers for cutting (Table 3). Compared to other flowers for cutting, bulbs also received more fungicide sprays (three compared to two respectively) and fungicide active substances (five compared to two).

Herbicides were applied to a mean of 87% of all outdoor bulb and flower crops, bulb crops receiving on average two sprays, while other flowers for cutting were generally treated only once (Tables 3 & 4).

Insecticides were applied to 49% of other flowers for cutting, and just 17% of bulb crops (Table 3). Overall, bulbs and other flowers for cutting received on average a single insecticide spray (Table 4a), with a single active substance applied to each (Table 4c).

Approximately 96% of lifted bulbs received pesticides applied directly to the bulb or via hot water treatment while 77% of other flowers for cutting were raised from treated seed (Table 3).

Table 2 *Treated areas of outdoor bulb and flower crops in Great Britain 2005 by crop group (spray hectares)*

Chemical group	**Outdoor bulbs**	**Other flowers for cutting**	**Total all outdoor bulb and flower crops**
Acaricides	10	.	10
Desiccants[1]	537	.	537
Fungicides	29,620	1,694	31,314
Growth regulators	42	.	42
Herbicides	15,390	566	15,956
Insecticides & nematicides	3,412	953	4,365
Molluscicides & repellents	1	24	25
Soil sterilants	.	61	61
Sulphur	.	10	10
Tar oils/acids	.	2	2
Seed treatments	157	170	326
Pesticides applied directly to bulbs[2]	65	.	65
Pesticides applied in hot water treatments[2]	3,206	.	3,206
All pesticides	**52,439**	**3,481**	**55,920**

Table 3 *Usage of pesticides on bulb and flower crops in Great Britain 2005 - percentage area of crops treated with pesticides*

Crop group	**Insecticides & nematicides**	**Fungicides**	**Herbicides**	**Desiccants[1]**	**Acaricides**	**Molluscicides & repellents**	**Seed/bulb[3] treatments[4]**	**Not treated**
Outdoor bulbs	17.2	88.5	93.7	11.7	0.3	.	95.6	4
Other flowers for cutting	48.5	52.3	49.2	.	.	3.6	76.7	30.2
All outdoor bulb and flower crops	**22.1**	**82.8**	**86.8**	**9.9**	**0.2**	**0.6**	**92.6**	**8.1**

[1]Sulphuric acid only

[2]Area listed refers to the area subsequently planted with bulbs so treated

[3]Represents first year crops only (second and third year, and older crops not included)

[4]Includes treatments applied via hot water dips

Table 4a *Usage of pesticides on bulb and flower crops in Great Britain 2005 – number of spray rounds applied to crops (excluding direct seed or bulb applications or those applied via hot water treatment)*

Crop group	Insecticides	Fungicides	Herbicides	Desiccants[1]	Molluscicides & repellents	All Pesticides
Outdoor bulbs	0.4	2.5	2.3	0.1	.	5.1
Other flowers for cutting	0.9	1.5	1.2	.	0.1	3.6
All outdoor bulb and flower crops	**0.5**	**2.3**	**2.1**	**0.1**	**.**	**4.8**

Table 4b *Usage of pesticides on bulb and flower crops in Great Britain 2005 – number of products applied to crops (excluding direct seed or bulb applications or those applied via hot water treatment)*

Crop group	Insecticides	Fungicides	Herbicides	Desiccants[1]	Molluscicides & repellents	All Pesticides
Outdoor bulbs	0.5	4.7	3.4	0.1	.	8.7
Other flowers for cutting	0.9	1.8	1.3	.	0.1	4.1
All outdoor bulb and flower crops	**0.6**	**4**	**2.9**	**0.1**	**.**	**7.6**

Table 4c *Usage of pesticides on bulb and flower crops in Great Britain 2005 – number of active substances applied to crops (excluding direct seed or bulb applications or those applied via hot water treatment)*

Crop group	Insecticides	Fungicides	Herbicides	Desiccants[1]	Molluscicides & repellents	All Pesticides
Outdoor bulbs	0.5	4.8	3.6	0.1	.	9
Other flowers for cutting	1	2	1.3	.	0.1	4.4
All outdoor bulb and flower crops	**0.6**	**4.1**	**3.1**	**0.1**	**.**	**7.9**

[1]Sulphuric acid only

EXTENT AND QUANTITIES OF PESTICIDE FORMULATIONS USED

The estimated total areas of each crop treated with each pesticide formulation are indicated in Table 5, whilst the estimated total quantities of pesticide active substances applied to each crop are shown in Table 6.

Fungicides accounted for 56% of the total pesticide-treated area of outdoor bulb and flower crops grown in Great Britain in 2005, herbicides 29%, insecticides 8%, pesticides applied to seed or bulbs (including in hot water treatments) 6%, desiccants one percent, with soil sterilants, growth regulators, molluscicides and repellents, acaricides, sulphur and tar oils/acids all accounting for less than one percent of the area. In contrast, desiccants accounted for 51% of the total weight of pesticide active substances applied, soil sterilants 18%, herbicides 12%, fungicides 11%, pesticides applied to seed or bulbs (including in hot water treatments) 7% and insecticides/nematicides, sulphur, tar oils/acids, molluscicides and repellents, growth regulators and acaricides all accounting for less than one percent of the weight

The most extensively-used foliar applied fungicide formulations were carbendazim (19% of the fungicide-treated area), chlorothalonil (19%), azoxystrobin (15%), tebuconazole (15%) and mancozeb (13%). In terms of weight applied, the most-used fungicide was chlorothalonil (34% of fungicide use), followed by mancozeb (30%) and carbendazim (13%).

The most extensively-used herbicide formulations were glyphosate, accounting for 28% of the herbicide-treated area, cyanazine (13%), chlorpropham (12%), diuron (8%), linuron (8%), diquat/paraquat (7%) and paraquat (6%). By weight, glyphosate accounted for 32% of herbicide use, followed by cyanazine (23%) and chlorpropham (15%).

Pyrethroids were the most extensively-used insecticides, accounting for 44% of the total insecticide-treated area (excluding pesticides applied to seed or bulbs) but for only 3% of the usage by weight, reflecting their relatively low rates of application. The next most extensively-used insecticides were the organophosphates, comprising 35% of the insecticide-treated area but 84% of the weight applied. The organophosphate dimethoate accounted for 28% of the total insecticide-treated area but 64% of the weight of all insecticides applied. The neonicotinoids, thiacloprid and imidacloprid accounted for a further 7% by area, carbamates (3%), benzoylureas, (3%), spinosyns (3%), azomethines, (3%) and pyrethroid/carbamates (2%). In terms of weight applied, the neonicotinoid active substances accounted for 5% of the total.

The only desiccant recorded was sulphuric acid, applied exclusively to bulbs. However, because of the relatively high rates at which this active substance is applied, it was also the most extensively-used pesticide by weight (51% of the total weight of all pesticides used, despite the fact that it was applied to only one percent of the total pesticide-treated area).

Formaldehyde was the main pesticide included in hot water treatments, accounting for 49% of all pesticides applied in this way by planted area. The use of formaldehyde was restricted to pre-planting treatments, including those made at lifting and in hot water treatments. It was used on 93% of the area of 1st year narcissi. Fungicides accounted for 43% of the planted area treated by application during hot water treatment, with insecticides accounting for 8%. After formaldehyde, the next most extensively-used individual pesticides in hot water treatments were thiabendazole (15%), prochloraz (13%) and carbendazim (12%). In terms of amount used by weight, formaldehyde accounted for 59% of usage, fungicides 29% and insecticides 11%. Thiabendazole (13%) and chlorpyrifos (11%) were the most important fungicides and insecticides respectively.

Usage of molluscicides/repellents was minimal with only metaldehyde, ferric phosphate, methiocarb and ziram being recorded.

Despite the fact that soil sterilants were used on less than one percent of the total area treated, because of the relatively high rates at which the active substance dazomet is applied, it accounted for 18% of the total weight of all pesticides used.

Table 5 *Usage of pesticides (field treatments) on outdoor bulb and flower crops grown in Great Britain, 2005 (spray hectares)*

	Outdoor bulbs	Other flowers for cutting	Total all outdoor bulb and flower crops
Acaricides			
Other[1] acaricides[2]	10	.	10
Insecticides & nematicides			
Azomethine			
Pymetrozine	113	1	115
Benzoylurea			
Teflubenzuron	.	121	121
Carbamate			
Pirimicarb	82	56	138
Neonicotinoids			
Thiacloprid	293	.	293
Organophosphate			
Chlorpyrifos	188	19	206
Dimethoate	1,234	.	1,234
Malathion	40	48	89
Pyrethroid			
Cypermethrin	254	343	597
Deltamethrin	183	122	305
Lambda-cyhalothrin	1,025	.	1,025
Pyrethroid/carbamate			
Lambda-cyhalothrin/pirimicarb	.	93	93
Spinosyn insecticides			
Spinosad	.	121	121
All other insecticides & nematicides[3]	.	27	28
All insecticides & nematicides	**3,412**	**953**	**4,365**

[1]Throughout all tables, “Other” refers to chemicals grouped together because they were applied to less than 0.1% of the total area treated with pesticides

[2]Other acaricides includes clofentezine.

[3]Other insecticides & nematicides includes bifenthrin, deltamethrin/pirimicarb, imidacloprid, nicotine, rotenone, unspecified insecticides & zeta-cypermethrin

Table 5 (cont.) *Usage of pesticides (field treatments) on outdoor bulb and flower crops grown in Great Britain, 2005 (spray hectares)*

	Outdoor bulbs	Other flowers for cutting	Total all outdoor bulb and flower crops
Fungicides			
Azoxystrobin	4,462	239	4,701
Boscalid	.	93	93
Carbendazim	6,096	2	6,098
Carbendazim/prochloraz	682	.	682
Chlorothalonil	5,653	271	5,924
Chlorothalonil/mancozeb	133	.	133
Epoxiconazole/kresoxim-methyl	408	.	408
Iprodione	607	258	865
Mancozeb	3,986	56	4,041
Maneb	221	.	221
Myclobutanil	83	1	84
Oxycarboxin	.	183	183
Prochloraz	808	.	808
Prochloraz/propiconazole	5	192	197
Propiconazole	.	168	168
Tebuconazole	4,489	163	4,651
Vinclozolin	1,800	27	1,827
Other fungicides[1]	185	42	227
All fungicides	**29,620**	**1,694**	**31,314**

[1]Other fungicides includes azoxystrobin/fenpropimorph, bupirimate, chlorothalonil/cyproconazole, copper oxychloride, cymoxanil/famoxadone, cymoxanil/mancozeb, cyproconazole, difenoconazole, dithianon, fluazinam, kresoxim-methyl, mancozeb/metalaxyl, pyrimethanil & zineb.

Table 5 (cont.) *Usage of pesticides (field treatments) on outdoor bulb and flower crops grown in Great Britain, 2005 (spray hectares)*

	Outdoor bulbs	Other flowers for cutting	Total all outdoor bulb and flower crops
Desiccants			
Sulphuric acid	537	.	537
Herbicides			
Bentazone	161	.	161
Chlorpropham	1,913	.	1,913
Cyanazine	2,058	56	2,114
Diquat	74	.	74
Diquat/paraquat	1,087	50	1,137
Diuron	1,337	.	1,337
Glyphosate	4,441	68	4,509
Lenacil	388	.	388
Linuron	1,309	.	1,309
Metamitron	305	1	306
Metazachlor	60	40	99
Metoxuron	131	.	131
Paraquat	972	53	1,025
Pendimethalin	538	152	690
Simazine	586	14	600
Other herbicides[1]	29	132	162
All herbicides	**15,390**	**566**	**15,956**

[1]Other herbicides includes chlorpropham/fenuron, chlorthal-dimethyl, clopyralid, clopyralid/fluroxypyr/triclopyr, cycloxydim, isoxaben, MCPA, oxadiazon, pentanochlor, propachlor, propyzamide & trifluralin.

Table 5 (cont.) *Usage of pesticides (field treatments) on outdoor bulb and flower crops grown in Great Britain, 2005 (spray hectares)*

	Outdoor bulbs	Other flowers for cutting	Total all outdoor bulb and flower crops
Growth regulators			
Other growth regulators[1]	42	.	42
All growth regulators	**42**	**.**	**42**
Molluscicides & repellents			
Other molluscicides & repellents[2]	1	24	25
All molluscicides & repellents	**1**	**24**	**25**
Soil sterilants			
Dazomet	.	61	61
Sulphurs			
Sulphur	.	10	10
Tar oils/acids			
Tar acids	.	2	2

[1]Other growth regulators include chlormequat/imazaquin

[2]Other molluscicides and repellents include ferric phosphate, metaldehyde, methiocarb & ziram

Table 5 (cont.) Usage *of pesticides on outdoor bulb and flower crops grown in Great Britain, 2005 (planted hectares)*

	Outdoor bulbs	Other flowers for cutting	Total all outdoor bulb and flower crops
Pesticides applied directly to bulbs at lifting			
Disinfectants			
Formaldehyde	25	.	25
Other disinfectants[1]	20	.	20
All disinfectants	**45**	**.**	**45**
Fungicides			
Thiabendazole	20	.	20
All pesticides applied directly to bulbs at lifting	**65**	**.**	**65**
Seed treatments			
Unspecified seed treatments	157	166	322
Other seed treatments[2]	.	4	4
All seed treatments	**157**	**170**	**326**
Pesticides applied in hot water treatments			
Disinfectants			
Formaldehyde	1,555	.	1,555
Other disinfectants[1]	25	.	25
All disinfectants	**1,580**	**.**	**1,580**
Fungicides			
Carbendazim	390	.	390
Mancozeb	11	.	11
Prochloraz	422	.	422
Thiabendazole	480	.	480
Vinclozolin	11	.	11
Other fungicides[3]	59	.	59
All fungicides	**1,372**	**.**	**1,372**
Insecticides			
Chlorpyrifos	244	.	244
Dimethoate	11	.	11
All insecticides	**254**	**.**	**254**
All pesticides applied in hot water treatments	**3,206**	**.**	**3,206**
All seed and bulb dip treatments	**3,428**	**170**	**3,598**

[1]Other disinfectants were peroxyacetic acid

[2]Other seed treatments were thiram

[3]Other fungicides were captan & cyproconazole/prochloraz

Table 6 *Usage of pesticides (field treatments) on outdoor bulb and flower crops grown in Great Britain, 2005 (kg active substance applied)*

	Outdoor bulbs	**Other flowers for cutting**	**Total all outdoor bulb and flower crops**
Acaricides			
Other acaricides[1]	2	.	2
Insecticides & nematicides			
Azomethine			
Pymetrozine	17	.	17
Benzoylurea			
Teflubenzuron	.	3	3
Carbamate			
Pirimicarb	12	6	18
Neonicotinoids			
Thiacloprid	36	.	36
Organophosphate			
Chlorpyrifos	137	8	145
Dimethoate	494	.	494
Malathion	6	4	10
Pyrethroid			
Cypermethrin	6	9	15
Deltamethrin	1	1	2
Lambda-cyhalothrin	6	.	6
Pyrethroid/carbamate			
Lambda-cyhalothrin/pirimicarb	.	15	15
Spinosyn insecticides			
Spinosad	.	4	4
All other insecticides & nematicides[3]	.	9	9
All insecticides & nematicides	**714**	**59**	**773**

[1]Other acaricides include clofentezine.

[2]Other insecticides & nematicide includes bifenthrin, deltamethrin/pirimicarb, imidacloprid, nicotine, rotenone, unspecified insecticides & zeta-cypermethrin

Table 6 (cont.) *Usage of pesticides (field treatments) on outdoor bulb and flower crops grown in Great Britain, 2005 (kg active substance applied)*

	Outdoor bulbs	Other flowers for cutting	Total all outdoor bulb and flower crops
Fungicides			
Azoxystrobin	686	67	753
Boscalid	.	16	16
Carbendazim	2,166	.	2,167
Carbendazim/prochloraz	376	.	376
Chlorothalonil	5,658	141	5,799
Chlorothalonil/mancozeb	285	.	285
Epoxiconazole/kresoxim-methyl	61	.	61
Iprodione	113	65	178
Mancozeb	5,155	52	5,207
Maneb	253	.	253
Myclobutanil	1	.	1
Oxycarboxin	.	29	29
Prochloraz	328	.	328
Prochloraz/propiconazole	2	94	97
Propiconazole	.	13	13
Tebuconazole	714	27	740
Vinclozolin	678	13	691
Other fungicides[1]	90	26	116
All fungicides	**16,565**	**544**	**17,110**

[1]Other fungicides includes azoxystrobin/fenpropimorph, bupirimate, chlorothalonil/cyproconazole, copper oxychloride, cymoxanil/famoxadone, cymoxanil/mancozeb, cyproconazole, difenoconazole, dithianon, fluazinam, kresoxim-methyl, mancozeb/metalaxyl, pyrimethanil & zineb.

Table 6 (cont.) *Usage of pesticides (field treatments) on outdoor bulb and flower crops grown in Great Britain, 2005 (kg active substance applied)*

	Outdoor bulbs	Other flowers for cutting	Total all outdoor bulb and flower crops
Desiccants			
Sulphuric acid	79,212	.	79,212
Herbicides			
Bentazone	85	.	85
Chlorpropham	2,918	.	2,918
Cyanazine	4,452	118	4,570
Diquat	46	.	46
Diquat/paraquat	525	22	547
Diuron	923	.	923
Glyphosate	6,150	81	6,231
Lenacil	436	.	436
Linuron	1,084	.	1,084
Metamitron	362	2	365
Metazachlor	28	29	57
Metoxuron	113	.	113
Paraquat	417	56	473
Pendimethalin	701	207	908
Simazine	425	16	441
Other herbicides[1]	15	269	284
All herbicides	**18,681**	**799**	**19,480**

[1]Other herbicide includes chlorpropham/fenuron, chlorthal-dimethyl, clopyralid, clopyralid/fluroxypyr/triclopyr, cycloxydim, isoxaben, MCPA, oxadiazon, pentanochlor, propachlor, propyzamide & trifluralin.

Table 6 (cont.) *Usage of pesticides (field treatments) on outdoor bulb and flower crops grown in Great Britain, 2005 (kg active substance applied)*

	Outdoor bulbs	Other flowers for cutting	Total all outdoor bulb and flower crops
Growth regulators			
Other growth regulators[1]	15	.	15
All growth regulators	**15**	**.**	**15**
Molluscicides & repellents			
Other molluscicides & repellents[2]	<1	30	30
All molluscicides & repellents	**<1**	**30**	**30**
Soil sterilants			
Dazomet	.	28,868	28,868
Sulphurs	.	79	79
Sulphur	**.**	**79**	**79**
Tar oils/acids	.	51	51
Tar acids	.	51	51

[1]Other growth regulators include chlormequat/imazaquin

[2]Other molluscicides and repellents include ferric phosphate, metaldehyde, methiocarb & ziram

Table 6 (cont.) *Usage of pesticides on outdoor bulb and flower crops grown in Great Britain, 2005 (kg active substance applied)*

	Outdoor bulbs	Other flowers for cutting	Total all outdoor bulb and flower crops
Pesticides applied directly to bulbs at lifting			
Disinfectants			
Formaldehyde	181	.	181
Other disinfectants[1]	3	.	3
All disinfectants	**184**	**.**	**184**
Fungicides			
Thiabendazole	29	.	29
All fungicides	**29**	**.**	**29**
All pesticides applied directly to bulbs at lifting	**213**	**.**	**213**
Seed treatments			
Other seed treatments[2]	.	<1	<1
All Seed Treatments	**.**	**<1**	**<1**
Pesticides applied in hot water treatments			
Disinfectants			
Formaldehyde	6,297	.	6,297
Other disinfectants[1]	2	.	2
All disinfectants	**6,299**	**.**	**6,299**
Fungicides			
Carbendazim	701	.	701
Mancozeb	57	.	57
Prochloraz	500	.	500
Thiabendazole	1,354	.	1,354
Vinclozolin	18	.	18
Other fungicides[3]	485	.	485
All fungicides	**3,115**	**.**	**3,115**
Insecticides			
Chlorpyrifos	1,194	.	1,194
Dimethoate	3	.	3
All insecticides	**1,196**	**.**	**1,196**
All pesticides applied in hot water treatments	**10,610**	**.**	**10,610**
All seed and bulb dip treatments	**10,823**	**<1**	**10,823**

[1]Other disinfectants were peroxyacetic acid

[2]Other seed treatments were thiram

[3]Other fungicides were captan & cyproconazole/prochloraz

EXTENT AND QUANTITIES OF ACTIVE SUBSTANCES USED

The 50 most extensively-used pesticide active substances on all outdoor bulb and flower crops in Great Britain in 2005 are listed in descending order of area treated in Table 7. A similar list showing the 50 most-used active substances in descending order of amount applied is presented in Table 8. In both tables, information is also provided on pesticide usage in the last survey (2001) and the change in usage for each active substance between the two surveys. The rating of active substances varies in each list depending upon their extent of usage, rate of application, rate of active substance per unit weight and relative proportions in different formulated products, especially for those products which contain more than one active substance.

The ten most extensively-used active substances by area treated included six fungicides and four herbicides. With the exception of chlorothalonil, tebuconazole and chlorpropham, the principal ten active substances showed decreases in the area treated. The use of tebuconazole was 33% higher than in 2001, chlorothalonil 8% and chlorpropham 7%. The use of vinclozolin had declined by 82%, mancozeb 56%, carbendazim 44% and paraquat 29%. The first insecticide in the list, dimethoate, appears at number fourteen.

In terms of weight of active substances applied in 2005, the list is dominated by sulphuric acid, showing an increase in use of 34% since the 2001 survey. The use of dazomet, number two in the list, increased by almost five times since 2001. The remainder of the top ten by weight comprised five herbicides and three fungicides. The first insecticide in the list, dimethoate, appears at number seventeen.

The most extensively-used fungicide active substances in 2005 by area treated were carbendazim, chlorothalonil, azoxystrobin, tebuconazole, mancozeb and vinclozolin. Chlorothalonil was the most extensively-used fungicide by weight, followed by mancozeb, carbendazim and azoxystrobin. Although used on a limited area, the fungicides boscalid, myclobutanil and pyrimethanil were recorded for the first time in 2005.

By area treated, the most widely-used herbicide active substances were glyphosate, paraquat, cyanazine, chlorpropham, diuron, linuron and diquat. By weight applied, however, glyphosate was the most important, followed by cyanazine, chlorpropham, linuron, diuron, pendimethalin and paraquat.

The only insecticides to appear in the top 25 by area treated were dimethoate, lambda-cyhalothrin and cypermethrin. Whilst the use of dimethoate decreased by 72% in terms of area treated, the use of lambda-cyhalothrin increased by almost four times and that of cypermethrin almost doubled. Dimethoate and chlorpyrifos were the only two insecticides to appear in the top 25 by weight applied. However, the use of chlorpyrifos decreased by 81% in terms of area treated and by 93% in terms of weight applied since the previous survey. The use of thiacloprid, spinosad and teflubenzuron was recorded for the first time in 2005.

Table 7 *Estimated area (ha) of application the fifty most extensively-used active substances on all outdoor bulb and flower crops surveyed in Great Britain in 2001 and 2005 (excluding seed & hot-water treatments)*

	Active substance	Area treated in 2005 (ha)	Area treated in 2001 (ha)	% change on 2001	Movement
1	Carbendazim	6,781	12,091	-44	↓
2	Chlorothalonil	6,093	5,660	8	↑
3	Azoxystrobin	4,748	4,963	-4	↓
4	Tebuconazole	4,651	3,502	33	↑
5	Glyphosate	4,509	5,313	-15	↓
6	Mancozeb	4,185	9,508	-56	↓
7	Paraquat	2,162	3,026	-29	↓
8	Cyanazine	2,114	2,275	-7	↓
9	Chlorpropham	1,917	1,790	7	↑
10	Vinclozolin	1,827	10,084	-82	↓
11	Prochloraz	1,688	1,692	0	↓
12	Diuron	1,337	536	149	↑
13	Linuron	1,309	2,862	-54	↓
14	Dimethoate	1,234	4,421	-72	↓
15	Diquat	1,211	2,190	-45	↓
16	Lambda-cyhalothrin	1,118	311	260	↑
17	Iprodione	865	647	34	↑
18	Pendimethalin	690	552	25	↑
19	Simazine	600	345	74	↑
20	Cypermethrin	597	393	52	↑
21	Sulphuric acid	537	328	63	↑
22	Kresoxim-methyl	411	107	284	↑
23	Epoxiconazole	408	107	281	↑
24	Lenacil	388	1,072	-64	↓
25	Propiconazole	365	84	337	↑
26	Deltamethrin	307	125	146	↑
27	Metamitron	306	1,911	-84	↓
28	Thiacloprid	293	.		↑
29	Pirimicarb	233	384	-39	↓
30	Maneb	221	398	-44	↓
31	Chlorpyrifos	206	1,073	-81	↓
32	Oxycarboxin	183	472	-61	↓
33	Bentazone	161	1,950	-92	↓
34	Metoxuron	131	14	858	↑
35	Spinosad	121	.		↑
36	Teflubenzuron	121	.		↑
37	Pymetrozine	115	82	39	↑
38	Metazachlor	99	59	68	↑
39	Boscalid	93	.		↑
40	Malathion	89	9	911	↑
41	Myclobutanil	84	.		↑
42	Dazomet	61	13	374	↑
43	Fluazinam	50	20	147	↑
44	Fenpropimorph	46	69	-33	↓
45	Chlormequat	42	.		↑
46	Imazaquin	42	.		↑
47	Pyrimethanil	40	.		↑
48	Cyproconazole	39	138	-72	↓
49	Pentanochlor	38	4	889	↑
50	Oxadiazon	32	28	12	↑

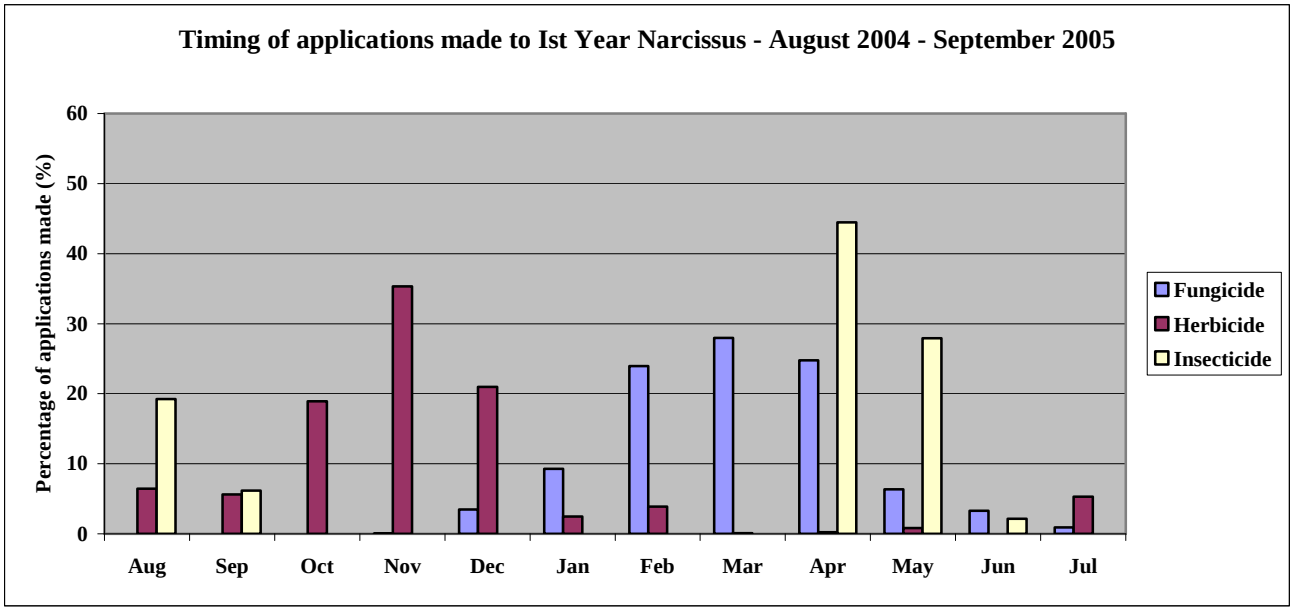
Table 8 *Estimated amount (kg) of the 50 active substances used most by weight on outdoor bulb & flower crops surveyed in 2001 and 2005 in Great Britain (excluding seed & hot-water treatments)*

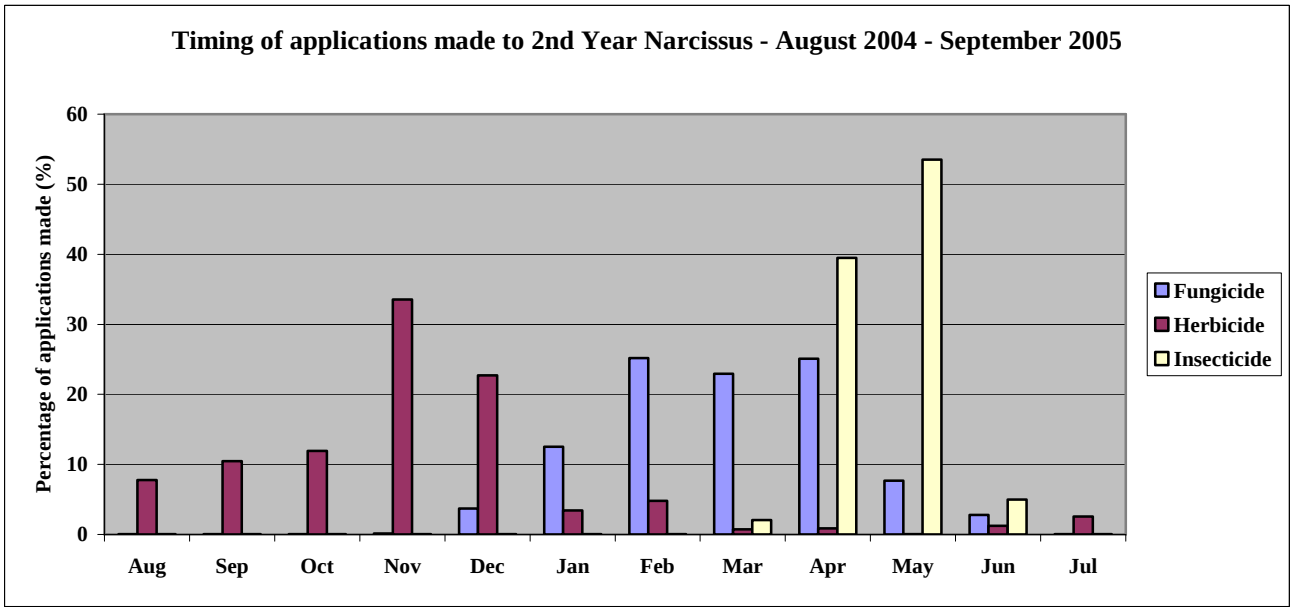
	Active substance	Amount used in 2005 (kg)	Amount used in 2001 (kg)	% change on 2001	Movement
1	Sulphuric acid	79,212	59,148	34	↑
2	Dazomet	28,868	5,996	381	↑
3	Glyphosate	6,231	6,610	-6	↓
4	Chlorothalonil	5,976	6,305	-5	↓
5	Mancozeb	5,352	12,988	-59	↓
6	Cyanazine	4,570	5,557	-18	↓
7	Chlorpropham	2,938	3,408	-14	↓
8	Carbendazim	2,269	4,156	-45	↓
9	Linuron	1,084	2,541	-57	↓
10	Diuron	923	390	137	↑
11	Pendimethalin	908	905	0	↑
12	Paraquat	801	1,235	-35	↓
13	Azoxystrobin	756	752	1	↑
14	Tebuconazole	740	489	51	↑
15	Vinclozolin	691	2,425	-71	↓
16	Prochloraz	680	611	11	↑
17	Dimethoate	494	1,799	-73	↓
18	Simazine	441	347	27	↑
19	Lenacil	436	932	-53	↓
20	Metamitron	365	1,394	-74	↓
21	Diquat	265	459	-42	↓
22	Maneb	253	434	-42	↓
23	Iprodione	178	215	-17	↓
24	Chlorpyrifos	145	2,022	-93	↓
25	Metoxuron	113	34	229	↑
26	Chlorthal-dimethyl	107	8	1,273	↑
27	Bentazone	85	877	-90	↓
28	Sulphur	79 .			↑
29	Pentanochlor	61	15	313	↑
30	Metazachlor	57	39	46	↑
31	Tar acids	51 .			↑
32	Propachlor	38	146	-74	↓
33	Thiacloprid	36 .			↑
34	Oxadiazon	34	54	-36	↓
35	Pirimicarb	33	45	-28	↓
36	Kresoxim-methyl	31	10	207	↑
37	Propiconazole	31	8	291	↑
38	Epoxiconazole	31	10	203	↑
39	Oxycarboxin	29	29	.	↓
40	Ziram	29 .			↑
41	Pyrimethanil	26 .			↑
42	Pymetrozine	17	1	1,592	↑
43	Boscalid	16 .			↑
44	Chlormequat	15 .			↑
45	Cypermethrin	15	10	51	↑
46	Zineb	12 .			↑
47	MCPA	11	81	-86	↓
48	Fluazinam	10	5	122	↑
49	Copper oxychloride	10 .			↑
50	Fenpropimorph	10	24	-60	↓

PESTICIDE USAGE ON OUTDOOR BULBS

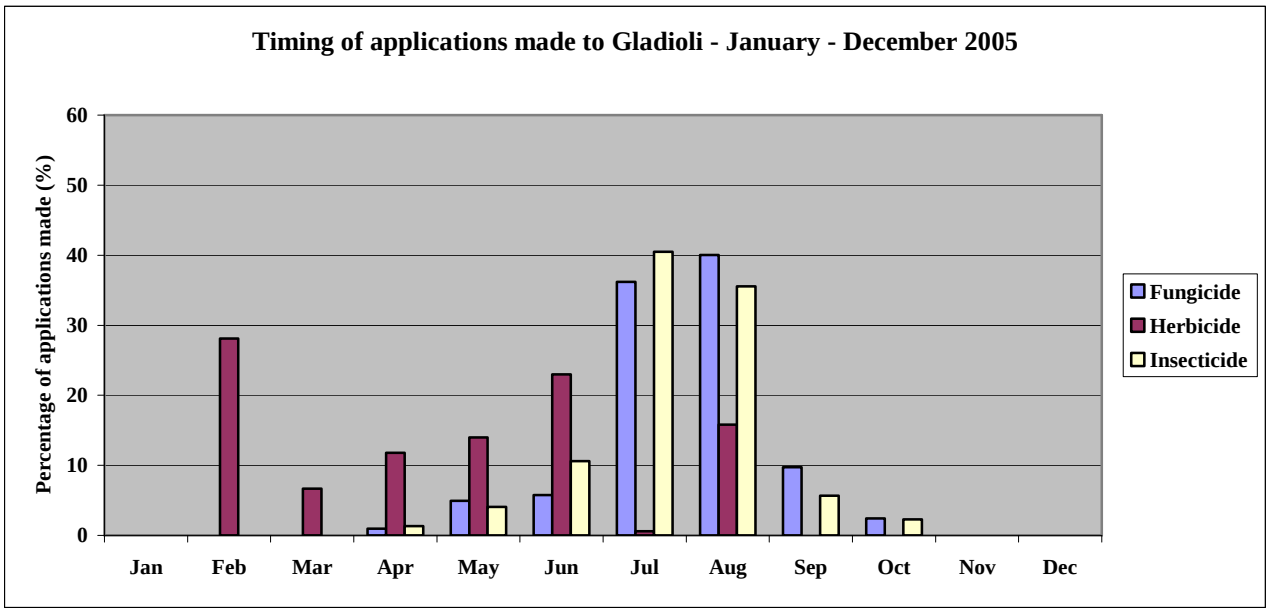
The area of bulbs treated with each formulation, and their reasons for use, are shown in Table 9. Bulb crops received on average 5 pesticide sprays, with 3 of these containing fungicides and 2 herbicides (Table 4a). Only 4% of the crop area received no pesticides at all (Table 3). Fungicides accounted for 56% of the total treated area of bulbs, herbicides 29%, applications directly to the bulb or via hot water treatment 7%, insecticides & nematicides 7%, desiccants one percent, with growth regulators, acaricides and molluscicides all less than one percent (Table 2). However, desiccants accounted for 63% of the weight applied (Table 6); the next most-used were herbicides (15%), fungicides (13%), bulb or hot water treatments (9%), insecticides one percent, with growth regulators, acaricides and molluscicides less than one percent each.

The charts below illustrate the timing of applications made to 1st and 2nd year narcissi. Insecticide use in August and September are applications made at the time of planting to protect 1st year narcissus bulbs from the large narcissus fly, *Merodon equestris.*





The chart below illustrates the timing of applications made to gladioli, with applications made to this one year crop, normally planted between March and May, contrasting sharply with those made to narcissi.



Bulbs – Fungicides

The most extensively-used, foliar-applied fungicide formulations were carbendazim, chlorothalonil, tebuconazole and azoxystrobin, with an average of two applications of each being applied to over half of the bulb area grown. Most applications were made at approximately two-thirds to three-quarters of the full label rate. Fungicide applications made to narcissi started in December, particularly in the South West, with most applications being made between February and April. Fungicide applications made to gladioli were most frequent in July and August with botrytis (*Botrytis cinerea*), being the main reason for use. General disease control was the most frequently cited reason for fungicide applications made to bulbs, with botrytis (*B. cinerea*) and smoulder (*Sclerotinia narcissicola*) being the most commonly encountered individual reasons.

	Formulation area treated (ha)	Weight of a.s. applied (kg)	Proportion of fungicide-treated area	Proportion of census area treated	Average number of applications (where applied)	Average proportion of full label rate
Carbendazim	6,096	2,166	0.21	0.63	1.96	0.77
Chlorothalonil	5,653	5,658	0.19	0.58	2.00	0.81
Tebuconazole	4,489	714	0.15	0.52	1.76	0.64
Azoxystrobin	4,462	686	0.15	0.54	1.68	0.61
Mancozeb	3,986	5,155	0.13	0.41	1.97	0.86

Bulbs – Herbicides

Glyphosate was the most extensively-used herbicide on bulbs, accounting for 29% of the herbicide-treated area, being used at three-quarters of the full recommended rate on three-quarters of the area grown. Where a herbicide active substance was used, it was normally applied as a single application. Most applications made to narcissi were made between October and December when the crop was dormant. By contrast, most herbicide use on gladioli took place in February in order to clear the ground before planting. Almost all herbicide use, where a reason was specified, was for general weed control (80%), with broad-leaved weed control accounting for 15%, grass weed control 4% and desiccation comprising less than one percent.

	Formulation area treated (ha)	Weight of a.s. applied (kg)	Proportion of herbicide-treated area	Proportion of census area treated	Average number of applications (where applied)	Average proportion of full label rate
Glyphosate	4,441	6,150	0.29	0.73	1.24	0.77
Cyanazine	2,058	4,452	0.13	0.40	1.05	0.83
Chlorpropham	1,913	2,918	0.12	0.39	1.01	0.35
Diuron	1,337	923	0.09	0.27	1.00	0.22
Linuron	1,309	1,084	0.09	0.24	1.10	0.83

Bulbs – Insecticides

Dimethoate was applied to 36% of the area treated with a foliar-applied insecticide and lambda-cyhalothrin to a further 30%. In contrast to lambda-cyhalothrin, where a single application was made, growers using dimethoate made an average of four applications, thiacloprid three applications and cypermethrin four applications. The average rate of lambda-cyhalothrin applied was 9% higher than the full label rate, this is due to HDC narcissus trials being encountered in the survey, where an experimental higher rate was being used to control large narcissus fly (*M. equestris*). The main individual reason given by the growers for insecticide use was large narcissus fly, which accounted for 52% of the insecticide-treated area where a reason was specified. Other targeted pests included aphids, caterpillars and thrips; in particular, most insecticide usage on gladioli was for the control of aphids and thrips. Large narcissus fly, *M. equestris*, is responsible for the primary damage to the bulb. Small narcissus flies, *Eumerus* spp., merely exacerbate damage already caused by basal rot or large narcissus fly. Though growers rarely specified the species it is actually large narcissus fly that is responsible for growers using control measures.

	Formulation area treated (ha)	Weight of a.s. applied (kg)	Proportion of insecticide-treated area	Proportion of census area treated	Average number of applications (where applied)	Average proportion of full label rate
Dimethoate	1,234	494	0.36	0.07	3.51	0.60
Lambda-cyhalothrin	1,025	6	0.30	0.16	1.33	1.09
Thiacloprid	293	36	0.09	0.02	3.42	1.03
Cypermethrin	254	6	0.07	0.01	4.09	0.78
Chlorpyrifos	188	137	0.06	0.03	1.27	1.01

Bulbs – Treatments made to the bulb (including hot water treatments)

Hot water treatments were used extensively to kill stem nematode (*Ditylenchus dipsaci*) in lifted bulbs, and give good control of bulb mite (*Rhyzoglyphus robini*), bulb scale mite (*Steneotarsonemus laticeps*) and, with the further addition of fungicides, the disease smoulder (*Sclerotinia narcissicola*). The most extensively-used treatment added to hot water was formaldehyde, added specifically to speed up the kill of stem nematode and reduce cross-infection with diseases such as basal rot (*Fusarium oxysporum* f. sp. *narcissi*) during hot water treatment. The next most extensively-used active substances by area treated that were added to hot water treatments, were the fungicides thiabendazole, prochloraz, and carbendazim. The majority of these were applied with formaldehyde in the hot water treatment, or specifically to protect the bulbs from diseases such as basal rot during storage after lifting. Use of two insecticides was encountered in hot water treatments: chlorpyrifos and dimethoate. The latter has no approval for use in this manner.

The only desiccant encountered was sulphuric acid, which was used at a range of relatively high rates depending on the degree of natural leaf senescence that had occurred before chemical desiccation.

Chlormequat/imazaquin was the only growth regulator recorded, being used on only a minor area of the a 2nd year narcissus crop.

Molluscicide usage was limited to a single active substance, ferric phosphate, used on relatively small area of bulbs.

Table 9 *Outdoor bulbs: pesticides applied as field treatments and their reasons for application (treated hectares) and total amount applied (kg active substance)*

	Botrytis/ general disease	Smoulder	General disease	Aphids/ caterpillars	Large narcissus fly	General pests	Reasons unspecified	Total area treated	Total weight applied
Fungicides									
Azoxystrobin	897	10	1,301	.	.	.	2,254	4,462	686
Carbendazim	328	92	2,733	.	.	.	2,943	6,096	2,166
Carbendazim/prochloraz	.	.	25	.	.	.	658	682	376
Chlorothalonil	947	22	2,317	.	.	.	2,367	5,653	5,658
Chlorothalonil/mancozeb	.	48	85	.	.	.	.	133	285
Epoxiconazole/kresoxim-methyl	.	.	.	.	.	.	408	408	61
Iprodione	78	.	291	.	.	.	238	607	113
Mancozeb	246	.	1,183	.	.	.	2,557	3,986	5,155
Maneb	.	.	221	.	.	.	.	221	253
Myclobutanil	.	.	83	.	.	.	.	83	1
Prochloraz	.	.	58	.	.	.	750	808	328
Prochloraz/propiconazole	.	.	5	.	.	.	.	5	2
Tebuconazole	186	10	1,512	.	.	.	2,781	4,489	714
Vinclozolin	20	48	747	.	.	.	986	1,800	678
Other fungicides[1]	.	.	3	.	.	.	182	185	90
All fungicides	**2,702**	**228**	**10,564**	**.**	**.**	**.**	**16,125**	**29,620**	**16,565**

[1]Other fungicides includes azoxystrobin/fenpropimorph, chlorothalonil/cyproconazole, cymoxanil/famoxadone, cyproconazole, fluazinam, pyrimethanil & zineb

Table 9 (cont.) *Outdoor bulbs: pesticides applied as field treatments and their reasons for application (treated hectares) and total amount applied (kg active substance)*

	Botrytis/ general disease	Smoulder	General disease	Aphids/ caterpillars	Narcissus fly	General pests	Reasons unspecified	Total area treated	Total weight applied
Insecticides & nematicides									
Chlorpyrifos	.	.	.	.	161	1	26	188	137
Cypermethrin	.	.	.	122	.	58	74	254	6
Deltamethrin	.	.	.	.	.	109	74	183	1
Dimethoate	.	.	.	21	752	243	217	1,234	494
Lambda-cyhalothrin	.	.	.	.	55	.	970	1,025	6
Malathion	.	.	.	40	.	.	.	40	6
Pirimicarb	.	.	.	72	.	.	10	82	12
Pymetrozine	.	.	.	.	.	.	113	113	17
Thiacloprid	.	.	.	.	.	243	49	293	36
Other insecticides & nematicides[1]	.	.	.	.	.	.	.	.	.
All insecticides & nematicides	**.**	**.**	**.**	**256**	**968**	**655**	**1,533**	**3,412**	**714**
Molluscicides & repellents									
Other molluscicides & repellents[2]	.	.	.	.	.	1	.	1	.
All molluscicides & repellents	**.**	**.**	**.**	**.**	**.**	**1**	**.**	**1**	**.**

[1]Other insecticides & nematicides includes zeta-cypermethrin

[2]Other molluscicides and repellents includes ferric phosphate

Table 9 (cont.) *Outdoor bulbs: pesticides applied as field treatments and their reasons for application (treated hectares) and total amount applied (kg active substance)*

	Desiccation	Broad-leaved weed control	Grass weed control	General weed control	Reasons unspecified	Total area treated	Total weight applied
Desiccants							
Sulphuric acid	446	.	.	.	91	537	79,212
Herbicides							
Bentazone	.	25	.	.	137	161	85
Chlorpropham	.	115	.	690	1,108	1,913	2,918
Cyanazine	.	409	.	1,176	473	2,058	4,452
Diquat	.	.	.	37	36	74	46
Diquat/paraquat	.	31	.	295	761	1,087	525
Diuron	.	48	.	335	954	1,337	923
Glyphosate	24	329	302	1,860	1,926	4,441	6,150
Lenacil	.	.	.	.	388	388	436
Linuron	.	115	.	298	896	1,309	1,084
Metamitron	.	25	.	.	281	305	362
Metazachlor	.	.	.	.	60	60	28
Metoxuron	.	.	.	61	70	131	113
Paraquat	.	.	.	586	386	972	417
Pendimethalin	.	.	.	266	272	538	701
Simazine	.	.	.	315	272	586	425
Other herbicides[1]	.	10	4	2	14	29	15
All herbicides	**24**	**1,107**	**306**	**5,921**	**8,032**	**15,390**	**18,681**

[1]Other herbicides includes cycloxydim, isoxaben & MCPA

`PESTICIDE USAGE ON OTHER FLOWERS FOR CUTTING

The area of other flowers for cutting treated with each formulation, and their reasons for use, are shown in Table 10. These crops received on average four pesticide sprays, with two of these containing fungicides and one each containing a herbicide and an insecticide (Table 4a). Thirty percent of the crop remained untreated (Table 3). Fungicides accounted for 49% of the pesticide-treated area, insecticides & nematicides 27%, herbicides 16%, seed treatments 5%, soil sterilants 2%, molluscicides and repellents one percent with sulphur, tar oils/acids less than one percent each (Table 2). By weight of active substances applied, soil sterilants were the most important, accounting for 95%, as usage was at relatively high rates. Herbicides accounted for 3% of pesticide usage on outdoor flower crops, fungicides 2%, sulphur, insecticides & nematicides, tar oils/acids and molluscicides & repellents all less than one percent each (Table 6).

Flowers for cutting – Fungicides

The most extensively-used fungicide formulations were chlorothalonil, iprodione and azoxystrobin. Control of botrytis was the most commonly-cited specific reason for use of a fungicide (47% of the area treated with fungicides where a reason was specified), followed by *Sclerotinia* (13%, limited to sunflower) and rust (8%, across a wide range of plants, mainly chrysanthemums, pinks and gladioli). General disease control was also an important reason for the use of a fungicide, and accounted for 32% of the area treated with fungicides where a reason was specified.

	Formulation area treated (ha)	Weight of a.s. applied (kg)	Proportion of fungicide-treated area	Proportion of census area treated	Average number of applications (where applied)	Average proportion of full label rate
Chlorothalonil	271	141	0.16	0.10	3.18	0.41
Iprodione	258	65	0.15	0.10	3.07	0.33
Azoxystrobin	239	67	0.14	0.12	2.45	1.12
Prochloraz/propiconazole	192	94	0.11	0.08	2.74	1.00
Oxycarboxin	183	29	0.11	0.07	2.97	0.61

Flowers for cutting – Insecticides

Cypermethrin was the principal insecticide used, accounting for 36% of the insecticide-treated area, with an average of two applications being made to a fifth of the area grown. The use of deltamethrin, spinosad and teflubenzuron each accounted for 13% of the insecticide-treated area with two applications being made to 7% of the area grown. Where reasons for use were given, the main ones were for aphids/caterpillars (53%), thrips (26%), aphids (16%) and general pests (5%). Thrips were primarily a problem on chrysanthemum crops, with teflubenzuron and spinosad being the main active substances used.

	Formulation area treated (ha)	Weight of a.s. applied (kg)	Proportion of insecticide-treated area	Proportion of census area treated	Average number of applications (where applied)	Average proportion of full label rate
Cypermethrin	343	9	0.36	0.21	2.01	0.98
Deltamethrin	122	1	0.13	0.07	2.00	1.00
Spinosad	121	4	0.13	0.07	2.00	1.00
Teflubenzuron	121	3	0.13	0.07	2.00	1.00
Lambda-cyhalothrin/pirimicarb	93	15	0.10	0.11	1.00	1.00

Flowers for cutting – Herbicides

Pendimethalin, applied to 27% of the herbicide-treated area, and 16% of the area grown, was the most extensively-used herbicide formulation. General weed control accounted for 92% of the herbicide-treated area where a reason was specified, with broadleaved weed control comprising the remainder.

	Formulation area treated (ha)	Weight of a.s. applied (kg)	Proportion of herbicide-treated area	Proportion of census area treated	Average number of applications (where applied)	Average proportion of full label rate
Pendimethalin	152	207	0.27	0.16	1.17	0.68
Glyphosate	68	81	0.12	0.06	1.49	0.59
Cyanazine	56	118	0.10	0.07	1.00	0.81
Paraquat	53	56	0.09	0.03	2.35	0.96
Diquat/paraquat	50	22	0.09	0.06	1.00	0.40

Dazomet was the only soil sterilant used, being applied pre-planting to 61 hectares of flowers for cutting. It accounted for less than one percent of the area treated, but comprised 95% of the weight applied.

Molluscicide usage was limited to metaldehyde and methiocarb. Each was used on a relatively small area of the crop. Ziram, used on a limited area, was the only repellent recorded.

There was only minimal use of sulphur and tar oils/acids.

Table 10 *Other flowers for cutting: pesticides and their reasons for application (treated hectares) and total amount applied (kg active substance)*

	Botrytis	Sclerotinia	Rust	General disease	General weed control	Aphids	Aphids/ Caterpillars	Thrips	General pests	Soil sterilisation	Reasons unspecified	Total area treated	Total weight applied
Fungicides													
Azoxystrobin	.	.	33	14	.	.	.	.	.	.	192	239	67
Boscalid	.	93	.	.	.	.	.	.	.	.	.	93	16
Carbendazim	.	.	2	1	.	.	.	.	.	.	.	2	.
Chlorothalonil	202	.	3	50	.	.	.	.	.	.	16	271	141
Iprodione	202	.	1	45	.	.	.	.	.	.	10	258	65
Mancozeb	50	.	2	.	.	.	.	.	.	.	4	56	52
Myclobutanil	.	.	1	.	.	.	.	.	.	.	.	1	.
Oxycarboxin	.	.	.	1	.	.	.	.	.	.	182	183	29
Prochloraz/propiconazole	.	.	1	9	.	.	.	.	.	.	182	192	94
Propiconazole	.	29	31	108	.	.	.	.	.	.	.	168	13
Tebuconazole	.	.	.	39	.	.	.	.	.	.	124	163	27
Vinclozolin	.	.	.	27	.	.	.	.	.	.	.	27	13
Other fungicides[1]	.	.	3	17	.	.	.	.	.	.	22	42	26
All fungicides	454	123	76	309	**.**	**.**	**.**	**.**	**.**	**.**	**732**	**1,694**	**544**
Insecticides & nematicides													
Chlorpyrifos	.	.	.	.	.	10	.	.	9	.	.	19	8
Cypermethrin	.	.	.	.	.	21	287	.	35	.	.	343	9
Deltamethrin	.	.	.	.	.	.	121	.	.	.	.	122	1
Lambda-cyhalothrin/pirimicarb	.	.	.	.	.	.	93	.	.	.	.	93	15
Malathion	.	.	.	.	.	48	.	.	.	.	.	48	4
Pirimicarb	.	.	.	.	.	51	.	.	3	.	2	56	6
Pymetrozine	.	.	.	.	.	1	.	.	.	.	.	1	.
Spinosad	.	.	.	.	.	.	.	121	.	.	.	121	4
Teflubenzuron	.	.	.	.	.	.	.	121	.	.	.	121	3
Other insecticides & nematicides[2]	.	.	.	.	.	20	.	6	2	.	.	27	9
All insecticides & nematicides	**.**	**.**	**.**	**.**	**.**	151	502	249	49	**.**	**2**	**953**	**59**

[1]Other fungicides includes bupirimate, copper oxychloride, cymoxanil/mancozeb, difenoconazole, dithianon, fluazinam, kresoxim-methyl, & mancozeb/metalaxyl

[2]Other insecticides & nematicides includes bifenthrin, deltamethrin/pirimicarb, imidacloprid, nicotine, rotenone & unspecified insecticides

Table 10 (cont.) *Other flowers for cutting: pesticides and their reasons for application (treated hectares) and total amount applied (kg active substance)*

	Botrytis	Mildew	Rust	General disease	Broad-leaf weed control	General weed control	Aphids/ caterpillars	General pests	Slugs	Soil sterilisation	Reasons unspecified	Total area treated	Total weight applied
Herbicides													
Cyanazine	.	.	.	.	.	50	.	.	.	.	6	56	118
Diquat/paraquat	.	.	.	.	.	50	.	.	.	.	.	50	22
Glyphosate	.	.	.	.	20	46	.	.	.	.	3	68	81
Metamitron	.	.	.	.	.	.	.	.	.	.	1	1	2
Metazachlor	.	.	.	.	9	31	.	.	.	.	.	40	29
Paraquat	.	.	.	.	.	44	.	.	.	.	9	53	56
Pendimethalin	.	.	.	.	.	151	.	.	.	.	1	152	207
Simazine	.	.	.	.	.	11	.	.	.	.	3	14	16
Other herbicides[1]	.	.	.	.	12	119	.	.	.	.	1	132	269
All herbicides	**.**	**.**	**.**	**.**	**41**	**502**	**.**	**.**	**.**	**.**	**23**	**566**	**799**
Soil sterilants													
Dazomet	.	.	.	.	.	.	.	.	.	.	61	61	28,868
Molluscicides & repellents													
Other molluscicides[2]	.	.	.	.	.	.	.	22	2	.	.	24	30
Sulphur													
Sulphur	.	.	.	.	.	.	.	.	.	.	10	10	79
Tar oils/acids													
Tar acids	.	.	.	2	.	.	.	.	.	.	.	2	51

[1]Other herbicides include chlorpropham/fenuron, chlorthal-dimethyl, clopyralid, clopyralid/fluroxypyr/triclopyr, cycloxydim, isoxaben, oxadiazon, pentanochlor, propachlor, propyzamide & trifluralin

[2]Other molluscicides/repellents were metaldehyde, methiocarb & ziram

COMPARISON WITH PREVIOUS SURVEYS IN 1993, 1997 AND 2001

Bulb crops and other flowers for cutting

Table 11 shows the areas treated with each chemical group and the amounts applied, for this survey and the previous surveys in 2001, 1997 and 1993. Data for all outdoor bulb and flower crops grown in the four survey years are compared. Table 12 shows the area treated with each chemical group expressed as a percentage of the total area grown, and the average rate applied. This table allows trends to be more easily seen, as changes in the total area grown are taken into account.

There was very little change in the total area of outdoor bulbs and other flowers for cutting grown in Great Britain between the four surveys, with the area grown in 2005 being less than one percent lower than in 2001, 5% greater than in 1997 and one percent lower than in 1993. When outdoor bulb crops alone are considered, the area grown has decreased by 6% since 2001, but has increased by 3% since both 1993 and 1997. The area of other flowers for cutting has fallen by 20% in comparison with 1993 but increased by 11% in comparison with 1997 and by 53% in comparison with the previous survey in 2001.

The area treated in 2005 was 35% less than in 2001 and 7% less than in 1997, but was 32% more than in 1993. By contrast, the weight applied in 2005 has decreased by 8% and 12% respectively compared with 2001 and 1997, and by 37% compared with 1993. The apparent inconsistency between the 32% increase in the area treated and the 37% reduction in the weight applied between 1993 and 2005 is due primarily to the reduction in the area treated with the desiccant sulphuric acid.

Since the previous survey the use of fungicides has decreased by 39% in terms of area treated, with a corresponding decrease in the weight applied. By contrast, the area treated with fungicides has increased by 46% since 1993, whilst the weight applied has decreased by 27%. This latter is due to the decreasing rates of fungicide application (Table 12), with rates of application falling from 1.25 kg of active substance per hectare in 1993 to 0.62 kg/ha in 2005, primarily driven by the introduction of newer molecules active at lower doses. The discrepancy is also due to an increase in the number of fungicide sprays applied in 2005 compared with 1993, with four applications in 1993, seven in 1997, nine in 2001 and six in 2005 (Table 12).

Since 2001, the area treated with insecticides has decreased by 37%, with the weight applied falling by 57%, in line with an increased use of pyrethroids applied at a much lower rate of application than the organophosphates they are replacing. The average rate of insecticide application fell from 0.63 kg/ha in 2001 to 0.43 kg/ha in 2005. Between 1993 and 2005 the area treated with insecticides decreased by 16%, but had increased by 23% since 1997. Average rates of application were similar in 1993, 1997 and 2005.

The pyrethroids were the principal insecticide group used in 2005, their use more than doubling compared with 2001, if the area treated is taken into account. Pyrethroids were used on a slightly larger area than organophosphates in 2005, the first time this has occurred in any survey of bulb and flower crops. The use of organophosphates has decreased. This was the principal insecticide group in each of the previous surveys but the area treated in 2005 dropped to well under a third of that treated in 2001. It appears that pyrethroids may be replacing organophosphates as the main treatment for the control of large narcissus flies, though this is not confirmed by Table 9, in which no reason was specified for much of the use of pyrethroids.

The use of carbamates in 2005 was 65% lower than in 2001, 30% less than in 1997 and 78% less than in 1993. Organochlorines, used to a limited extent in 1993, 1997 and 2001, were not recorded in 2005.

Usage of desiccants had increased, in terms of area treated, by 64% since 2001 and by 34% in terms of weight applied. However, the area treated had decreased by 22% compared with 1997 and by 43% compared with 1993, with corresponding decreases in the weight applied. The percentage of the area of bulb crops treated with desiccants dropped from 16% in 1993, to 12% in 1997, to 6% in 2001, with an increase to 9% in 2005. All desiccant use is accounted for by sulphuric acid, which is applied at relatively high rates. The rate of application has varied over each of the four surveys although applications in reduced from 183 kg/ha in 1993 to 148 kg/ha in 2005.

Since 2001, the herbicide-treated area had fallen by 30% with the weight applied decreasing by 23%. However, between 1993 and 2005, the herbicide-treated area increased by 42%, and had increased by 4% in 2005 compared to 1997. In terms of weight applied, herbicides increased by 5% between 1993 and 2005 but decreased by 9% in 2005 compared with 1997. The disparity between the increases in area treated and amount applied is accounted for by a reduction in the rate of herbicide application, from 1.64 kg/ha in 1993 to 1.22 kg/ha in 2005.

The area grown, lifted and treated with the disinfectant formaldehyde, in hot water treatments, as a percentage of the area grown, has remained fairly constant over the last four survey years being 31% in 1993, 36% in 1997, 39% in 2001 and 28% in 2005. This reflects the continuing need, and lack of inexpensive alternatives, for this additive in post-lifting bulb dips and hot water treatment. The rate of application in 1993 was 6.95 kg/ha, falling to 6.59 kg/ha in 1997, 5.21 kg/ha in 2001 and 3.99 kg/ha in the current survey.

Usage of molluscicides and repellents has been minimal in all four surveys. However, the area treated with molluscicides and repellents in 2005 decreased by 89% since 2001, although the amount used decreased by only 75%. This is accounted for by an increased rate of application, from 0.54 kg/ha on average in 2001 to 1.2 kg/ha in 2005.

Although the area treated with soil sterilants had reduced by 22% since 1993, the total amount applied more than doubled over the same period, in line with an increase in the rate of application from 146 kg/ha in 1993 to 475 kg/ha in 2005. By contrast, the area treated in 2005 was 45% greater than in 2001, yet the weight applied decreased by 17% reflecting a reduction in the rate of application from 831 kg/ha in 2001 to 475 kg/ha in 2005. There was no recorded use of soil sterilants in 1997. In the three surveys in which soil sterilants were recorded, they were used to treat one percent of the area grown. No use of methyl bromide was encountered in 2005, though a small area was treated prior to planting bulbs or other flowers in 2001 (29 ha) and also in 1993 (65 ha), though in 1993 usage was restricted to use prior to growing chrysanthemums or other flowers for cutting.

Changes in the use of seed treatments is related mainly to the fluctuation in the areas of other flowers for cutting grown from seed in each survey year.

Pruning paints, applied to *Eucalyptus* grown as foliage plants, was only recorded in 1997.

There was only minimal usage of growth regulators, sulphur and tar oils/acids in any survey between 1993 and 2005.

Table 11 *Comparison of pesticide usage on outdoor bulb and other flowers for cutting, 1993-2005, area treated (ha) and amount used (kg)*

Chemical	**1993**		**1997**		**2001**		**2005**	
	ha	**kg**	**ha**	**kg**	**ha**	**kg**	**ha**	**kg**
Acaricides	.	.	12	0	27	0	10	2
Insecticides[1]								
Benzoylureas	78	2	.	.	.	.	121	3
Carbamates	619	688	197	44	397	97	138	18
Organochlorines	37	29	105	59	21	2	.	.
Organophosphates	3,548	1,690	2,865	1,641	5,907	4,438	1,783	1,844
Pyrethroids	1,066	17	525	8	828	13	1,930	23
Other insecticides	155	49	53	87	130	7	647	81
Total - all insecticides	5,505	2,475	3,746	1,839	7,283	4,557	4,619	1,969
Desiccants	948	173,366	685	111,030	328	59,148	537	79,212
Disinfectants[2]	1,794	12,466	1,985	13,068	2,254	11,752	1,625	6,483
Fungicides[3]	22,378	27,864	38,033	29,616	53,713	34,009	32,711	20,254
Sulphur	45	224	.	.	.	.	10	79
Growth regulators	.	.	3	1	.	.	42	15
Herbicides	11,254	18,495	15,356	21,347	22,673	25,390	15,956	19,480
Molluscicides & repellents	334	217	139	289	220	119	25	30
Soil sterilants	78	11,435	.	.	42	34,894	61	28,868
Tar oil/acids	.	.	.	.	.	.	2	51
Pruning paints	.	.	42	0	.	.	.	.
Seed treatments	79	< 1	243	0	4	< 1	322	< 1
Total - all registered pesticides	42,414	246,541	60,244	177,191	86,544	169,869	55,920	156,444
Area grown	**5,792**		**5,492**		**5,777**		**5,740**	

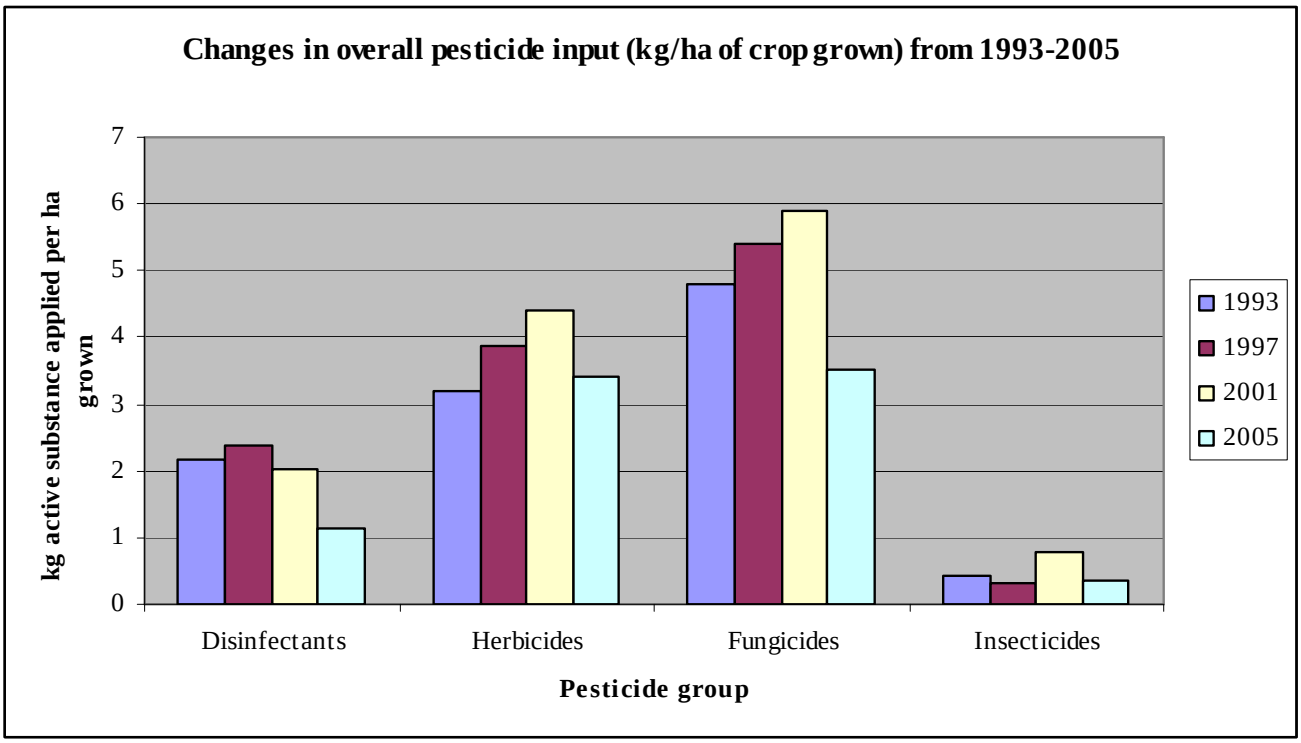
[1]includes insecticides applied directly to seed or bulbs or via hot water treatments
[2]includes disinfectants applied via hot water treatments
[3]includes fungicides applied directly to seed or bulbs or via hot water treatments

Table 12 *Comparison of pesticide usage on outdoor bulb and other flowers for cutting, 1993 - 2005, treated area as a percentage of area grown and average rate applied (kg/ha)*

Chemical	1993		1997		2001		2005	
	Area treated as% of area	Rate (kg/ha)	Area treated as% of area	Rate (kg/ha)	Area treated as% of area	Rate (kg/ha)	Area treated as% of area	Rate (kg/ha)
Acaricides	.	.	.	.	< 1	0.01	< 1	0.16
Insecticides[1]								
Benzoylureas	1	0.02	.	.	.	.	2	0.03
Carbamates	11	1.11	4	0.23	7	0.24	2	0.13
Organochlorines	1	0.77	2	0.56	< 1	0.07	.	.
Organophosphates	61	0.48	52	0.57	102	0.75	31	1.03
Pyrethroids	18	0.02	10	0.02	14	0.02	34	0.01
Other insecticides	3	0.32	1	1.62	2	0.06	11	0.12
Total - all insecticides	95	0.45	68	0.49	126	0.63	80	0.43
Desiccants	16	182.93	12	162.05	6	180.15	9	147.57
Disinfectants[2]	31	6.95	36	6.59	39	5.21	28	3.99
Fungicides[3]	386	1.25	693	0.78	930	0.63	570	0.62
Sulphur	1	4.98	.	.	.	.	< 1	8.00
Growth regulators	.	.	< 1	0.41	.	.	1	0.37
Herbicides	194	1.64	280	1.39	392	1.12	278	1.22
Molluscicides & repellents	6	0.65	3	2.09	4	0.54	< 1	1.20
Soil sterilants	1	146.07	.	.	1	830.78	1	475.30
Tar oil/acids	.	.	.	.	.	.	< 1	20.79
Pruning paints	.	.	1	0.01	.	.	.	.
Seed treatments	1	< 0.01	4	< 0.01	.	.	6	< 0.01
Total - all registered pesticides	732	5.81	1,097	2.94	1,498	1.96	974	2.80
Area grown	**5,792**		**5,492**		**5,777**		**5,740**	

[1]includes insecticides applied directly to seed or bulbs or via hot water treatments
[2]includes disinfectants applied via hot water treatments
[3]includes fungicides applied directly to seed or bulbs or via hot water treatments

The chart below illustrates the change in major pesticide use as the amount of active substance (in kg) applied to produce one hectare of crop. Across the four surveys since 1993, for all major pesticide groups except disinfectants, usage was at a maximum in 2001. In the current survey, usage of all these pesticide groups declined compared to 2001, and for all groups except herbicides, was at its lowest in any survey.



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