

PESTICIDE USAGE SURVEY REPORT 211

HARDY NURSERY STOCK IN GREAT BRITAIN 2005



D. G. Garthwaite & M. R. Thomas

Pesticide Usage Survey Group

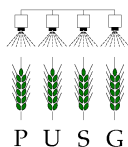
Central Science Laboratory

Sand Hutton

York UK

YO41 1LZ

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



CONTENTS	Page
Definitions	iv
Quality Control of Data	iv
Summary	1
Introduction	2
Methods	3
Results and Discussion	6
Crops	6
Overall Usage of Pesticides	7
Extent and Quantities of Pesticide Formulations Used	12
Extent and Quantities of Active Substances Used	23
Pesticide Usage on Fruit Stock	26
Pesticide Usage on Roses	28
Pesticide Usage on Ornamental Trees	30
Pesticide Usage on Shrubs etc.	32
Pesticide Usage on Herbaceous Plants	34
Pesticide Usage on Mixed Areas	36
Pesticide Usage on Christmas trees	39
Comparison with Previous Surveys	41
Acknowledgements	46
References	46
Appendix	47

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 of insecticides, acaricides, molluscicides, fungicides, herbicides, desiccants, soil sterilants, nematocides, growth regulators, sulphur, urea or tar oils/acids, registered under the Control of Pesticides Regulations (as amended) 1986, or under further regulations implementing the EC Council Directive 91/414/EEC.

b) 'Treated area' is the gross area treated with a pesticide, including all repeated applications, some of which may have been applied to the land in preparation for drilling and thus may appear as an inappropriate use on that crop.

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

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

e) Mixed areas include all container-grown plants as recorded on the June 2005 Agricultural Census, but may also include small areas of field grown crops from all other categories. With the exception of mixed areas, all other crops were grown in field situations.

f) Common and Latin names for pests, weeds and diseases are usually taken as those used by Scopes & Stables (1989).

g) Pesticides classed as insecticides may have some acaricidal activity, but are mainly used against insect pests. Similarly, pesticides classed as acaricides may be active against some insect pests, but are principally used against mites.

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) Other chemicals includes surface cleaners, disinfectants, growth stimulants and other chemicals, not registered as pesticides, but which were seen as important in the production of hardy nursery stock, and in some cases, were employed as physical control agents, defoliantes or to control mosses and liverworts.

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 Sand Hutton, 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 contains information concerning all aspects of pesticide usage on hardy nursery stock covering a full 12-month period from the beginning of autumn 2004 through to the end of summer 2005 growing season. The actual span of 12 months varied from holding to holding according to convenience for the grower and recording system. Information concerning seven types of hardy nursery stock crops and data on pesticide usage were collected from 727 examples grown on 306 holdings throughout Great Britain. The sample accounted for 35% of the total area of hardy nursery stock grown in Great Britain during the 2004/05 season. A comparison is also made with previous surveys of hardy nursery stock conducted in 1981, 1993, 1997 and 2001.

The area of hardy nursery stock grown had decreased by one percent since 2001 and by 6% since 1993. Mixed areas (see Definitions, page iv) accounted for 22% of the total area of crops grown in the survey. All other stock were field grown and comprised ornamental trees on a further 32% of the total area of crops grown in the survey, Christmas trees 23%, shrubs etc. 9%, fruit stock 6%, roses 5% and herbaceous perennials 3%. Approximately 70% of the area of hardy nursery stock was grown in four regions, London & the South East, Eastern, West Midlands and the South West, with less than 10% being grown in each of the remaining six areas.

Approximately 82% of all crops received some form of treatment, although the proportion left untreated varied from crop group to crop group. Almost all roses received some form of treatment, as did 98% of fruit stock and 92% of mixed areas. In contrast, over 44% of Christmas trees, 28% of herbaceous plants and 16% of shrubs etc. remained untreated. On average, herbicides were used on 58% of all crops, insecticides on 42%, fungicides on 21%, sulphur on 9% and acaricides on 6%. Overall, an average of fourteen sprays, nineteen products and twenty-one active substances were applied to hardy nursery stock crops.

Herbicides accounted for 44% of the total pesticide-treated area of hardy nursery stock crops grown in Great Britain in 2005, fungicides 27%, insecticides 20%, sulphur 4%, "other pesticides" 3%, acaricides 2%, growth regulators one percent and molluscicides & repellents less than one percent. In terms of weight of active substances applied, "other pesticides", principally dazomet, accounted for 46% of the total, herbicides 23%, fungicides 20%, sulphur 5%, insecticides 5% and growth regulators, acaricides and molluscicides & repellents less than one percent each.

Glyphosate was the most frequently used herbicide active substance; being used on 17% of the herbicide-treated area, with phenmedipham on 12%, simazine on 7%, metazachlor on 7%, isoxaben on 6% and oxadiazon on 5%.

The most extensively-used fungicide formulations were myclobutanil, used on 17% of the fungicide-treated area, chlorothalonil on 10%, bupirimate on 7%, azoxystrobin on 7% and fenpropimorph on 5%. By weight applied, fosetyl-aluminium, used primarily as a drench, was the principal fungicide formulation, accounting for 53% of the total weight of fungicides applied.

Pyrethroids were the most extensively-used insecticides, accounting for 35% of the insecticide-treated area, followed by organophosphates 25% and carbamates 24%. However, the organophosphate chlorpyrifos, used in granular formulations incorporated for the control of vine weevil larvae (*Otiorhynchus sulcatus*) in containers, accounted for 58% of the total weight of insecticides applied.

Clofentezine accounted for 41% of the acaricide-treated area, tebufenpyrad for 28%, abamectin for 14% and fenpropathrin for 12%.

"Other registered pesticides" were used on 3% of the treated area but comprised 46% of the total weight of pesticides applied. By weight applied, the most important active substance was dazomet, accounting for 54% of the weight of all "other registered pesticides", with 29.9 tonnes applied to 74 ha of land used in the production of ornamental trees, shrubs etc. and herbaceous plants. Dazomet is a soil fumigant and is therefore used at a high rate.

The area treated with registered pesticides has increased by 18% since 2001 and by 10% since 1993. However, in terms of the weight of pesticides applied, there had been an increase of 51% since the last survey and a one percent decrease since 1993. The overall rate of application of all pesticides has fallen from 1.9 kg/hectare in 1993 to 1.72 kg/hectare in 2005.

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 and 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 hardy nursery stock in 2004/05 by visiting holdings throughout Great Britain during the winter of 2005/06.

This was the seventh survey of pesticide usage solely on hardy nursery stock carried out by the Pesticide Usage Survey teams. Previous surveys have been reported for 2001, 1997 and 1993 in Great Britain (Garthwaite & Thomas, 2003: 1999; 1995) and 1981 in England & Wales (Sly & Umpelby, 1983) and Scotland (McNeil, 1985) and for 1971 & 1976 (Greaves *et al.*, 1979), which included comparable data for 1976 in Scotland.

All surveys of pesticide usage in agriculture and horticulture are now fully co-ordinated by the two survey teams and present reports of pesticide usage throughout Great Britain. Information on all aspects of pesticide usage in Great Britain plus the DEFRA regions of England & Wales can be obtained from the Pesticide Usage Survey team at the Central Science Laboratory, Sand Hutton. Further data related specifically to Scotland can be obtained from the Pesticide Usage Survey Team at the Scottish Agricultural Science Agency, Edinburgh.

A list of the most recently published reports is included in the Appendix.

Copies of the most recent cycle of pesticide usage surveys can be downloaded in PDF format from the survey team's web site at [http:// www.csl.gov.uk/pus](http://www.csl.gov.uk/pus)

METHODS

The samples of holdings to be surveyed were selected using data from the Agricultural Census Returns for England & Wales, June 2004 (Anon., 2005a) and for Scotland, June 2004 (Anon., 2005b) based on the distribution of hardy nursery stock in Great Britain.

The samples were drawn so as to represent the area of hardy nursery stock grown throughout England, Scotland and Wales. For England & Wales, the sample was selected within each of the six former DEFRA regions (Fig. 1) and in Scotland the country was divided into 11 land use regions (Wood, 1931). The samples were stratified according to the total area of all hardy nursery stock grown in each region and by holding size group based on the total area of hardy nursery stock grown on each holding.

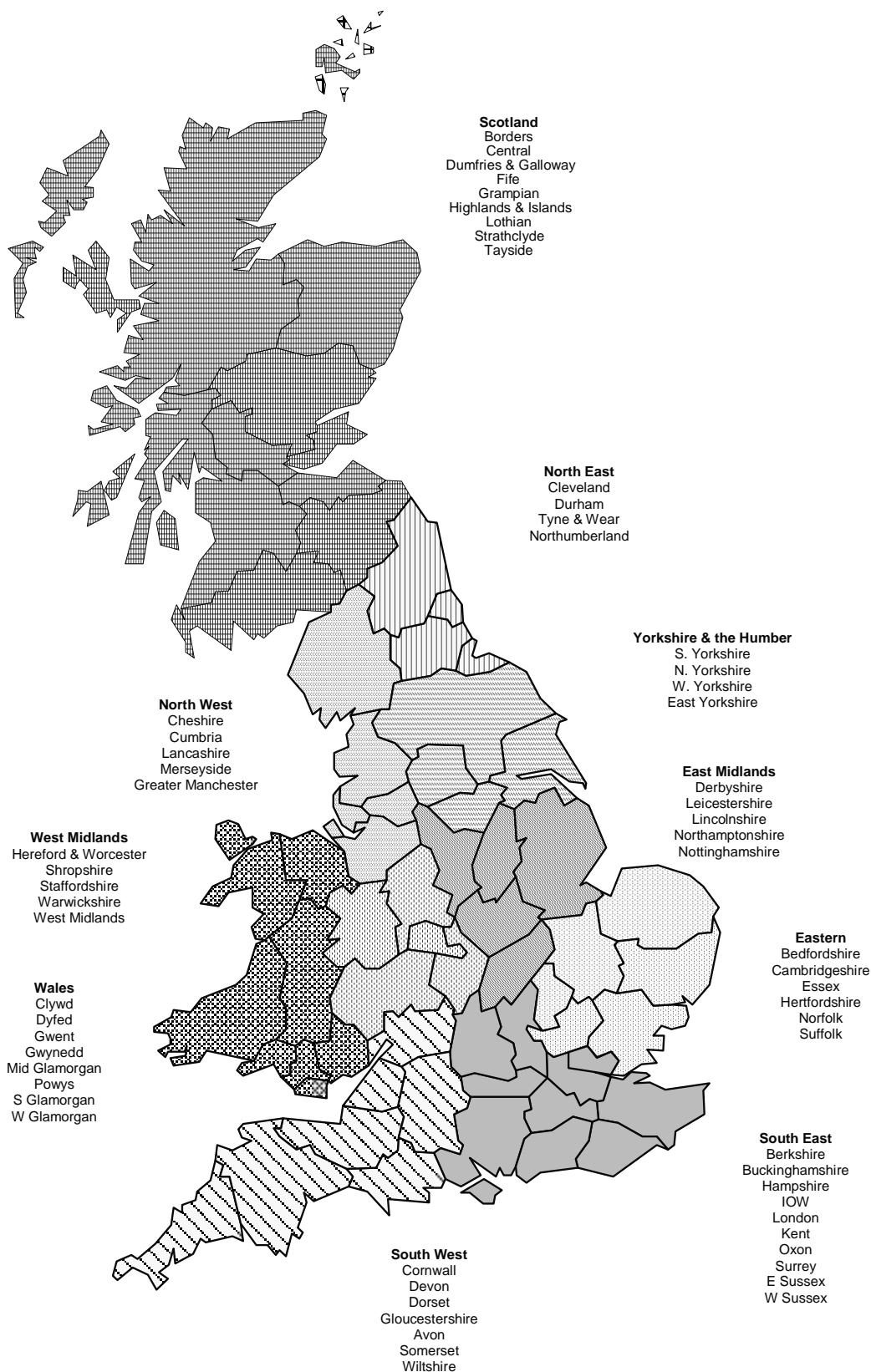
For the purposes of this survey, the total area of hardy nursery stock was taken as the sum of the areas of the following crops: fruit stock, roses, ornamental trees, shrubs etc., herbaceous perennials, mixed areas and Christmas trees.

An introductory letter was sent to the occupiers of the selected holdings explaining the purpose of the survey. A total of 306 holdings were visited during the winter of 2005/2006 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 unable to provide data, it was replaced with another from the same size group and region, held on a reserve list.

This survey includes usage of pesticides on **outdoor** hardy nursery stock only. Treatments made under glass or polythene during the propagation or early stages of the crop are covered fully in surveys of protected ornamental crops, the most recent one being Pesticide Usage Survey Report 196, Protected Crops (Edible and Ornamental) 2003.

Propagation of hardy nursery stock conducted in field situations is included in this survey. Usage at garden centres or other retail outlets not recognised as agricultural/horticultural holdings was excluded from this survey. However, retail outlets and wholesale operations submitting June Census returns are included.

Fig. 1 Counties in Defra regions of England & Wales and regions covered by SEERAD Scotland



Raising factors

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 holding size group and region and the second dependent on crop area and region. 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 (Thomas, 2001).

The raising factors were based on the areas of hardy nursery grown in 2005 as recorded in the June Agricultural Census Returns, both for England & Wales (Anon., 2006a) and Scotland (Anon., 2006b).

The Questionnaire

The questionnaire for the main part of the visit survey consisted of two forms, which were completed by an experienced pesticide usage surveyor during an interview with the grower.

Form 1 summarised the areas of hardy nursery stock grown on the designated holding during the 2005 season.

Form 2 recorded all aspects of pesticide usage on the individual crops grown on the holding in 2004/05, a separate form being used for each field. Chemicals applied prior to planting and those used to maintain non-cropped areas, such as pathways and gravel beds within the holding, were included. Certain agronomic details, which may have influenced pesticide usage (including the propagation method, the age of the crop, whether it was field or container-grown, use of adjuvants and the volume of water applied with pesticides), were also recorded on form 2.

RESULTS AND DISCUSSION

CROPS

Information concerning seven types of hardy nursery stock crops and data on pesticide usage were collected from 727 examples, (accounting for 977 fields or blocks of hardy nursery stock), grown on 306 holdings throughout Great Britain. The sample accounted for 35% of the total area of hardy nursery stock grown in Great Britain during the 2004/05 season. Stock plants as well as those grown for resale were included in this survey.

Fruit stock included stone and pome fruit, bush fruit, cane fruit and strawberries for runner production. Fifty eight percent of fruit stock, used as stock plants or for sale, was over one year old. Roses are normally grown on a two-year system with lifting occurring in the second year. This fact was borne out in this survey where approximately 41% of the crop was recorded as being less than one year old. The majority, 75%, of ornamental trees, which included both indigenous and non-indigenous species, was over one year old. Shrubs etc. included a wide variety of plant types and hundreds of species including conifers, hedging plants and ornamental shrubs, most of which, 58%, were over one year old. Herbaceous plants included wallflowers, wild flowers, and hundreds of species of annual, biennial and perennial plants. Approximately 58% of herbaceous plants were less than one year old and were mainly propagated from seed or plug plants/small liners. The crop group "mixed areas" (see: Definitions, p iv) included container-grown crops from hundreds if not thousands of species, and small areas of field grown crops from all other categories. Almost two thirds, 64%, of the mixed areas recorded were less than one year old. Christmas trees, in line with other ornamental trees, were mainly over a year old, with only 13% of the area grown being less than this. With the exception of mixed areas, all other crops were grown in field situations.

Ornamental trees accounted for 32% of the total area of crops recorded in the survey, Christmas trees for a further 23%, mixed areas 22%, shrubs etc. 9%, fruit stock 6%, roses 5% and herbaceous perennials 3%. Approximately 70% of the area of hardy nursery stock was grown in four regions, London & the South East, Eastern, West Midlands and the South West, with less than 10% being grown in each of the remaining six areas.

The distribution of most of the crops was varied between regions around the country. Ornamental trees, which accounted for the largest individual area of hardy nursery stock, were grown mainly in London & the South East (36%). The distribution of Christmas trees, the second largest group of hardy nursery stock, was similar with 36% again being grown in London & the South East. Twenty-six percent of mixed areas were grown in Eastern region, 21% in London & the South East, 12% in the North West and 10% in the West Midlands region. Forty-four percent of shrubs were grown in the West Midlands region, 14% in London & the South East and 10% in Eastern region. Sixty-three percent of fruit stock and 67% of roses were grown in Eastern region, with a further 16% of fruit stock being grown in London & the South East and 11% in Scotland. Field-grown herbaceous perennials were grown mainly in the Eastern region (39%) and the East Midlands (20%).

Table 1 Area of hardy nursery stock grown in Great Britain 2005 and in previous years surveyed in 2001, 1997 and 1993 (hectares)

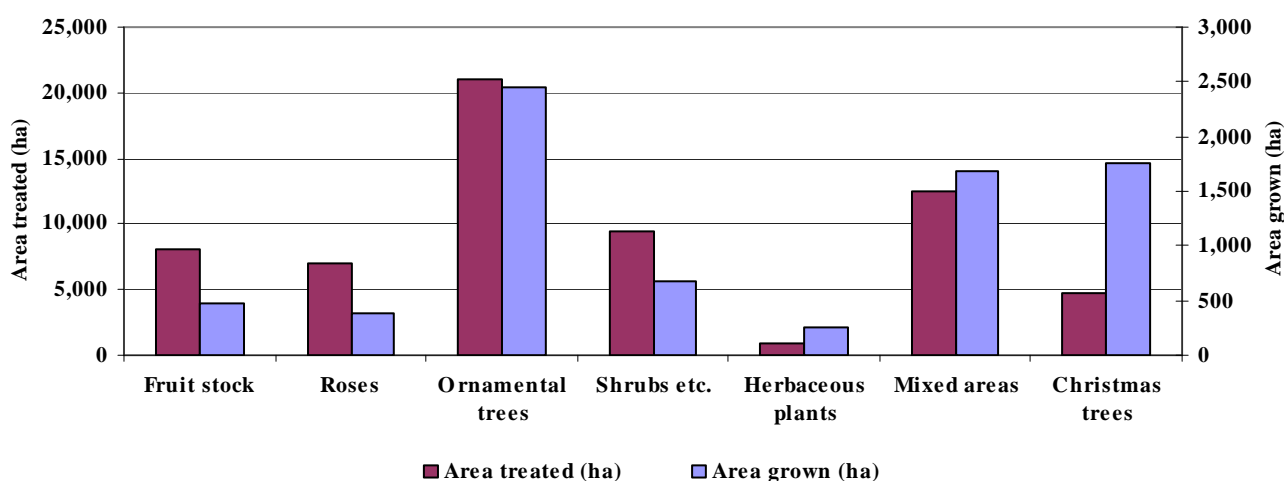
Crop group	2005	2001	1997	1993
Fruit stock	472	512	776	799
Roses	391	592	860	862
Ornamental trees	2,460	1,839	1,527	1,842
Shrubs etc.	680	359	1,203	1,474
Herbaceous plants	254	364	351	304
Mixed areas	1,682	1,556	2,010	2,125
Christmas trees	1,758	2,584	1,978	766
All hardy nursery stock	7,697	7,806	8,705	8,172

OVERALL USAGE OF PESTICIDES

Pesticide usage on crops

The extent of pesticide usage varied with each crop group (Table 2 and Figure 2). Ornamental trees accounted for 33% of the pesticide-treated area, mixed areas 20%, shrubs etc. 15%, fruit stock 13%, roses 11%, Christmas trees 7% and herbaceous plants one percent. This reflects both the area of each crop grown and the frequency of applications made to each individual crop group.

Fig. 2 Treated area of hardy nursery grown in Great Britain 2005



n.b. Area treated will be greater than area grown where multiple applications have been applied to a crop in one season

The regional usage of pesticides related not only to the total area of crops grown in each region, but also to the crop groups grown within each region. For example West Midlands region comprised 14% of the hardy nursery stock area but, because of the relatively large areas of shrubs etc. grown, accounted for 29% of the pesticide-treated area. Similarly Eastern and London & the South East regions accounted for a further 27% and 18% of the pesticide-treated area respectively.

The importance of each pesticide group varied from crop to crop. Applications made to ornamental trees accounted for 41% of herbicides, with a further 18% being used on Shrubs etc., 16% on mixed areas and 12% on Christmas trees. Fungicides, the second most important pesticide group, were used mainly on ornamental trees, 29%, mixed areas, 23%, fruit stock, 19% and roses 16%. Insecticides were used mainly on ornamental trees 27%, roses, 20%, mixed areas, 20%, and shrubs etc. 18%. The majority of acaricide usage, 39%, was on fruit stock, in particular strawberry runners, with a further 34% being used on Christmas trees. Growth regulator use was minimal and predominantly used on Christmas trees and mixed areas.

In terms of the total weight of active substances applied, the area treated with "other pesticides" influenced the amount used on any individual crop group. "Other pesticides" includes soil sterilants and tar oils/acids, which have high rates of application, and therefore have a significant effect on the total weight of pesticides applied. Ornamental trees accounted for 38% of the weight of pesticides applied to hardy nursery stock, with 60% of the total being "other pesticides", primarily dazomet and other soil sterilants used for pre-planting applications. Mixed areas accounted for 31% of the total weight of active substances applied, and shrubs etc. a further 16%, with most of this being due to the use of fungicides used as drenches to control diseases such as *Phytophthora* spp. and soil sterilants such as dazomet, chloropicrin and methyl bromide.

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 to each crop are shown in Tables 4a, b and c.

Approximately 82% of all crops received some form of treatment, although the proportion left untreated varied from crop group to crop group. Almost all roses received some form of treatment, as did 98% of fruit stock and 92% of mixed areas. In contrast, over 44% of Christmas trees, 28% of herbaceous plants and 16% of shrubs etc. remained untreated. On average, herbicides were used on 58% of all crops, insecticides on 42%, fungicides on 21%, sulphur on 9% and acaricides on 6%. Overall, an average of fourteen sprays, nineteen products and twenty one active substances were applied to hardy nursery stock crops.

Herbicides were used on over 92% of roses, 89% of fruit stock, 74% of shrubs etc., 56% of herbaceous plants, 53% of mixed areas, 52% of ornamental trees and 44% of Christmas trees. On average, six herbicide sprays, eight products and ten active substances were used. Usage of herbicides was most intensive on treated mixed areas, which received eight sprays, fourteen products and sixteen active substances. Herbaceous plants received the lowest number of herbicide applications with only two sprays, two products and two active substances applied on average.

Fungicides were used on 89% of roses, 65% of fruit stock, 26% of mixed areas, 22% of herbaceous plants, 14% of ornamental trees and 13% of shrubs etc. On average, five sprays, six products and six fungicide active substances were used on hardy nursery stock. However, the number of sprays applied ranged from ten on mixed areas to no usage Christmas trees. Mixed areas were additionally treated with ten products and eleven active substances. Fruit stock received on average five sprays; seven products and seven active substances and roses five sprays, seven products and seven active substances.

Insecticides were used on approximately 74% of roses, 64% of fruit stock, 63% of mixed areas, 49% of Shrubs etc., 31% of herbaceous plants and 29% of ornamental trees. On average, crops were treated with three insecticidal sprays, three products and three active substances, reflecting the large number of single active substance insecticide formulations available. Mixed areas received the largest number of insecticidal treatments averaging four sprays, five products and five active substances, with fruit stock, roses and ornamental trees receiving three sprays, three products and three active substances.

Sulphur was used on 9% of all crops with almost half of all fruit stock receiving two applications.

Acaricides were used on 6% of all crops but 40% of fruit stock. On average, a single acaricide spray, product and active substance was used on fruit stock.

Usage of "other pesticide" groups was minimal, although mixed areas received, on average, three applications, three products and three active substances. On mixed areas the main pesticides used were biological control agents and growth stimulants.

Usage of molluscicides & repellents was minimal, with crops receiving, on average, less than one application.

Table 2. *Treated area of hardy nursery stock in Great Britain 2005 by crop group (spray hectares)*

Chemical group	Fruit stock	Roses	Ornamental trees	Shrubs etc.	Herbaceous plants	Mixed areas	Christmas trees	All crops
Insecticides & nematicides	1,153	2,448	3,365	2,244	180	2,446	647	12,484
Fungicides	3,287	2,734	4,862	1,858	413	3,857	37	17,049
Herbicides	2,117	1,550	11,448	4,942	274	4,380	3,291	28,003
Growth regulators	.	.	2	3	.	100	231	336
Acaricides	451	25	65	16	.	208	393	1,158
Sulphur	701	210	1,164	315	.	13	174	2,577
Molluscicides & repellents	.	.	.	1	1	180	.	183
Other pesticides	350	107	94	38	39	1316	.	1,944
All pesticides	8,060	7,074	21,000	9,418	908	12,500	4,774	63,733

Table 2a. *Weight of pesticides applied to hardy nursery stock in Great Britain 2005 by crop group (kg of active substance)*

Chemical group	Fruit stock	Roses	Ornamental trees	Shrubs etc.	Herbaceous plants	Mixed areas	Christmas trees	All crops
Insecticides & nematicides	355	640	597	271	10	3,481	158	5,513
Fungicides	2,255	1,037	3,959	925	820	15,205	23	24,225
Herbicides	1,757	1,516	10,216	3,334	355	6,939	3,525	27,643
Growth regulators	.	.	< 1	1	.	102	119	222
Acaricides	39	1	37	2	.	20	73	171
Sulphur	1,234	680	2,984	730	.	42	724	6,394
Molluscicides & repellents	.	.	.	< 1	10	87	.	97
Other pesticides	613	1,433	27,115	13,870	796	11,619	.	55,446
All pesticides	6,253	5,309	44,908	19,132	1,993	37,497	4,623	119,711

Table 3. Usage of pesticides on hardy nursery stock in Great Britain 2005 - percentage area of crops treated with pesticides

Crop group	Insecticides	Acaricides	Fungicides	Sulphur	Herbicides	Molluscicides & repellents	Other pesticides	Not treated
Fruit stock	64.0	40.2	65.0	49.8	88.9	.	55.1	1.5
Roses	74.4	.	89.2	14.6	92.2	.	0.6	0.3
Ornamental trees	29.3	0.3	13.6	7.9	52.4	.	3.9	12.0
Shrubs etc.	48.8	.	12.6	3.6	74.2	0.1	3.5	15.7
Herbaceous plants	30.5	.	21.7	.	56.3	.	< 0.1	28.1
Mixed areas	62.6	5.6	26.1	< 0.1	53.4	4.3	19.3	7.2
Christmas trees	25.9	5.7	.	5.7	43.8	.	2.2	44.3
All crops (weighted mean)	42.4	5.7	21.2	8.7	57.6	0.9	0.9	17.7

Table 4a. Usage of pesticides on hardy nursery stock in Great Britain 2005 - number of spray rounds¹ applied to crops (excluding seed treatments)

	Insecticides	Acaricides	Fungicides	Sulphur	Herbicides	Molluscicides & repellents	Other pesticides	All pesticides
Fruit stock	2.7	0.8	5.4	1.5	3.2	.	0.8	10.7
Roses	2.7	.	4.6	0.1	2.9	.	0.1	8.2
Ornamental trees	2.5	0.1	3.3	0.2	6.3	.	0.2	12.0
Shrubs etc.	1.4	.	3.0	0.2	4.3	< 0.1	0.2	8.8
Herbaceous plants	1.2	.	1.9	.	1.8	.	< 0.1	4.5
Mixed areas	4.3	0.4	9.8	< 0.1	8.3	0.3	2.8	24.4
Christmas trees	1.0	0.3	.	0.6	2.7	.	0.1	4.3
All crops (weighted mean)	2.8	0.3	5.4	0.3	5.6	0.1	1.2	14.4

¹indicates number of pesticide application occasions and may include applications of molluscicide granules or incorporation of insecticide granules in compost, as well as sprays

Table 4b. *Usage of pesticides on hardy nursery stock in Great Britain 2005 - number of products (other than seed treatments) applied to crops, including repeat applications of the same product*

	Insecticides	Acaricides	Fungicides	Sulphur	Herbicides	Molluscicides & repellents	Other pesticides	All pesticides
Fruit stock	3.4	0.9	7.3	1.5	4.9	.	0.8	18.8
Roses	2.7	.	6.5	0.1	4.1	.	0.1	13.4
Ornamental trees	2.6	0.1	3.5	0.2	8.9	.	0.2	15.5
Shrubs etc.	1.4	.	3.0	0.2	4.9	< 0.1	0.2	9.7
Herbaceous plants	1.3	.	2.6	.	2.0	.	< 0.1	6.0
Mixed areas	4.5	0.4	10.2	< 0.1	13.6	0.3	2.9	32.0
Christmas trees	1.1	0.5	.	0.6	3.9	.	0.1	6.0
All crops (weighted mean)	3.0	0.3	6.0	0.3	8.4	0.1	1.2	19.4

Table 4c. *Usage of pesticides on hardy nursery stock in Great Britain 2005 - number of active substances (other than seed treatments) applied to crops, including repeat applications of the same active substance*

	Insecticides	Acaricides	Fungicides	Sulphur	Herbicides	Molluscicides & repellents	Other pesticides	All pesticides
Fruit stock	3.7	0.9	7.4	1.5	5.4	.	0.8	19.5
Roses	3.2	.	6.8	0.1	4.3	.	0.1	14.4
Ornamental trees	2.7	0.1	3.7	0.2	10.5	.	0.2	17.5
Shrubs etc.	1.6	.	3.0	0.2	5.2	< 0.1	0.2	10.2
Herbaceous plants	1.3	.	2.7	.	2.0	.	< 0.1	6.1
Mixed areas	4.5	0.4	11.1	< 0.1	16.1	0.3	3.0	35.5
Christmas trees	1.1	0.5	.	0.6	3.9	.	0.1	6.1
All crops (weighted mean)	3.1	0.3	6.3	0.3	9.7	0.1	1.3	21.2

EXTENT AND QUANTITIES OF PESTICIDE FORMULATIONS USED

The estimated total areas of each crop treated in Great Britain with each pesticide formulation are illustrated in Table 5, whilst the estimated total quantities of formulated active substances used are shown in Table 6.

Herbicides accounted for 44% of the total pesticide-treated area of hardy nursery stock crops grown in Great Britain in 2005, fungicides 27%, insecticides 20%, sulphur 4%, "other pesticides" 3%, acaricides 2%, growth regulators one percent and molluscicides & repellents less than one percent. In terms of weight of active substances applied, "other pesticides", principally dazomet, accounted for 46% of the total, herbicides 23%, fungicides 20%, sulphur 5%, insecticides 5% and growth regulators, acaricides and molluscicides & repellents less than one percent each.

Glyphosate was the most frequently used herbicide active substance; being used on 17% of the herbicide-treated area, with phenmedipham 12%, simazine 7%, metazachlor 7%, isoxaben 6% and oxadiazon on 5%. In terms of weight applied, glyphosate accounted for 21%, oxadiazon 13%, metazachlor 8%, simazine 7%, pendimethalin 6% and dichlobenil 6% of the total.

The most extensively-used fungicide formulations were myclobutanil, used on 17% of the treated area, chlorothalonil on 10%, bupirimate on 7%, azoxystrobin on 7% and fenpropimorph on 5%. By weight applied, fosetyl-aluminium, used primarily as a drench, was the principal fungicide formulation, accounting for 53% of the total. Other major uses were of the commodity chemical potassium hydrogen carbonate, accounting for 13% of the weight applied, and chlorothalonil for 7%.

Pyrethroids were the most extensively-used insecticides, accounting for 35% of the insecticide-treated area, followed by organophosphates 25% and carbamates 24%. Three insecticides accounted for approximately 56% of the total insecticide-treated area of all hardy nursery stock crops: pirimicarb 24%, deltamethrin 20% and dimethoate 12%. However, the organophosphate chlorpyrifos, used in granular formulations incorporated for the control of vine weevil (*Otiorhynchus sulcatus*) larvae in containers, accounted for 58% of the total weight of insecticides applied.

Clofentezine accounted for 41% of the acaricide-treated area, tebufenpyrad for 28%, abamectin for 14% and fenpropathrin for 12%. Clofentezine comprised 51% of the total weight of acaricides applied.

"Other registered pesticides" accounted for 3% of the area treated, but, by weight, they comprised 46% of the total of pesticides applied. By weight applied, the most important active substance was dazomet, accounting for 54% of the weight of all "other registered pesticides", with 29.9 tonnes applied to 74 ha of land used in the production of ornamental trees, shrubs etc. and herbaceous plants. Also important by weight were methyl bromide, with 11 tonnes applied prior to planting 11 ha of ornamental trees, shrubs etc and chloropicrin, with 0.5 tonnes applied to 2 ha of land used for fruit stock production.

The most widely used biological control agents recorded were the predatory mite, *Phytoseiulus persimilis*, used primarily on fruit stock and mixed areas for the control of the two-spotted spider mite, *Tetranychus urticae*; *Amblyseius spp.* (in particular *Amblyseius cucumeris*, another predatory mite) generally used for control of thrips, though frequently cited by growers to be for the control of the two-spotted spider mite; and the entomopathogenic nematode *Steinernema kraussei*, used for the control of vine weevil (*O. sulcatus*) larvae.

Compost tea was widely used by a number of growers, with over 460 ha of plants treated, primarily container grown stock, especially lavender, and roses.

Table 5. Usage of pesticides on hardy nursery stock grown in Great Britain, 2005 (spray hectares)

	Fruit stock	Roses	Ornamental trees	Shrubs etc.	Herbaceous plants	Mixed areas	Christmas trees	All crops
<i>Insecticides & nematicides</i>								
Bifenthrin	34	1	12	9	.	259	.	314
Chlorpyrifos	332	8	308	21	5	352	35	1,061
Cypermethrin	7	.	179	15	108	184	44	537
Deltamethrin	4	492	669	1,050	9	242	25	2,491
Diflubenzuron	72	.	36	.	1	16	.	125
Dimethoate	13	520	388	458	7	72	66	1,524
Fipronil	.	.	.	1	.	474	.	475
Imidacloprid	.	.	11	2	.	251	.	264
Lambda-cyhalothrin	75	226	323	159	35	52	17	888
Lambda-cyhalothrin/pirimicarb	64	309	78	18	.	1	5	475
Malathion	.	406	36	.	.	91	.	534
Nicotine	.	46	.	.	.	24	.	70
Pirimicarb	365	392	1,076	503	13	195	445	2,990
Pymetrozine	187	45	4	.	.	94	.	331
Tau-fluvalinate	.	.	169	.	.	.	.	169
Thiacloprid	.	.	42	7	.	68	.	117
Other ¹ insecticides & nematicides ²	.	3	34	.	1	71	11	121
All insecticides & nematicides	1,153	2,448	3,365	2,244	180	2,446	647	12,484
<i>Acaricides</i>								
Abamectin	87	.	.	.	.	69	.	157
Clofentezine	50	.	.	.	.	80	339	469
Fenpropathrin	126	.	8	.	.	.	.	134
Tebufenpyrad	187	25	.	16	.	53	41	322
Other acaricides ³	.	.	57	.	.	5	13	76
All acaricides	451	25	65	16	.	208	393	1,158
<i>Fungicide/insecticides</i>								
Other fungicide/insecticides ⁴	.	.	12	.	.	13	.	25

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

²Other insecticides & nematicides include aldicarb, buprofezin, deltamethrin/heptenophos, fatty acids, heptenophos, methoxyfenozide, petroleum oil, pirimiphos-methyl, rotenone, spinosad, spiromesifen, teflubenzuron, triazamate and unspecified insecticides.

³Other acaricides include amitraz, dicofol/tetradifon, fenbutatin oxide and fenpyroximate.

⁴Other fungicide/insecticides include bifenthrin/myclobutanil and permethrin/sulphur/triforine.

Table 5 (cont.) *Usage of pesticides on hardy nursery stock grown in Great Britain, 2005 (spray hectares)*

	Fruit stock	Roses	Ornamental trees	Shrubs etc.	Herbaceous plants	Mixed areas	Christmas trees	All crops
<i>Molluscicides & repellents</i>								
Metaldehyde	.	.	.	1	1	93	.	96
Methiocarb	.	.	.	.	.	79	.	79
Other molluscicides & repellents ¹	.	.	.	.	.	8	.	8
All molluscicides & repellents	.	.	.	1	1	180	.	183
<i>Growth regulators</i>								
1-naphthylacetic acid	.	.	2	.	.	.	231	232
Daminozide	.	.	.	2	.	96	.	97
Other growth regulators ²	.	.	.	1	.	5	.	6
All growth regulators	.	.	2	3	.	100	231	336
<i>Soil sterilants</i>								
Dazomet	.	.	47	27	.	.	.	74
Other soil sterilants ³	2	.	9	2	.	.	.	13
All soil sterilants	2	.	56	30	.	.	.	88
<i>Tar oils/acids</i>	.	.	.	.	.	1	.	1
<i>Urea</i>	78	.	.	.	.	.	.	78

¹Other molluscicides & repellents include aluminium sulphate, ferric phosphate, unspecified molluscicides and ziram.

²Other growth regulators include 2-chloroethylphosphonic acid, chlormequat, copper hydroxide, and paclobutrazol.

³Other soil sterilants include chloropicrin and methyl bromide.

Table 5 (cont.) Usage of pesticides on hardy nursery stock grown in Great Britain, 2005 (spray hectares)

	Fruit stock	Roses	Ornamental trees	Shrubs etc.	Herbaceous plants	Mixed areas	Christmas trees	All crops
<i>Surface cleaners & disinfectants</i>								
Quinoclamín	112	.	112
Other disinfectants ¹	.	.	1	.	.	121	.	123
<i>Defoliant²</i>								
	.	2	5	.	.	1	.	7
<i>Algicides³</i>								
	7	.	7
<i>Growth stimulants</i>								
Compost tea	.	60	.	.	39	369	.	468
Plant extracts	.	45	.	2	.	55	.	102
Other growth stimulants ⁴	<1	.	<1
All growth stimulants	.	105	.	2	39	424	.	571
<i>Physical control agents</i>								
Garlic	.	.	.	4	.	69	.	73
Other physical control agents ⁵	.	.	.	2	.	29	.	31
All physical control agents	.	.	.	7	.	98	.	104
<i>Biological control agents</i>								
<i>Amblyseius spp.</i>	66	.	.	.	.	.	.	66
<i>Amblyseius cucumeris</i>	169	.	169
<i>Phytoseiulus persimilis</i>	203	.	.	.	.	173	.	376
<i>Steinernema kraussei</i>	65	.	65
Other biological control agents ⁶	.	.	19	.	.	131	.	149
All biological control agents	270	.	19	.	.	538	.	826

¹Other disinfectants include dichlorophen, formaldehyde, peroxyacetic acid and unspecified disinfectants.

²Defoliant² were copper masquolate.

³Algicides were benzalkonium chloride.

⁴Other growth stimulants were *Trichoderma* spp.

⁵Other physical control agents include dodecylphenol ethoxylate and natural plant extracts.

⁶Other biological control agents include *Bacillus thuringiensis var. kurstaki*, *Chrysoperla carnea*, *Heterorhabditis megidis*, *Phasmarhabditis hermaphrodita*, *Steinernema feltiae* and unspecified nematodes.

Table 5 (cont.) Usage of pesticides on hardy nursery stock grown in Great Britain, 2005 (spray hectares)

	Fruit stock	Roses	Ornamental trees	Shrubs etc.	Herbaceous plants	Mixed areas	Christmas trees	All crops
Fungicides								
Azoxystrobin	2	109	442	297	.	316	.	1,167
Bupirimate	345	210	284	137	.	266	.	1,242
Captan	.	.	127	49	.	9	.	185
Carbendazim	113	122	76	40	3	154	.	508
Carbendazim/prochloraz	.	.	66	.	.	25	.	91
Chlorothalonil	260	75	966	60	1	336	37	1,735
Copper oxychloride	144	.	84	27	.	24	.	280
Cupric ammonium carbonate	.	.	17	.	.	176	.	192
Cyproconazole	.	16	75	215	.	.	.	306
Fenarimol	31	.	75	35	.	141	.	282
Fenhexamid/tolyfluanid	72	.	36	.	.	.	.	108
Fenpropidin	.	58	.	.	45	.	.	103
Fenpropimorph	527	64	238	26	.	20	.	874
Fosetyl-aluminium	9	38	65	3	32	451	.	597
Iprodione	66	11	.	.	35	90	.	202
Kresoxim-methyl	2	32	74	13	.	74	.	196
Mancozeb	.	175	339	.	104	16	.	634
Mancozeb/metalaxyl-M	.	50	33	55	6	103	.	247
Myclobutanil	619	1,178	333	213	12	490	.	2,845
Penconazole	.	.	342	85	.	34	.	461
Potassium hydrogen carbonate	462	5	178	23	.	57	.	725
Prochloraz	.	35	7	.	1	273	.	316
Propiconazole	.	231	.	.	73	1	.	305
Pyraclostrobin	.	36	115	20	.	.	.	171
Quinoxifen	198	.	333	90	.	.	.	620
Spiroxamine	.	.	329	253	.	.	.	582
Tebuconazole	172	150	4	120	7	88	.	541
Thiram	.	.	19	.	.	74	.	93
Tolyfluanid	255	.	30	.	32	164	.	481
Triadimenol	.	9	153	27	.	.	.	189
Trifloxystrobin	.	15	6	30	.	68	.	119
Other fungicides ¹	9	118	17	40	60	406	.	651
All fungicides	3,287	2,734	4,862	1,858	413	3,857	37	17,049
Sulphur	701	210	1,164	315	.	13	174	2,577

¹Other fungicides include benodanil, benomyl, boscalid/pyraclostrobin, bupirimate/triforine, carbendazim/flusilazole, chlorothalonil/metalaxyl, chlorothalonil/propiconazole, copper sulphate, cyflufenamid, cymoxanil/famoxadone, cymoxanil/mancozeb/oxadixyl, difenoconazole, dimethomorph/mancozeb, dithianon, dodine, epoxiconazole, etridiazole, fenhexamid, fluazinam, flusilazole, imazalil, mancozeb/zoxamide, mepanipyrim, metalaxyl-M, metalaxyl/thiram, metrafenone, oxycarboxin, potassium hydroxyquinoline sulphate, prochloraz/propiconazole, propamocarb hydrochloride, pyrifenoxy, pyrimethanil and tolclofos-methyl.

Table 5 (cont.) Usage of pesticides on hardy nursery stock grown in Great Britain, 2005 (spray hectares)

	Fruit stock	Roses	Ornamental trees	Shrubs etc.	Herbaceous plants	Mixed areas	Christmas trees	All crops
Herbicides								
2,4-D	.	.	747	2	.	6	8	764
Atrazine	4	337	304	5	.	12	242	903
Chlorthal-dimethyl	75	.	.	.	28	3	.	105
Clopyralid	200	194	154	94	1	2	129	774
Dichlobenil	.	4	56	41	.	121	1	223
Diflufenican/isoproturon	.	.	202	.	.	.	.	202
Diquat/paraquat	187	9	491	113	2	223	.	1,025
Diuron	.	4	101	.	.	98	471	674
Ethofumesate	.	.	496	402	.	.	.	898
Glufosinate-ammonium	54	22	258	10	.	141	.	485
Glyphosate	81	96	2,006	524	56	742	1,348	4,854
Isoxaben	261	35	316	164	40	953	43	1,812
Isoxaben/trifluralin	.	.	.	.	.	68	.	68
Lenacil	.	.	508	804	40	49	.	1,401
Linuron	.	4	102	68	.	.	.	174
MCPA	.	.	171	20	.	.	12	204
Metamitron	.	.	250	49	1	.	.	300
Metazachlor	87	456	918	296	6	180	65	2,008
Napropamide	67	2	402	80	2	40	.	593
Oxadiazon	71	37	194	24	12	1,154	33	1,524
Paraquat	44	28	281	29	24	236	6	648
Pendimethalin	182	1	462	79	.	4	352	1,079
Phenmedipham	279	.	1,671	1,276	1	.	4	3,231
Propachlor	108	.	8	.	49	3	.	169
Propaquizafop	9	.	222	402	.	.	.	633
Propyzamide	4	9	450	258	.	10	84	815
Simazine	394	311	535	142	.	209	421	2,012
Other herbicides	11	.	141	61	12	127	72	424
All Herbicides	2,117	1,550	11,448	4,942	274	4,380	3,291	28,003

¹Other herbicides include 2,4-D/dicamba/triclopyr, amitrole, amitrole/diquat/paraquat/simazine, carbetamide/diflufenican/oxadiazon, clopyralid/fluroxypyr/triclopyr, clopyralid/triclopyr, cyanazine, dicamba/MCPA/mecoprop-P, dicamba/mecoprop-P, diflufenican/trifluralin, diquat, fluazifop-P-butyl, fluroxypyr, fluroxypyr/triclopyr, isoproturon, MCPB, terbacil, triclopyr, trifluralin and unspecified herbicides.

Table 6. Usage of pesticides on hardy nursery stock grown in Great Britain, 2005 (kg of active substance used)

	Fruit stock	Roses	Ornamental trees	Shrubs etc.	Herbaceous plants	Mixed areas	Christmas trees	All crops
<i>Insecticides & nematicides</i>								
Bifenthrin	1	.	.	.	.	15	.	16
Chlorpyrifos	219	5	239	14	3	2,689	50	3,220
Cypermethrin	.	.	5	0	3	6	1	16
Deltamethrin	.	5	9	13	.	2	.	30
Diflubenzuron	10	.	5	.	.	1	.	16
Dimethoate	1	208	132	156	2	26	33	557
Fipronil	.	.	.	.	.	71	.	71
Imidacloprid	.	.	1	.	.	409	.	410
Lambda-cyhalothrin	.	1	3	1	.	.	.	7
Lambda-cyhalothrin/pirimicarb	7	48	12	3	.	.	1	71
Malathion	.	259	31	.	.	103	.	393
Nicotine	.	24	0	.	.	24	.	47
Pirimicarb	79	83	149	64	2	31	72	480
Pymetrozine	37	7	1	.	.	15	.	60
Tau-fluvalinate	.	.	4	.	.	.	.	4
Thiacloprid	.	.	6	1	.	11	.	17
Other ¹ insecticides & nematicides ²	.	.	1	17	.	78	1	97
All insecticides & nematicides	355	640	597	271	10	3,481	158	5,513
<i>Acaricides</i>								
Abamectin	.	.	.	.	.	.	.	1
Clofentezine	9	.	.	.	.	13	65	87
Fenpropathrin	3	.	1	.	.	.	.	4
Tebufenpyrad	26	1	.	2	.	5	6	41
Other acaricides ³	.	.	36	.	.	1	1	39
All acaricides	39	1	37	2	.	20	73	171
<i>Fungicide/insecticides</i>								
Other fungicide/insecticides⁴	.	.	1	.	.	1	.	1

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

²Other insecticides & nematicides include aldicarb, buprofezin, deltamethrin/heptenophos, fatty acids, heptenophos, methoxyfenozide, petroleum oil, pirimiphos-methyl, rotenone, spinosad, spiromesifen, teflubenzuron, triazamate and unspecified insecticides.

³Other acaricides include amitraz, dicofol/tetradifon, fenbutatin oxide and fenpyroximate.

⁴Other fungicide/insecticides include bifenthrin/myclobutanil and permethrin/sulphur/triforine.

Table 6 (cont.) Usage of pesticides on hardy nursery stock grown in Great Britain, 2005 (kg of active substance used)

	Fruit stock	Roses	Ornamental trees	Shrubs etc.	Herbaceous plants	Mixed areas	Christmas trees	All crops
Molluscicides & repellents								
Metaldehyde	.	.	.	<1	10	49	.	59
Methiocarb	.	.	.	.	.	16	.	16
Other molluscicides & repellents ¹	.	.	.	.	.	22	.	22
All molluscicides & repellents	.	.	.	<1	10	87	.	97
Growth regulators								
1-naphthylacetic acid	.	.	<1	.	.	.	119	119
Daminozide	.	.	.	<1	.	81	.	81
Other growth regulators ²	.	.	.	1	.	21	.	22
All growth regulators	.	.	<1	1	.	102	119	222
Soil sterilants								
Dazomet	.	.	18,221	11,666	15	.	.	29,902
Other soil sterilants ³	515	.	8,862	2,192	.	.	.	11,568
All soil sterilants	515	.	27,083	13,858	15	.	.	41,471
<i>Tar oils/acids</i>	.	.	.	.	.	12	.	12
<i>Urea</i>	98	.	.	.	.	.	.	98

¹Other molluscicides & repellents include aluminium sulphate, ferric phosphate, unspecified molluscicides and ziram.

²Other growth regulators include 2-chloroethylphosphonic acid, chlormequat, copper hydroxide, and paclobutrazol.

³Other soil sterilants include chloropicrin and methyl bromide.

Table 6 (cont.) Usage of pesticides on hardy nursery stock grown in Great Britain, 2005 (kg of active substance used)

	Fruit stock	Roses	Ornamental trees	Shrubs etc.	Herbaceous plants	Mixed areas	Christmas trees	All crops
<i>Surface cleaners & disinfectants</i>								
Quinoclamín	280	.	280
Other disinfectants ¹	.	.	1	.	.	831	.	831
<i>Defoliant²</i>								
	.	24	31	.	.	7	.	63
<i>Algicides³</i>								
	25	.	25
<i>Growth stimulants</i>								
Compost tea	.	1,365	.	.	781	9,925	.	12,071
Plant extracts	.	45	.	5	.	111	.	160
Other growth stimulants ⁴	2	.	2
All growth stimulants	.	1,409	.	5	781	10,037	.	12,233
<i>Physical control agents</i>								
Garlic	.	.	.	4	.	194	.	198
Other physical control agents ⁵	.	.	.	3	.	232	.	234
All physical control agents	.	.	.	7	.	425	.	432
<i>Biological control agents</i>								
<i>Amblyseius spp.</i>
<i>Amblyseius cucumeris</i>
<i>Phytoseiulus persimilis</i>
<i>Steinernema kraussei</i>
Other biological control agents ⁶	1	.	1
All biological control agents	1	.	1

¹Other disinfectants include dichlorophen, formaldehyde, peroxyacetic acid and unspecified disinfectants.

²Defoliant² were copper masquolate.

³Algicides were benzalkonium chloride.

⁴Other growth stimulants were *Trichoderma* spp.

⁵Other physical control agents include dodecylphenol ethoxylate and natural plant extracts.

⁶Other biological control agents include *Bacillus thuringiensis var. kurstaki*, *Chrysoperla carnea*, *Heterorhabditis megidis*, *Phasmarhabditis hermaphrodita*, *Steinernema feltiae* and unspecified nematodes.

Table 6 (cont.) Usage of pesticides on hardy nursery stock grown in Great Britain, 2005 (kg of active substance used)

	Fruit stock	Roses	Ornamental trees	Shrubs etc.	Herbaceous plants	Mixed areas	Christmas trees	All crops
Fungicides								
Azoxystrobin	.	16	69	43	.	73	.	201
Bupirimate	74	69	101	42	.	101	.	388
Captan	.	.	130	138	.	12	.	280
Carbendazim	55	38	38	12	.	76	.	219
Carbendazim/prochloraz	.	.	8	.	.	14	.	22
Chlorothalonil	112	59	1,007	121	3	444	23	1,770
Copper oxychloride	97	.	55	26	.	28	.	205
Cupric ammonium carbonate	.	.	4	.	.	41	.	46
Cyproconazole	.	1	3	12	.	.	.	16
Fenarimol	1	.	4	1	.	8	.	14
Fenhexamid/tolyfluanid	108	.	54	.	.	.	.	162
Fenpropidin	.	43	.	.	33	.	.	76
Fenpropimorph	221	34	123	19	.	13	.	410
Fosetyl-aluminium	26	374	167	249	534	11,522	.	12,873
Iprodione	17	5	.	.	12	30	.	65
Kresoxim-methyl	.	2	8	1	.	12	.	24
Mancozeb	.	191	508	.	90	14	.	803
Mancozeb/metalaxyl-M	.	41	42	71	8	127	.	290
Myclobutanil	47	65	21	17	.	30	.	181
Penconazole	.	.	12	3	.	1	.	16
Potassium hydrogen carbonate	1,250	25	1,400	45	.	482	.	3,202
Prochloraz	.	4	2	.	.	119	.	125
Propiconazole	.	29	.	.	9	.	.	38
Pyraclostrobin	.	4	29	5	.	.	.	38
Quinoxifen	25	.	25	9	.	.	.	58
Spiroxamine	.	.	82	63	.	.	.	145
Tebuconazole	24	22	1	30	1	18	.	96
Thiram	.	.	23	.	.	189	.	212
Tolyfluanid	195	.	19	.	95	162	.	471
Triadimenol	.	1	19	3	.	.	.	24
Trifloxystrobin	.	4	1	8	.	10	.	23
Other fungicides ¹	1	9	4	4	34	1,679	.	1,732
All fungicides	2,255	1,037	3,959	925	820	15,205	23	24,225
Sulphur	1,234	680	2,984	730	.	42	724	6,394

¹Other fungicides include benodanil, benomyl, boscalid/pyraclostrobin, bupirimate/triforine, carbendazim/flusilazole, chlorothalonil/metalaxyl, chlorothalonil/propiconazole, copper sulphate, cyflufenamid, cymoxanil/famoxadone, cymoxanil/mancozeb/oxadixyl, difenoconazole, dimethomorph/mancozeb, dithianon, dodine, epoxiconazole, etridiazole, fenhexamid, fluazinam, flusilazole, imazalil, mancozeb/zoxamide, mepanipyrim, metalaxyl-M, metalaxyl/thiram, metrafenone, oxycarboxin, potassium hydroxyquinoline sulphate, prochloraz/propiconazole, propamocarb hydrochloride, pyrifenoxy, pyrimethanil and tolclofos-methyl.

Table 6 (cont.) Usage of pesticides on hardy nursery stock grown in Great Britain, 2005 (kg of active substance used)

	Fruit stock	Roses	Ornamental trees	Shrubs etc.	Herbaceous plants	Mixed areas	Christmas trees	All crops
Herbicides								
2,4-D	.	.	586	2	.	10	16	613
Atrazine	5	372	339	6	.	18	375	1,115
Chlorthal-dimethyl	278	.	.	.	74	18	.	370
Clopyralid	17	20	28	15	.	.	15	96
Dichlobenil	.	30	485	340	.	668	2	1,526
Diflufenican/isoproturon	.	.	111	.	.	.	.	111
Diquat/paraquat	158	9	353	84	1	211	.	817
Diuron	.	8	118	.	.	202	413	741
Ethofumesate	.	.	316	161	.	.	.	476
Glufosinate-ammonium	32	8	144	5	.	98	.	287
Glyphosate	111	124	2,403	689	86	1,082	1,282	5,777
Isoxaben	46	6	76	39	7	198	9	381
Isoxaben/trifluralin	.	.	.	.	.	176	.	176
Lenacil	.	.	223	354	10	34	.	621
Linuron	.	6	97	61	.	.	.	165
MCPA	.	1	269	31	.	.	12	312
Metamitron	.	.	487	58	3	.	.	548
Metazachlor	69	518	1,089	300	8	193	81	2,257
Napropamide	164	8	281	146	5	88	.	691
Oxadiazon	100	42	278	39	8	3,192	36	3,693
Paraquat	27	19	136	27	17	216	5	448
Pendimethalin	217	1	736	104	.	5	558	1,620
Phenmedipham	87	.	441	341	1	.	4	875
Propachlor	259	.	15	.	121	20	.	415
Propaquizafop	1	.	22	40	.	.	.	63
Propyzamide	2	14	519	294	.	16	130	976
Simazine	158	329	535	136	.	284	524	1,966
Other Herbicides	26	.	130	64	16	208	62	506
All Herbicides	1,757	1,516	10,216	3,334	355	6,939	3,525	27,643

¹Other herbicides include 2,4-D/dicamba/triclopyr, amitrole, amitrole/diquat/paraquat/simazine, carbetamide/diflufenican/oxadiazon, clopyralid/fluroxypyr/triclopyr, clopyralid/triclopyr, cyanazine, dicamba/MCPA/mecoprop-P, dicamba/mecoprop-P, diflufenican/trifluralin, diquat, fluazifop-P-butyl, fluroxypyr, fluroxypyr/triclopyr, isoproturon, MCPB, terbacil, triclopyr, trifluralin and unspecified herbicides.

EXTENT AND QUANTITIES OF ACTIVE SUBSTANCES USED

The 50 pesticide active substances used most extensively on all hardy nursery stock 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. The rating of active substances varies in each list depending upon their extent of usage, rate of application, relative activity per unit weight and their relative proportions in formulated products, especially for those products that contain more than one active substance.

In terms of area treated, the principal ten active substances comprised five herbicides, two fungicides, two insecticides and sulphur. By weight applied, the principal ten comprised two soil sterilants, four herbicides, two fungicides, one insecticide and sulphur.

Herbicide active substances appeared regularly in the principal twenty of both lists, reflecting the large area of herbicide usage and the relatively high rates of application used. The use of herbicides for general weed control accounted for 81% of all usage, with thistles, willowherb, bindweed, mares tail and being the only major weed species specified. Glyphosate, phenmedipham, simazine, metazachlor and isoxaben were the five principal herbicides in terms of area-treated, whilst glyphosate, oxadiazon, metazachlor and simazine were the principal four by weight applied. Glyphosate was frequently used to clear areas before planting in field situations or to clear standing areas for container-grown stock. Glyphosate was used predominantly around ornamental trees, Christmas trees and mixed areas; phenmedipham almost exclusively on ornamental trees, Christmas trees and fruit stock. The use of ethofumesate was recorded for the first time on hardy nursery stock, mainly ornamental trees and shrubs etc., in 2005.

Myclobutanil was the most frequently used of all fungicide active substances in terms of area treated. The use of myclobutanil was most common on roses, fruit stock and mixed areas, where it was used mainly for the control of mildew and blackspot. Other important fungicides, by area treated, were chlorothalonil, bupirimate, and azoxystrobin. Use of potassium hydrogen carbonate was encountered for the first time, presumably being used to replace 'synthetic' fungicides or as an inexpensive alternative. Although all four active substances were used extensively, only chlorothalonil appeared within the first twenty by weight, reflecting the low rates of application of most fungicides. Only two fungicides appeared within the principal ten pesticides by weight applied; fosetyl-aluminium, used for *Phytophthora spp.* and *Pythium spp.* root rots; and potassium hydrogen carbonate, being encountered for the first time in 2005 and used primarily for mildew control, reflecting the comparatively high rates of application of these two active substances. Mildews, both powdery and downy, were the most important reasons given for the use of all fungicides, accounting for over half of the applications made (where a reason was specified). The use of spiroxamine was encountered for the first time in 2005.

Insecticides also figured prominently by area treated. Within the principal twenty active substances, pirimicarb was the most important insecticide, followed by deltamethrin, dimethoate, lambda-cyhalothrin and chlorpyrifos. By weight, only chlorpyrifos was included in the principal twenty. Chlorpyrifos was commonly applied as a granular incorporation for the prophylactic control of vine weevil, *O. sulcatus* and other pests, in container-grown stock and as such the rates of application were higher than for conventional field applications. Control of aphids accounted for almost two-thirds, 63%, of all insecticide applications made to hardy nursery stock, where a reason was specified, vine weevil 16%, caterpillars 6%, aphids/caterpillars 3% and two-spot spider mite 2%. The use of fipronil, as a granular incorporated insecticide for vine weevil control, was encountered for the first time in 2005.

The area treated with sulphur, primarily for mildew control, 74% of the treated area where a reason was specified, more than tripled since 2001, whilst the weight applied increased by almost three times. Approximately 11% of all usage was for the control of mites, in particular apple rust mite, *Aculus schlechtendali* and pear rust mite, *Epirimerus piri*.

The area treated with soil sterilants was small, with no soil sterilants appearing in the top 50 by area treated. However, dazomet, because of its high rate of application, was the major active substance used by weight and was applied mainly before the planting of ornamental trees and shrubs etc. The only other soil sterilant encountered was methyl bromide, applied prior to the planting of ornamental trees, shrubs etc. and fruit stock, which appeared at number three in terms of weight applied. Usage of both dazomet and methyl bromide increased both in terms of area treated and weight applied between 2001 and 2005.

Table 7. Estimated area (ha) of application of the fifty most extensively-used active substances on all hardy nursery stock surveyed in 2005 in Great Britain

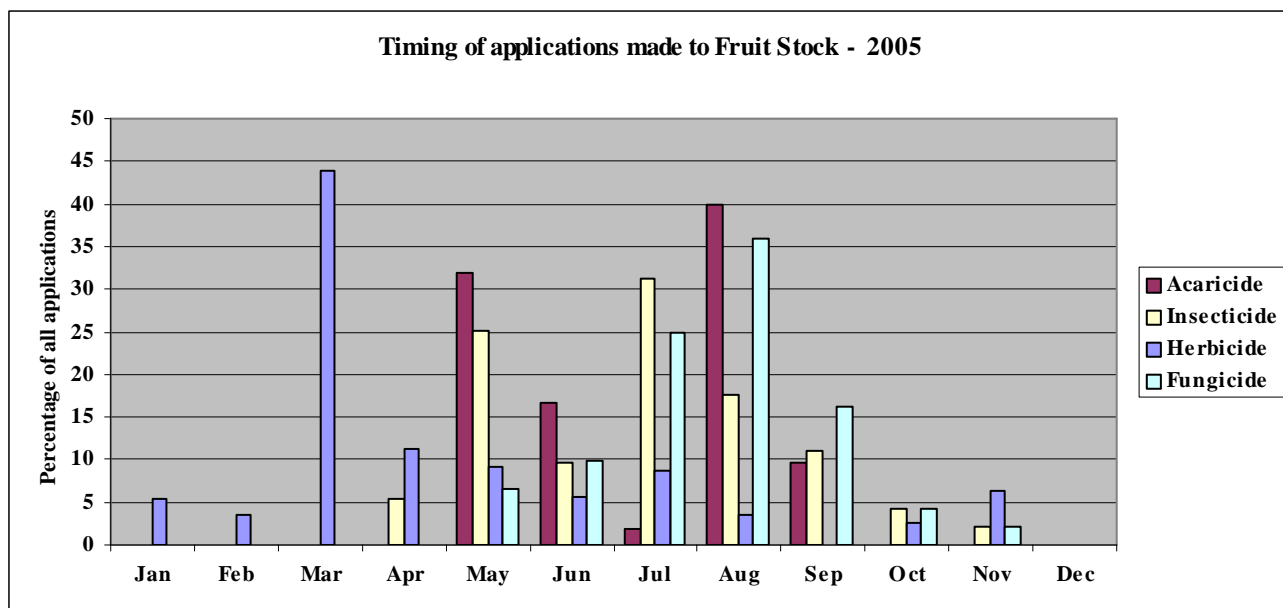
	Active substance	Area treated (ha)	Area treated 2001 (ha)	% change on 2001	Movement
1	Glyphosate	4,854	4,175	16	↑
2	Pirimicarb	3,464	3,962	-13	↓
3	Phenmedipham	3,231	639	406	↑
4	Myclobutanil	2,870	5,395	-47	↓
5	Sulphur	2,577	804	221	↑
6	Deltamethrin	2,496	1,254	99	↑
7	Simazine	2,013	1,929	4	↑
8	Metazachlor	2,008	1,643	22	↑
9	Isoxaben	1,879	1,996	-6	↓
10	Chlorothalonil	1,747	333	424	↑
11	Paraquat	1,674	2,869	-42	↓
12	Oxadiazon	1,532	1,143	34	↑
13	Dimethoate	1,524	431	254	↑
14	Lenacil	1,401	142	887	↑
15	Lambda-cyhalothrin	1,363	1,159	18	↑
16	Bupirimate	1,244	2,531	-51	↓
17	Azoxystrobin	1,167	611	91	↑
18	Pendimethalin	1,079	911	19	↑
19	Chlorpyrifos	1,061	1,563	-32	↓
20	Diquat	1,051	1,839	-43	↓
21	Mancozeb	938	573	64	↑
22	Atrazine	903	669	35	↑
23	Ethofumesate	898	.	↑	
24	Fenpropimorph	874	894	-2	↓
25	Propyzamide	815	884	-8	↓
26	Clopyralid	796	762	4	↑
27	2,4-D	766	19	3,878	↑
28	Potassium hydrogen carbonate	725	.	↑	
29	Diuron	674	999	-33	↓
30	Carbendazim	662	688	-4	↓
31	Propaquizafop	633	46	1,274	↑
32	Quinoxifen	620	194	220	↑
33	Fosetyl-aluminium	597	443	35	↑
34	Napropamide	593	173	244	↑
35	Tolyfluanid	589	63	829	↑
36	Spiroxamine	582	.	↑	
37	Tebuconazole	541	160	239	↑
38	Cypermethrin	537	971	-45	↓
39	Malathion	534	766	-30	↓
40	Glufosinate-ammonium	485	1,127	-57	↓
41	Fipronil	475	.	↑	
42	Clofentezine	469	231	103	↑
43	Penconazole	461	456	1	↑
44	Prochloraz	414	443	-7	↓
45	Bifenthrin	340	299	14	↑
46	Pymetrozine	331	195	70	↑
47	Tebufenpyrad	322	709	-55	↓
48	Propiconazole	320	231	39	↑
49	Metaxyl-M	310	25	1,130	↑
50	Cyproconazole	306	21	1,354	↑

Table 8. *Estimated amount (kg) of application of the fifty most extensively-used active substances on all hardy nursery stock surveyed in 2005 in Great Britain*

	Active substance	Amount used (kg)	Amount used 2001 (kg)	% change on 2001	Movement
1	Dazomet	29,902	11,238	166	↑
2	Fosetyl-aluminium	12,873	5,909	118	↑
3	Methyl bromide	11,054	5,775	91	↑
4	Sulphur	6,394	2,257	183	↑
5	Glyphosate	5,777	5,115	13	↑
6	Oxadiazon	3,715	2,400	55	↑
7	Chlorpyrifos	3,220	5,956	-46	↓
8	Potassium hydrogen carbonate	3,202	.	↑	
9	Metazachlor	2,257	2,027	11	↑
10	Simazine	1,967	2,005	-2	↓
11	Chlorothalonil	1,774	410	332	↑
12	Pendimethalin	1,620	1,346	20	↑
13	Dichlobenil	1,526	783	95	↑
14	Propamocarb hydrochloride	1,169	142	721	↑
15	Atrazine	1,115	880	27	↑
16	Mancozeb	1,113	698	60	↑
17	Propyzamide	976	906	8	↑
18	Paraquat	933	1,392	-33	↓
19	Phenmedipham	875	223	292	↑
20	Diuron	741	1,406	-47	↓
21	Napropamide	691	326	112	↑
22	Lenacil	621	174	258	↑
23	2,4-D	615	36	1,585	↑
24	Tolyfluanid	579	46	1,157	↑
25	Dichlorophen	562	755	-26	↓
26	Dimethoate	557	164	240	↑
27	Metamitron	548	14	3,729	↑
28	Pirimicarb	547	569	-4	↓
29	Chloropicrin	515	.	↑	
30	Ethofumesate	476	.	↑	
31	Isoxaben	418	744	-44	↓
32	Propachlor	415	549	-24	↓
33	Fenpropimorph	410	347	18	↑
34	Imidacloprid	410	248	65	↑
35	Malathion	393	618	-36	↓
36	MCPA	389	37	962	↑
37	Bupirimate	388	724	-46	↓
38	Chlorthal-dimethyl	370	.	↑	
39	Diquat	348	437	-20	↓
40	Etridiazole	314	.	↑	
41	Glufosinate-ammonium	287	562	-49	↓
42	Captan	280	67	316	↑
43	Quinoclamim	280	111	152	↑
44	Carbendazim	228	215	6	↑
45	Thiram	212	565	-62	↓
46	Copper oxychloride	205	241	-15	↓
47	Azoxystrobin	201	119	69	↑
48	Trifluralin	185	74	151	↑
49	Myclobutanil	182	220	-18	↓
50	Linuron	165	15	982	↑

PESTICIDE USAGE ON FRUIT STOCK

Fruit stock accounted for 6% of the total area of hardy nursery stock, with 63% being grown in Eastern region, 16% in London & the South East and 11% in Scotland. Raspberries accounted for 49% of the area sampled, fruit trees 24%, strawberries for runner production for 21% and bush fruit 6%. Fungicides comprised 41% of the total pesticide-treated area, herbicides 26%, insecticides 14%, sulphur 9%, acaricides 6% and “other pesticides” including biological control agents and soil sterilants 4%. In terms of weight applied, fungicides accounted for 36% of the total, herbicides 28%, sulphur 20%, soil sterilants 10% and acaricides one percent. Over 98% of fruit stock sampled received a pesticide application. Crops were treated on average with eleven sprays, nineteen products and twenty active substances.



Fruit Stock – Fungicides

Myclobutanil was the most frequently used fungicide, being used on 19% of the fungicide-treated area with an average of three applications being made to 40% of the area grown. By weight applied, potassium hydrogen carbonate was the principal active substance used, accounting for 55% of the total. Powdery mildew was cited as the growers' main reason for using fungicides, accounting for 57% of the area treated where a reason was specified. Cane disease of raspberries was also given as a reason comprising a further 22% of fungicide usage.

	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)
Myclobutanil	619	47	0.19	0.40	3.27
Fenpropimorph	527	221	0.16	0.23	4.95
Potassium hydrogen carbonate	462	1,250	0.14	0.22	4.42
Bupirimate	345	74	0.10	0.37	1.97
Chlorothalonil	260	112	0.08	0.14	3.92

Fruit Stock – Herbicides

Simazine was the principal herbicide used on fruit stock, accounting for 19% of the herbicide-treated area, with an average of two applications being made to 44% of the area grown. In terms of weight applied, chlorthal-dimethyl was the principal active substance used, comprising 16% of the total. Most herbicides, 95%, were used for general weed control with thistle control, 4%, being the main weed specified.

	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)
Simazine	394	158	0.19	0.44	1.91
Phenmedipham	279	87	0.13	0.17	3.42
Isoxaben	261	46	0.12	0.45	1.24
Clopyralid	200	17	0.09	0.27	1.56
Diquat/paraquat	187	158	0.09	0.36	1.11

Fruit Stock – Insecticides

The carbamate, pirimicarb, and the organophosphate, chlorpyrifos, were the main insecticides used on fruit stock, with an average of two applications being made to approximately a third or more of the area grown. Overall, carbamates accounted for 32% of the insecticide-treated area and organophosphates 30%. By weight applied, chlorpyrifos was the major active substance, accounting for 62% of the total weight of insecticides. Control of aphids was the main reason for insecticide use, accounting for 84% of the area treated, where a reason was specified. Other major reasons included caterpillars on 5% of the area-treated, aphids/caterpillars combined on 5% and two-spotted spider mite on 5%.

	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)
Pirimicarb	365	79	0.32	0.32	2.42
Chlorpyrifos	332	219	0.29	0.47	1.50
Pymetrozine	187	37	0.16	0.22	1.83
Lambda-cyhalothrin	75	0	0.07	0.02	6.42
Diflubenzuron	72	10	0.06	0.15	1.00

Fruit Stock – Acaricides

The principal active substance used was tebufenpyrad, accounting for 41% of the acaricide-treated area, with the two-spotted spider mite, *T. urticae*, being the most important species, according to growers.

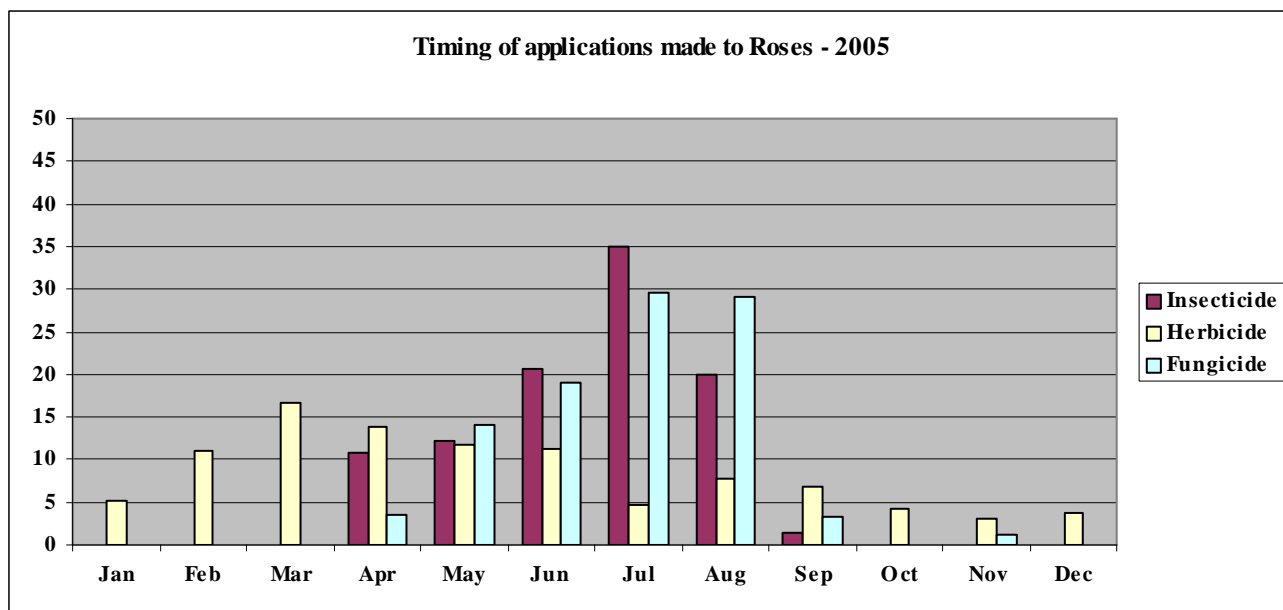
Fruit Stock – Other pesticides

"Other pesticides" used on fruit stock accounted for three percent of the treated area. However, usage of the soil sterilant chloropicrin, and its high recommended rate, greatly influenced the total weight of active substances applied.

Approximately 270 hectares of strawberries and raspberries were treated with the biological control agents *Phytoseiulus persimilis* and *Amblyseius* spp., primarily for the control of the two-spotted spider mite.

PESTICIDE USAGE ON ROSES

Roses accounted for 5% of the total area of hardy nursery stock, with 67% being grown in Eastern region and 17% in the East Midlands. Fungicides comprised 39% of the total pesticide-treated area, insecticides 35%, herbicides 22%, sulphur 3%, “other pesticides” 2% and acaricides less than one percent. In terms of weight applied, herbicides accounted for 29% of the total, “other pesticides” 27%, fungicides 20%, sulphur 13%, insecticides & nematocides 12% and acaricides less than one percent. Almost all roses, 99.7%, sampled received a pesticide application. On average, rose crops were treated with eight sprays, thirteen products and fourteen active substances.



Roses – Fungicides

The major fungicide active substance applied to roses was myclobutanil, comprising 43% of the fungicide-treated area, with five applications being used on 60% of the area grown. By weight, fosetyl-aluminium accounted for 36% of fungicide use, with mancozeb comprising a further 18% of the total quantity of active substances applied. Mildew, rust and black spot/other diseases were the most important reasons given by growers for the use of fungicides. Mildew control accounted for 42% of the total area treated where a reason was specified, black spot/other diseases for 16%, mildew/rust for 15% and rust alone for 12%

	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)
Myclobutanil	1,178	65	0.43	0.60	4.99
Propiconazole	231	29	0.08	0.27	2.16
Bupirimate	210	69	0.08	0.22	2.47
Mancozeb	175	191	0.06	0.08	5.68
Tebuconazole	150	22	0.05	0.18	2.18

The use of sulphur for mildew control accounted for 3% of the total area of roses treated and 13% of the weight of pesticides applied.

Roses – Insecticides

Dimethoate was the principal insecticide active substance used, accounting for 21% of the insecticide-treated area with an average of four applications being made to a third of the crop grown. Together, malathion and dimethoate comprised 73% of the weight of insecticide active substances applied. Organophosphate insecticides were used on 38% of the total insecticide-treated area, pyrethroids 29%, carbamates 16% and pyrethroid/carbamates 13%. Aphid control was the only reason specified for the use of insecticides.

	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)
Dimethoate	520	208	0.21	0.32	4.17
Deltamethrin	492	5	0.20	0.10	12.34
Malathion	406	259	0.17	0.18	5.72
Pirimicarb	392	83	0.16	0.28	3.59
Lambda-cyhalothrin/pirimicarb	309	48	0.13	0.40	1.98

Roses – Herbicides

Three herbicides comprised 71% of the herbicide-treated area, metazachlor 29%, atrazine 22% and simazine 20%, with an average of two applications of each being applied to the rose crop. By weight, the same three active substances accounted for 80% of the total. Where reasons were specified, the main reason given, 70% of the area treated, was general weed control, reflecting the broad-spectrum action of the three major herbicides. A further 12% of herbicide usage was targeted specifically at bindweed (*Convolvulus* spp.), 9% at thistles (*Cirsium* spp.), 3% at nettles (*Urtica* spp./*Lamium* spp.), one percent groundsel (*Senecio vulgaris*) with the remaining 5% being used to control general broad-leaved weeds.

	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)
Metazachlor	456	518	0.29	0.63	1.85
Atrazine	337	372	0.22	0.49	1.74
Simazine	311	329	0.20	0.42	1.88
Clopyralid	194	20	0.13	0.23	2.12
Glyphosate	96	124	0.06	0.17	1.42

Roses – Acaricides

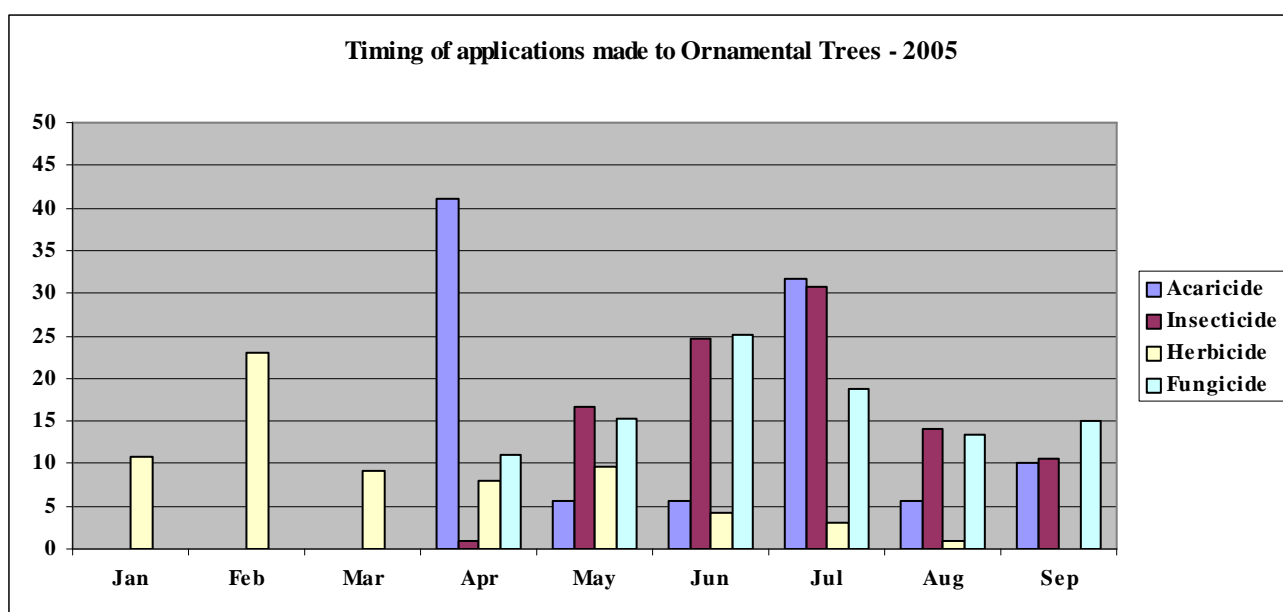
Tebufenpyrad was the only acaricide recorded.

Roses – Other pesticides

The growth stimulants, “Compost tea” and plant extracts were the main “other pesticides” recorded, with both being used in an attempt to increase the plants resistance to disease.

PESTICIDE USAGE ON ORNAMENTAL TREES

Ornamental trees accounted for 32% of the total area of hardy nursery stock grown in Great Britain, with 36% being grown in London & the South East, 13% in West Midlands, 12% in the South West and 10% in East Midlands. Herbicides comprised 55%, fungicides 23%, insecticides 16%, sulphur 6% and “other pesticides”, acaricides and growth regulators less than one percent of the total pesticide-treated area. In terms of weight applied, “other pesticides”, primarily soil sterilants, accounted for 60% of the total, herbicides 23%, fungicides 9%, sulphur 7%, insecticides one percent and acaricides and growth regulators less than one percent. Eighty-eight percent of ornamental trees sampled received a pesticide application. On average, ornamental trees were treated with twelve sprays, sixteen products and eighteen active substances.



Ornamental trees - Herbicides

Glyphosate, the most frequently applied herbicide, was used on 18% of the total herbicide-treated area, with an average of two applications being applied to 40% of the area grown. The use of phenmedipham repeat-low-dose applications accounted for 5 applications made to 15% of the area grown. By weight, glyphosate and metazachlor comprised 24% and 11% of the total respectively. In line with the broad-spectrum activities of the major herbicides, the growers' most common reason for use (74% of the area treated where a reason was specified) was general weed control. The major weeds individually specified were thistles (*Cirsium* spp.), 13% of the area treated and willowherb (*Epilobium* spp.) 3%. Grass weeds accounted for a further 5% of the area treated where a reason was specified.

	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)
Glyphosate	2,006	2,403	0.18	0.40	2.05
Phenmedipham	1,671	441	0.15	0.15	4.62
Metazachlor	918	1,089	0.08	0.27	1.40
2,4-D	747	586	0.07	0.12	2.57
Simazine	535	535	0.05	0.12	1.78

Ornamental trees - Fungicides

Chlorothalonil was used on 20% of the fungicide-treated area, with an average of four applications being made to 9% of the area grown. Potassium hydrogen carbonate and chlorothalonil were the principal active substances used by weight applied accounting for 35% and 25% respectively. Where a reason was specified, mildew, both powdery and downy, accounted for 40% of the total area treated, mildew/scab for 25% and root rots, such as *Phytophthora* and *Pythium* 3%.

	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)
Chlorothalonil	966	1,007	0.20	0.09	4.15
Azoxystrobin	442	69	0.09	0.06	2.80
Penconazole	342	12	0.07	0.06	2.30
Mancozeb	339	508	0.07	0.03	4.00
Quinoxifen	333	25	0.07	0.05	2.94

Ornamental trees - Insecticides

Pirimicarb was the principal insecticide active substance used, with two applications being applied to almost a quarter of the area grown. Chlorpyrifos was the most extensively used insecticide by weight applied, comprising 40% of the total. Pyrethroids were the major insecticide group accounting for 40% of the insecticide-treated area, carbamates for 32% and organophosphates for 22%. Aphids were the main reason for use, accounting for 70% of the total treated area, caterpillar control comprised a further 5%, mites 5% and general pest control another 15%.

	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)
Pirimicarb	1,076	149	0.32	0.22	1.99
Deltamethrin	669	9	0.20	0.10	2.84
Dimethoate	388	132	0.12	0.09	1.69
Lambda-cyhalothrin	323	3	0.10	0.06	2.26
Chlorpyrifos	308	239	0.09	0.07	1.86

Ornamental trees - Acaricides

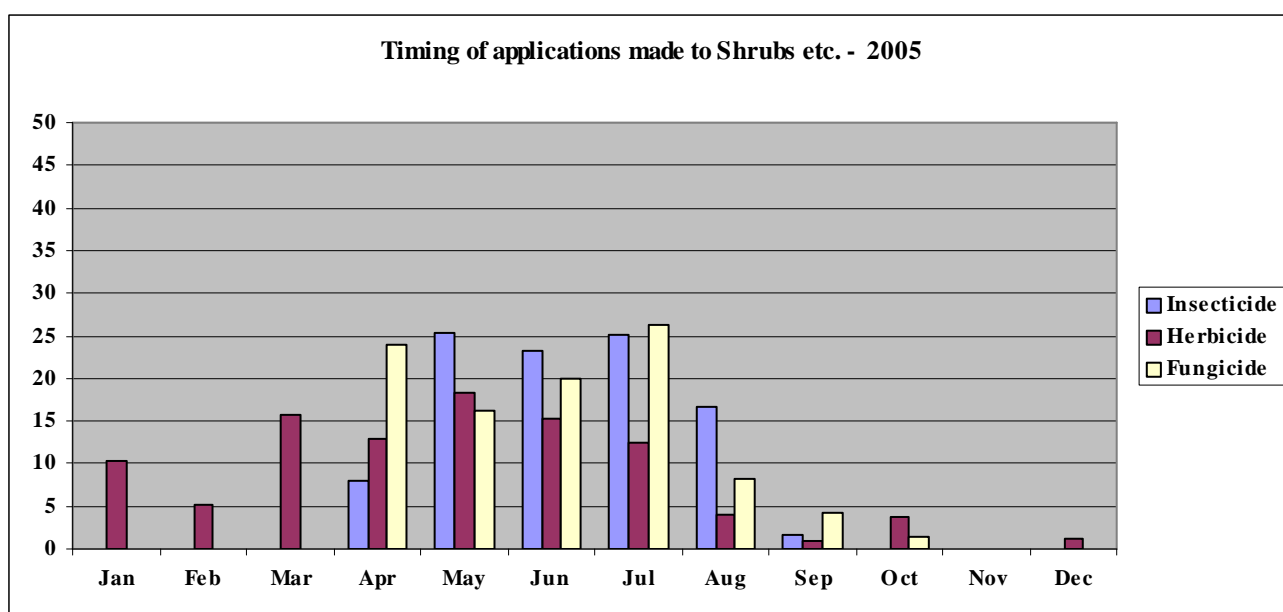
Amitraz accounted for 81% of the total area treated with acaricides, with most usage being targeted at gall mites, 77% and rust mites, 9%.

Ornamental trees – Other pesticides

"Other pesticides", which included soil sterilants, biological control agents, defoliants and surface cleaners, accounted for less than one percent of the total treated area, made up 60% of the total weight of pesticides applied to ornamental trees. Dazomet accounted for almost all, 84%, of soil sterilant usage, with methyl bromide comprising the remaining 16%.

PESTICIDE USAGE ON SHRUBS ETC.

Shrubs etc. accounted for 9% of the total area of hardy nursery stock, with 44% being grown in West Midlands region, 14% in London & the South East and 10% in Eastern region. Herbicides comprised 52% of the total pesticide-treated area, insecticides 24%, fungicides 20%, sulphur 3% and “other pesticides”, acaricides, growth regulators and molluscicides all less than one percent each. “Other pesticides”, primarily the soil sterilant dazomet, comprised 72% of the total weight of all active substances applied. By weight, herbicides made up a further 17%, fungicides 5%, sulphur 4%, insecticides one percent and acaricides, growth regulators and molluscicides all less than one percent each. Over 84% of shrubs etc. sampled received a pesticide application. Shrubs etc. were treated on average with nine sprays, ten products and ten active substances.



Shrubs etc. - Herbicides

Phenmedipham was the principal herbicide active substance, accounting for 26% of the herbicide-treated area, with an average of five applications being made to 40% of the area grown. By weight applied, glyphosate accounted for 21% of the total, lenacil for 11%, phenmedipham for 10% and dichlobenil for 10%. General weed control was the main reason for herbicide use, accounting for 78% of the herbicide-treated area, with general broad-leaved weed control comprising a further 15%. Where a reason was specified, treatments for thistles (*Cirsium* spp.) and unspecified grass weeds, each accounted for 3% of the total herbicide-treated area.

	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)
Phenmedipham	1,276	341	0.26	0.40	4.75
Lenacil	804	354	0.16	0.30	3.99
Glyphosate	524	689	0.11	0.28	2.72
Ethofumesate	402	161	0.08	0.30	2.00
Propaquizafop	402	40	0.08	0.30	2.00

Shrubs etc. - Fungicides

The four principal fungicide active substances used, were azoxystrobin, spiroxamine, cyproconazole and myclobutanil, with three to four applications of each being applied to approximately a tenth of the area grown. By weight applied, use of fosetyl-aluminium, primarily for root rots on a limited area, accounted for 27% of the weight of all fungicides applied, reflecting its relatively high-recommended rate of use. Where reasons were specified, the main reason for use was mildew, mainly powdery, accounting for 93% of the total area treated. Other important reasons for use included leaf spot, which comprised 2% of the area treated and mildew/scab and root rots, each accounting for one percent of the treated area.

	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)
Azoxystrobin	297	43	0.16	0.14	3.19
Spiroxamine	253	63	0.14	0.10	3.72
Cyproconazole	215	12	0.12	0.10	3.17
Myclobutanil	213	17	0.11	0.08	3.89
Bupirimate	137	42	0.07	0.11	1.79

Shrubs etc. - Insecticides

Deltamethrin was the main insecticide used on shrubs, applied to 47% of the insecticide-treated area, with an average of four applications being made to over one third of the area grown. Other major active substances were pirimicarb and dimethoate, with two applications of each being made to approximately one third of the area grown. In terms of weight applied, dimethoate accounted for 58% of the total. By area treated the pyrethroids were the main insecticide used, accounting for 55% of the total, carbamates for 22% and organophosphates 21%. Where a reason for use was specified, aphids were the main reason given, accounting for 35% of the area. Other important reasons for use included aphids/caterpillars 10% and two-spotted spider mite 8%.

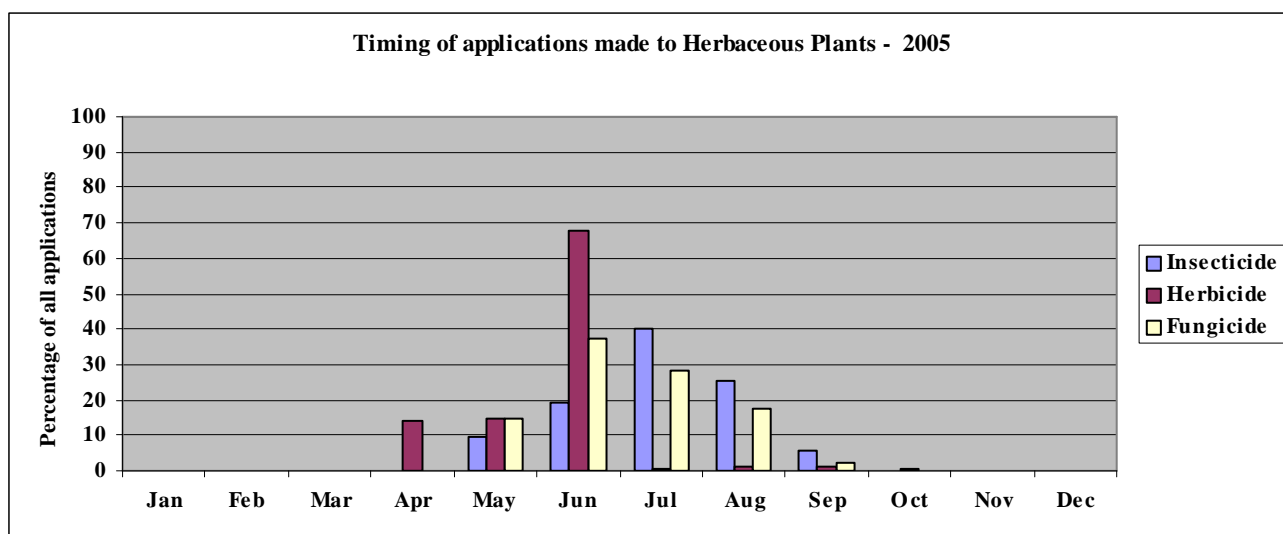
	Formulation area treated (ha)	Weight of a.s. applied (kg)	Proportion of insecticide-treated area	Proportion of census area treated	Average number of applications (where applied)
Deltamethrin	1,050	13	0.47	0.35	4.47
Pirimicarb	503	64	0.22	0.37	2.02
Dimethoate	458	156	0.20	0.32	2.09
Lambda-cyhalothrin	159	1	0.07	0.04	5.36
Chlorpyrifos	21	14	0.01	0.02	1.48

Shrubs etc. – Other pesticides

By weight “other pesticides” accounted for 72% of the all pesticides applied to shrubs etc. but by area treated they comprised less than one percent. Soil sterilants, applied prior to planting the crop, accounted for almost all of the weight of “other pesticides” applied (99.9%), with dazomet comprising 84% of the total weight of soil sterilants and methyl bromide the remaining 16%.

PESTICIDE USAGE ON HERBACEOUS PLANTS

Specific areas of field grown herbaceous plants comprised only 3% of the total area of hardy nursery stock grown. Included within this total are both field-grown plants for resale and stock or mother plants used for propagating new material. Thirty-nine percent of the area of herbaceous plants was grown in Eastern region, 20% in East Midlands, 14% in London & the South East and 13% in the South West. Fungicides accounted for 45% of the total pesticide-treated area, herbicides 30%, insecticides 20%, “other pesticides” 4% and molluscicides & repellents less than one percent. In terms of weight of active substances applied, fungicides accounted for 41% of the total, “other pesticides”, solely compost tea, 40%, herbicides 18%, insecticides and molluscicides & repellents one percent each. Almost 72% of herbaceous plants sampled received a pesticide application. On average herbaceous plants were treated with five sprays, six products and six active substances.



Herbaceous Plants - Fungicides

Mancozeb was the principal fungicide applied, with an average of five applications being made to 8% of the area grown. The approval of benomyl ended in 2004 and its use on all crops has now been revoked. By weight applied, fosetyl-aluminium accounted for 65% of the total weight of fungicide active substances applied, reflecting its relatively high rate when used as a drench for the control of root rots, primarily *Phytophthora* spp. and *Pythium* spp. Where a reason was given, most fungicides (60%) were used to combat mildew/rust, with 37% to control mildew alone.

	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)
Mancozeb	104	90	0.25	0.08	5.33
Propiconazole	73	9	0.18	0.08	3.78
Benomyl	60	34	0.15	0.06	4.00
Fenpropidin	45	33	0.11	0.06	3.00
Iprodione	35	12	0.08	0.08	1.78

Herbaceous Plants - Herbicides

Most of the major herbicides used were for total weed control prior to planting or for weed control prior to the emergence of crops grown from seed. Usage of the four principal herbicide active substances was similar, with a single application of each being applied to 16-19% of the area grown. By weight of active substances applied, propachlor comprised 34% of the total, glyphosate 24% and chlorthal-dimethyl 21%. Where a reason was specified, general weed control accounted for 82% of the total, broad-leaved weeds 16% and mare's tail (*Equisetum arvense*), thistles and nettles being the major weeds specified.

	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)
Glyphosate	56	86	0.21	0.19	1.14
Propachlor	49	121	0.18	0.19	1.00
Isoxaben	40	7	0.14	0.16	1.00
Lenacil	40	10	0.14	0.16	1.00
Chlorthal-dimethyl	28	74	0.10	0.11	1.00

Herbaceous Plants - Insecticides

Two insecticides, cypermethrin, accounting for 60% of the treated area, and lambda-cyhalothrin, for 19%, were used on most of the total area treated, with four applications of each being applied. The pyrethroids accounted for 85% of the insecticide-treated area, carbamates 7% and organophosphates 7%. General pest control was the main reason specified by growers for the use of insecticides, accounting for 50% of the total insecticide-treated area, with aphids and caterpillars, accounting for a further 36% and 14% respectively.

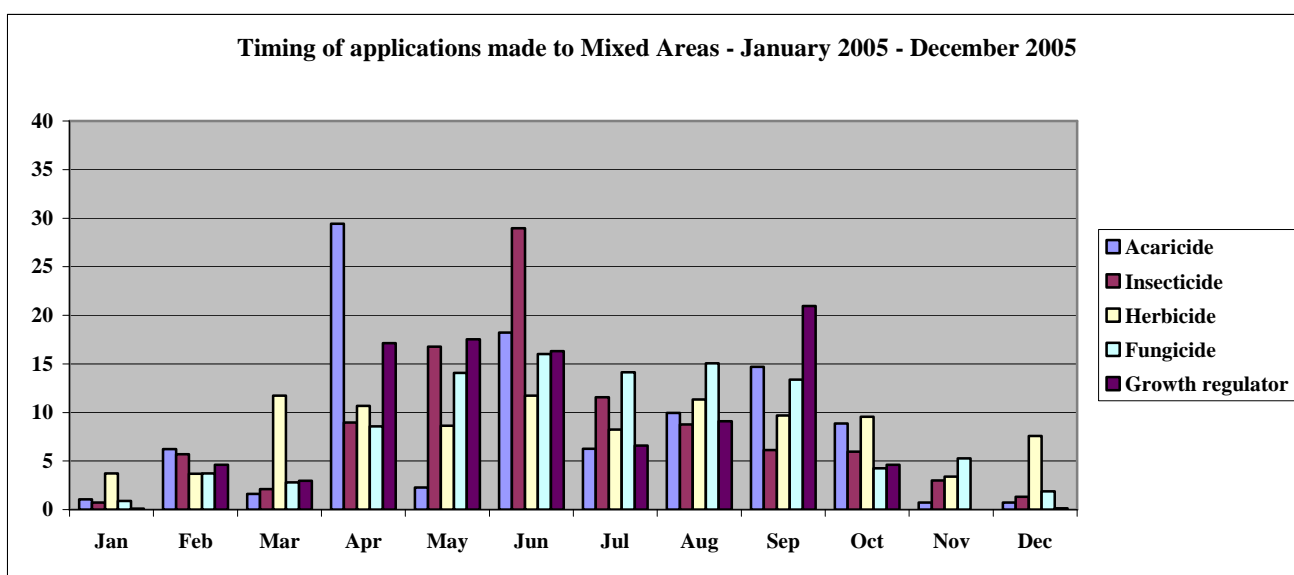
	Formulation area treated (ha)	Weight of a.s. applied (kg)	Proportion of insecticide-treated area	Proportion of census area treated	Average number of applications (where applied)
Cypermethrin	108	3	0.60	0.11	3.80
Lambda-cyhalothrin	35	0	0.19	0.03	4.00
Pirimicarb	13	2	0.07	0.05	1.00
Deltamethrin	9	0	0.05	0.03	1.11
Dimethoate	7	2	0.04	0.02	1.27

Herbaceous Plants – Other pesticides

Compost teas were the only “other pesticide” recorded. Compost teas are made using a compost tea brewer where air is circulated through a mixture of compost and water. The resulting ‘tea’ that is extracted can be rich in microbial organisms as well as containing nutrients. Compost tea is claimed to have many beneficial effects including protection against pests and diseases and stimulating healthy crop growth (Soil Association website).

PESTICIDE USAGE ON MIXED AREAS

Mixed areas of mainly container-grown plants accounted for 22% of the total area of hardy nursery stock, with 26% being grown in the Eastern region, 21% in London & the South East region, 12% in the North West and 10% in the West Midlands. Herbicides accounted for 35% of the total pesticide-treated area, fungicides 31%, insecticides 20%, "other pesticides" 11%, acaricides 2%, molluscicides and growth regulators one percent each and sulphur less than one percent. In terms of weight of active substances applied, fungicides comprised 41% of the total, "other pesticides" 31%, herbicides 19%, insecticides 9% and growth regulators, molluscicides, sulphur and acaricides less than one percent each. Because of the diversity of species of container-grown plants, the range of pesticides used and their reasons for use are far greater than for any other hardy nursery stock crop group. Over 92% of mixed areas sampled received a pesticide application. On average, mixed areas were treated with twenty-four sprays, thirty-two products and thirty-six active substances. However, many of these sprays are likely to include spot applications and partial treatments to areas with specific pest, disease and weed problems. Crop movements around a nursery also presents additional problems and data collected relate to the annual production of each individual nursery. Approximately 64% of the container crop is 12 months old or less.



Mixed areas - Fungicides

Myclobutanil and fosetyl-aluminium were the most frequently used fungicide active substances, with an average of three applications of each being used on 10% of the area grown. By weight, fosetyl-aluminium, applied mainly as a drench for root rots, primarily *Phytophthora* spp. and *Pythium* spp., accounted for 76% of the total. General disease control was given as a reason for use on 31% of the area treated, where a reason was specified. Specifically important diseases included mildew, both downy and powdery, on 35% of the area, bacterial canker/shot hole on 6%, root rots 6%, mildew/scab 5%, rusts 4%, scab 3%, botrytis 3% and leaf spot 2%.

	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)
Myclobutanil	490	30	0.13	0.10	2.86
Fosetyl-aluminium	451	11,522	0.12	0.10	2.56
Chlorothalonil	336	444	0.09	0.08	2.38
Azoxystrobin	316	73	0.08	0.08	2.40
Prochloraz	273	119	0.07	0.08	2.15

Mixed areas - Herbicides

Herbicides were used both for weed control on beds prior to standing down and for the control of weeds on the surface of containers. Oxadiazon, the principal herbicide, accounted for 26% of the herbicide-treated area, with an average of two applications used on 28% of the total area grown. The use of isoxaben comprised a further 22% of the herbicide-treated area with an average of three products used on 22% of the area grown. Two active substances, oxadiazon (46%) and glyphosate (16%), accounted for over half of the total weight of herbicides applied. General weed control was the main reason given, comprising 95% of the treated area where a reason was specified. Broad-leaved weeds accounted for the remainder, with hairy bitter cress (*Cardamine hirsuta*), willowherb (*Epilobium spp.*) and pearlwort (*Sagina procumbens*) being the most commonly identified species.

	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)
Oxadiazon	1,154	3,192	0.26	0.38	1.79
Isoxaben	953	198	0.22	0.22	2.57
Glyphosate	742	1,082	0.17	0.19	2.36
Paraquat	236	216	0.05	0.09	1.62
Diquat/paraquat	223	211	0.05	0.05	2.45

Mixed areas - Insecticides

Pyrethroids were the major insecticide group used, accounting for 30% of the pesticide-treated area; organophosphates were used on a further 21%; the pyrazole fipronil 19%: neonicotinoids 13% and carbamates 8%. Fipronil was the most extensively-used active substance, with a single compost incorporation, mainly applied for vine weevil (*Otiorhynchus sulcatus*) control, being used on 28% of the area grown and accounting for 19% of the insecticide-treated area. An average of two applications of chlorpyrifos were made to 12% of the area grown. By weight chlorpyrifos, mainly applied for vine weevil control either as a drench or as incorporated granules, comprised 77% of the total weight of insecticides applied. Imidacloprid, again mainly used as compost incorporation for the control of vine weevil, comprised a further 12% of the total weight of insecticides applied. Vine weevil control was the reason given for treatment of 52% of the insecticide-treated area, where a reason was specified; aphids comprised a further 22% and caterpillars 11%.

	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)
Fipronil	474	71	0.19	0.28	1.01
Chlorpyrifos	352	2,689	0.14	0.12	1.78
Bifenthrin	259	15	0.11	0.12	1.28
Imidacloprid	251	409	0.10	0.11	1.41
Deltamethrin	242	2	0.10	0.07	2.10

Mixed areas – Other pesticides

Usage of "other pesticides" included biological control agents, which accounted for 41% of the total area, growth stimulants for 32%, disinfectants 9%, surface cleaners 9%, physical control agents 7%, algicides one percent and tar oil and defoliant for less than one percent.

Most biological control agents, 58%, were used for two-spotted spider mite control, these included *Phytoseiulus persimilis* and *Amblyseius cucumeris*, accounting for 32% and 31% of the total biological control-treated area respectively. Vine weevil control comprised a further 22% of the total with *Steinernema kraussei*, *Phasmarhabditis hermaphrodita*, *Steinernema feltiae* and *Heterorhabditis megidis* being the principal nematodes recorded. The use of *Bacillus thuringiensis var. kurstaki* for caterpillar control accounted for a further 10% of the biological control-treated area where a reason was specified.

Mixed areas – Other pesticides (cont.)

Compost tea accounted for 87% of the area treated with growth stimulants, with plant extracts comprising much of the remainder.

Peroxyacetic acid and dichlorophen were the principal disinfectants recorded, being used primarily for sterilising beds prior to standing out, 81% of the total area, but also for disease and liverwort/moss control, 6% of the total area each.

Quinoclammin was the only surface cleaner recorded.

Garlic was the principal physical control agent used, accounting for 70% of the total area treated.

Mixed areas – Acaricides

Three active substances, clofentezine accounting for 38%, abamectin for 33% and tebufenpyrad for 25%, comprised over 97% of the total area treated with acaricides. Eighty-seven percent of acaricide usage, where a reason was specified, was for the control of two-spotted spider mite (*T. urticae*), 5% for aphids and 5% for other mites.

Mixed areas – Molluscicides

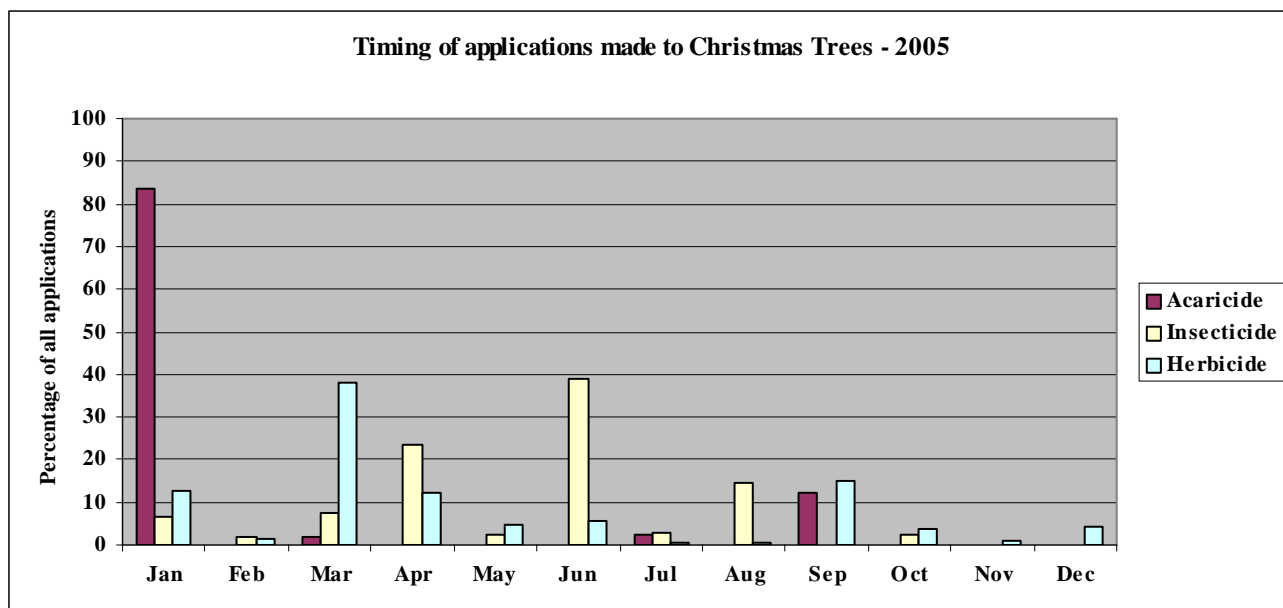
Metaldehyde, for slug control, accounted for 52% of the molluscicide & repellent treated area, methiocarb for 44%, with ferric phosphate and aluminium sulphate being the only other molluscicides specified. Ziram was the only repellent recorded, being used on only one hectare of mixed areas.

Mixed areas – Growth regulators

Daminozide was the principal growth regulator encountered, comprising 95% of the total area treated.

PESTICIDE USAGE ON CHRISTMAS TREES

Christmas trees accounted for 23% of the total area of hardy nursery stock grown, with 36% being grown in London & the South East, 15% in the South West, 14% in the West Midlands and 13% in Yorkshire & the Humber. Herbicides accounted for 69% of the total pesticide-treated area, insecticides 14%, acaricides 8%, growth regulators 5%, sulphur 4% and fungicides one percent. In terms of weight of active substances applied, herbicides comprised 76% of the total, sulphur 16%, insecticides and growth regulators 3% each, acaricides 2% and fungicides less than one percent. Over 55% of Christmas trees sampled received a pesticide application. On average, Christmas trees were treated with four sprays, six products and six active substances.



Christmas trees - Herbicides

Glyphosate was the principal active substance used, accounting for 41% of the herbicide-treated area, with an average of two applications being made to almost half of the area grown. Other important herbicides were diuron, simazine, pendimethalin and atrazine. In terms of weight applied, glyphosate was again the most important herbicide, comprising 36% of the total, with pendimethalin making up a further 16% and simazine 15%. Where a reason for use was specified, general weed control accounted for 69% of the total, willowherb (*Epilobium* spp.) for 13%, broad-leaved weeds 8%, thistles (*Cirsium* spp.) 7%, grass weeds 2% and nettles (*Urtica* spp.) 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)
Glyphosate	1,348	1,282	0.41	0.46	1.68
Diuron	471	413	0.14	0.23	1.18
Simazine	421	524	0.13	0.22	1.07
Pendimethalin	352	558	0.11	0.17	1.15
Atrazine	242	375	0.07	0.11	1.22

Christmas trees - Insecticides

Pirimicarb accounted for 69% of the insecticide-treated area, with, on average a single application being applied to 20% of the area grown. In terms of weight applied, pirimicarb accounted for 46%, chlorpyrifos 32% and dimethoate 21%. Carbamates comprised 69% of the total area of Christmas trees treated with insecticides, organophosphates 16% and pyrethroids 13%. Where a reason for use was specified, control of aphids accounted for 88% of the total area treated, general pest control 8%, with a combination of aphids/mites accounting for a further 4%. The most important individual aphid species mentioned was the green spruce aphid, *Elatobium abietinum*.

	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)
Pirimicarb	445	72	0.69	0.20	1.25
Dimethoate	66	33	0.10	0.03	1.10
Cypermethrin	44	1	0.07	0.02	1.22
Chlorpyrifos	35	50	0.05	0.01	2.00
Deltamethrin	25	0	0.04	0.01	1.39

Christmas trees - Acaricides

One active substance, clofentezine, comprised 96% of the acaricide-treated area, with a single application being made to 18% of the area grown. Growers in many cases cited mites, including probably erroneously two-spotted spider mite and rust mites, as the main reasons for use, though the species also cited and more likely to be encountered is the conifer spinning mite *Oligonychus ununguis*.

	Formulation area treated (ha)	Weight of a.s. applied (kg)	Proportion of acaricide-treated area	Proportion of census area treated	Average number of applications (where applied)
Clofentezine	339	65	0.96	0.18	1.08
Tebufenpyrad	41	6	1.00	0.02	1.00
Fenpyroximate	13	1	0.04	0.01	1.00

Christmas trees – Growth regulators

1-naphylacetic acid was the only growth regulator encountered in the survey; with most applications being made using a roller impregnated with the product being applied directly to the growing points of an individual tree where growth retardation was required.

Christmas trees - Sulphur

The usage of sulphur, 56% of the area treated where a reason was specified, was for the control of rust mites, with the remaining 44% being used for unspecified mite species.

COMPARISON WITH PREVIOUS SURVEYS

Comparisons are made between the current survey and previous three surveys in 1993, 1997 and 2001 (Tables 9 & 10).

Since 1993, there had been a 6% decrease in the total area of hardy nursery stock grown, with a one percent decrease since the previous survey in 2001. However, since 2001, the relative areas of some crop groups had changed. The areas of roses, Christmas trees, herbaceous plants and fruit stock decreased by 34%, 32%, 30% and 8% respectively. However, the areas of shrubs etc. increased by 89% since 2001, that of ornamental trees by 34% and mixed areas by 7%.

Since 1993, the overall pesticide-treated area had increased by 10% and by 18% since the previous survey. However, in terms of the weight of pesticides applied, there had been decreases of one percent since 1993, 8% since 1997 but an increase of 51% since the last survey, reflecting the increased use of soil sterilants between 2001 and 2005. The overall rate of application of all registered pesticides had declined over the last twelve years from 1.9 kg/hectare in 1993, to 1.72 kg in the current survey. The area treated as a percentage of the area grown increased from 676% in 2001 to 807% in this survey, continuing the rise from 694% in 1981, reflecting an increase in the average number of sprays from 9 sprays in 1993 to 14 sprays in 2005.

Herbicides - Comparison

As in 1997 and 2001, herbicides were the major pesticide group recorded in 2005. However, their usage had increased by 33% percent since 1993, 12% since 1997 and 33% since the previous survey. However, despite the increase in the area treated the weight of herbicides applied fell by 19% since 1993, but increased by 26% since 2001. In terms of the rate of application of herbicides, the decline over the same period was from 1.62 kg/hectare in 1993 to 0.99 kg/hectare in this survey. In the current survey herbicides comprised 50% of the principal 20 active substances by area treated. Usage of the two principal herbicides in 2005, glyphosate and phenmedipham, had increased by 16% and 406% respectively since the last survey. Since 1993 the use of simazine, the principal herbicide used in this year, has largely been replaced by glyphosate. By weight applied, glyphosate was the most important herbicide used in 2005, increasing by 13% since 2001.

Changes in the area treated (ha) for the top five herbicides in 2005 used over the period 1993 – 2005 (figures in parentheses refer to position in previous years)				
Formulation	2005	2001	1997	1993
Glyphosate	4,854	4,175 (1)	3,477 (1)	1,989 (5)
Phenmedipham	3,231	639 (14)	1,253 (8)	219 (15)
Simazine	2,012	1,923 (3)	3,236 (2)	2,576 (1)
Metazachlor	2,008	1,643 (5)	1,835 (4)	2,322 (3)
Isoxaben	1,812	1,971 (2)	2,572 (3)	1,434 (7)

Fungicides - Comparison

Levels of fungicide usage have declined since 1993, with a 22% decrease observed since 1993 and 5% since 2001. However, the rate of fungicide application has increased from 1.31 kg/ha in 1993, 0.71 kg/ha in 2001 to 1.42 kg/ha in 2005, with much of this rise being due to an increased usage of fosetyl-aluminium drenches and the introduction of potassium hydrogen carbonate both of which are used at relatively high recommended rates. Because of the increase in the average rate of fungicides applied, the total weight applied in 2005 was 17% less than in 1993, but 81% more than in 2001. Myclobutanil, the most important fungicide in all four surveys, showed a 47% decrease in the area treated since 2001. Chlorothalonil, at number ten by area treated, increased by five times since 2001, with a four-fold increase in the weight applied. Usage of bupirimate, azoxystrobin and fenpropimorph all showed declines since in area treated since 2001. As has already been mentioned, the weight of fosetyl-aluminium used in 2005 more than doubled since 2001, whilst potassium hydrogen carbonate, ranked eighth by weight applied, was recorded for the first time in 2005.

Changes in the area treated (ha) for the top five fungicides in 2005 used over the period 1993 – 2005 (figures in parentheses refer to position in previous years)				
Formulation	2005	2001	1997	1993
Myclobutanil	2,845	5,395 (1)	6,262 (1)	5,444 (1)
Chlorothalonil	1,735	333 (15)	617 (8)	1,303 (4)
Bupirimate	1,242	1,656 (2)	1,492 (4)	1,527 (3)
Azoxystrobin	1,167	611 (7)	.	.
Fenpropimorph	874	894 (3)	2,246 (2)	550 (11)

Insecticides - Comparison

Overall, in terms of area treated, insecticide usage had increased by 6% since 1993 and by 19% since 2001. The average rate of application of insecticides decreased from 0.98 kg/hectare in 1993 to 0.44 kg/hectare in 2005, primarily resulting from the decreased use and rate of application of organophosphate insecticides, particularly as granular compost-incorporated products. This reduction in rate of application has resulted in a fall in the weight of insecticides applied, of 54% since 1993 and 34% since 2001. Much of this weight reduction has been due to an increase in the area treated with pyrethroids, the principal insecticide group for the first time in 2005, which are applied at relatively low recommended rates. Use of pyrethroids has more than doubled since 1993 and increased by 74% since 2001. Since 1993 the area treated with organophosphates has halved and decreased by 4% since 2001. Carbamate usage has increased by 29% since 1993, but decreased by 4% since 2001.

Five insecticides were present in the principal twenty by area treated, but only one, chlorpyrifos, by weight applied. Usage of deltamethrin, dimethoate and lambda-cyhalothrin increased in terms of area treated, whereas the usage of pirimicarb and chlorpyrifos both decreased. The weight of the organophosphate insecticide, chlorpyrifos, commonly applied at relatively high rates as an incorporated granule at potting for the control of vine weevil, *O. sulcatus*, decreased by 46% since 2001. By contrast, the weight of imidacloprid applied increased by 65% and the use of fipronil was recorded for the first time in 2005; both active substances are used as alternatives to chlorpyrifos for vine weevil control.

Changes in the area treated (ha) for the top five insecticides in 2005 used over the period 1993 – 2005 (figures in parentheses refer to position in previous years)				
Formulation	2005	2001	1997	1993
Pirimicarb	2,990	3,033 (1)	3,600 (1)	1,948 (1)
Deltamethrin	2,491	1,254 (3)	1,565 (5)	555 (8)
Dimethoate	1,524	431 (7)	427 (8)	675 (7)
Chlorpyrifos	1,061	1,563 (2)	1,919 (2)	1,519 (3)
Lambda-cyhalothrin	888	292 (8)	133 (11)	226 (12)

Acaricides - Comparison

The area treated with acaricides increased by 11% since 1993, but had decreased by 41% since the previous survey. No acaricide active substances appeared in the principal twenty by area treated or weight applied. Clofentezine was forty-second by area treated and showed a doubling of use since 2001, while tebufenpyrad, appearing at number forty-seven, had decreased by 55% since 2001. The rate of acaricide application declined from 0.36 kg/hectare in 1993 to 0.15 kg/hectare in 2005.

Changes in the area treated (ha) for the top five acaricides in 2005 used over the period 1993 – 2005 (figures in parentheses refer to position in previous years)				
Formulation	2005	2001	1997	1993
Clofentezine	469	231 (2)	559 (4)	245 (1)
Tebufenpyrad	322	709 (1)	438 (6)	
Abamectin	157	147 (4)	539 (5)	
Fenpropathrin	134	118 (6)	986 (1)	216 (2)
Amitraz	53	207 (3)	59 (10)	59 (4)

Other pesticides – Comparison

The area treated with sulphur in 2005 was twenty times greater than that in 1993, and over three times greater than in 2001. Growers cited mildew, primarily powdery mildew, as the main reason for use.

The use of biological control agents, particularly non-registered predatory or parasitic species, accounted for one percent of the treated area, but had increased over three times since 1993 and by over eight times since 2001. In particular the use of *Phytoseiulus persimilis* increased by almost five times since 1993 and by almost sixty-three times since 2001. In general, however, biological control accounted for only a fraction of conventional pesticide control and is still a long way from replacing chemical usage.

The use of growth regulators, primarily on Christmas trees and mixed areas, increased in usage by almost four times since 1993 and by thirty-seven times since the last survey.

Molluscicide & repellent usage in terms of area treated decreased by 43% between 1993 and 2005, and by 54% since 2001. No molluscicides appeared in the principal 50 active substances by area treated or weight applied.

The area treated with soil sterilants decreased by 26% since 1993, but doubled between 2001 and 2005, with the weight applied by increasing by 46% since 1993 and doubling between 2001 and 2005. The three major soil sterilants by weight applied in 2005, dazomet, first in the principal twenty, methyl bromide third and chloropicrin, twenty-ninth, did not appear in the principal 50 by area treated. Usage of dazomet and methyl bromide increased since 2001, whilst chloropicrin was recorded for the first time.

Usage of tar oils/acids was minimal in 2005, with the area treated declining by 98% since 1993 and by 98% since 2001.

The use of registered disinfectants has remained consistent, with a decrease of 7% between 1993 and 2005, and 17% since the last survey.

The usage of urea, not recorded in 1993, had increased by over four times since 2001.

Table 9. Comparison of pesticide usage on hardy nursery stock 1993 - 2005, area treated (ha) and amount used (kg)

	1993		1997		2001		2005	
	ha	kg	ha	kg	ha	kg	ha	kg
<i>Acaricides</i>	1,046	280	5,432	1,476	1,948	294	1,158	171
<i>Insecticides</i>								
<i>Benzoylureas</i>	149	14	20	1	56	157	158	17
<i>Carbamates</i>	2,313	1,452	3,652	1,022	3,125	770	2,994	512
<i>Organochlorines</i>	933	111	625	426	44	21	.	.
<i>Organophosphates</i>	6,282	10,251	5,283	6,901	3,289	7,019	3,142	4,176
<i>Pyrethroids</i>	1,999	38	3,514	66	2,522	44	4,400	73
<i>Other insecticides</i>	154	61	292	78	1,422	380	1,791	735
Total – all insecticides	11,830	11,927	13,387	8,493	10,460	8,391	12,484	5,513
<i>Registered biological control agents</i>	139	105	47	12	< 1	< 1	62	1
<i>Fungicides</i>	21,819	29,014	22,303	20,322	17,948	13,403	17,049	24,225
<i>Sulphur</i>	128	912	69	526	804	2,257	2,577	6,394
<i>Growth regulators</i>	91	544	128	535	9	10	336	222
<i>Herbicides</i>	21,113	34,135	25,062	28,126	21,032	21,995	28,003	27,643
<i>Molluscicides & repellents</i>	323	1,493	236	700	400	169	183	97
<i>Nematicides</i>	.	.	8	1,995	2	576	.	.
<i>Soil sterilants</i>	119	28,421	95	52,164	43	20,482	88	41,471
<i>Tar oils/acids</i>	52	877	39	1,868	41	2,994	1	12
<i>Fungicide/insecticides</i>	2	1	7	2	.	.	25	1
<i>Urea</i>	.	.	7	4	18	36	78	98
<i>Disinfectants</i>	61	542	31	360	69	755	57	691
<i>Algicides</i>	.	.	.	.	.	.	7	25
<i>Other registered pesticides</i>	18	3	51	1	62	11	.	.
Total - all registered pesticides	56,676	107,690	66,870	116,223	52,768	70,616	62,118	106,616
<i>Non-registered biological control agents</i>	130	.	32	.	101	.	764	.
<i>Other non-registered pesticides</i>	.	.	124	357	200	412	851	13,147
Area grown	8,172		8,706		7,806		7,697	

Table 10. Comparison of pesticide usage on hardy nursery stock, 1981 - 2001, area treated as % of area grown and rate of active substance use (kg/ha)

	1993		1997		2001		2005	
	area treated as % of area grown	rate (kg/ha)	area treated as % of area grown	rate (kg/ha)	area treated as % of area grown	rate (kg/ha)	area treated as % of area grown	rate (kg/ha)
<i>Acaricides</i>	9	0.36	53	0.32	21	0.17	15	0.15
<i>Insecticides</i>								
<i>Benzoylureas</i>	2	0.10	< 1	0.05	1	2.79	2	0.11
<i>Carbamates</i>	28	0.63	42	0.28	40	0.25	39	0.17
<i>Organochlorines</i>	11	0.12	7	0.68	1	0.48	.	.
<i>Organophosphates</i>	77	1.63	61	1.31	42	2.13	41	1.33
<i>Pyrethroids</i>	28	0.02	50	0.02	36	0.02	57	0.02
<i>Other insecticides</i>	2	0.39	3	0.27	18	0.27	23	0.41
<i>Total – all insecticides</i>	148	0.98	163	0.60	138	0.78	162	0.44
<i>Registered biological control agents</i>	2	0.75	1	0.25	< 1	1.48	1	0.02
<i>Fungicides</i>	266	1.31	257	0.89	229	0.71	221	1.42
<i>Growth regulators</i>	1	6.01	1	4.17	< 1	1.08	4	0.66
<i>Herbicides</i>	258	1.62	288	1.12	269	1.05	364	0.99
<i>Molluscicides & repellents</i>	4	4.62	3	2.97	5	0.42	2	0.53
<i>Nematicides</i>	.	.	< 1	254.25	< 1	254.25	.	.
<i>Soil sterilants</i>	1	239.82	1	549.90	1	470.96	1	472.22
<i>Sulphur</i>	2	7.14	1	7.66	10	2.81	33	2.48
<i>Tar oils/acids</i>	1	16.96	< 1	47.70	1	73.78	< 1	9.18
<i>Urea</i>	.	.	< 1	0.56	< 1	1.97	1	1.25
<i>Other pesticides</i>	< 1	0.16	1	0.02	1	0.18	.	.
<i>Total - all registered pesticides</i>	694	1.90	768	1.74	676	1.34	807	1.72
<i>Other chemicals</i>	.	.	1	14.26	2	7.89	11	15.28
<i>Non-registered biological control agents</i>	2	.	.	.	1	0.75	10	.

ACKNOWLEDGEMENTS

Thanks are due to all of the growers who willingly participated in this survey, providing invaluable information upon which this report is based. Many thanks are also due to Helen Anderson, Alistair Battersby, Edward Heywood, Jeremy Snowden, Harley Stoddart, Gillian Struthers, and Louis Thomas for their invaluable role in collecting data, as well as to Gillian Parrish and Lynda Smith for their able assistance in data collation.

REFERENCES

Anon. (2005a) *Agricultural Statistics in England and Wales 2004*. London: HMSO.

Anon. (2005b) *Agricultural Statistics in Scotland 2004*. Edinburgh: HMSO.

Anon. (2006a) *Agricultural Statistics in England and Wales 2005*. London: HMSO.

Anon. (2006b) *Agricultural Statistics in Scotland 2005*. Edinburgh: HMSO.

Garthwaite, D. G. & Thomas, M. R. (1995) *Pesticide Usage Survey Report 120 - Hardy Nursery Stock in Great Britain 1993*. London: MAFF

Garthwaite, D. G. & Thomas, M. R. (1999) *Pesticide Usage Survey Report 152 - Hardy Nursery Stock in Great Britain 1997*. London: MAFF

Garthwaite, D. G. & Thomas, M. R. (2003) *Pesticide Usage Survey Report 182 - Hardy Nursery Stock in Great Britain 2001*. London: MAFF

Greaves, D. A., Sly, J. M. A. & Cutler, J. R. (1979) *Pesticide Usage Survey Report 14 - Hardy Nursery Stock 1971, 1976*. London: MAFF

McNeil, H. B. (1985) *Pesticide Usage Survey Report 43 - Hardy Nursery Stock 1981, Field Grown Bulbs 1981*. Edinburgh: DAFS.

Scopes, N. & Stables, L. (1989) eds. *Pest and Disease Control Handbook 3rd Edition*. Bracknell: BCPC Publications.

Sly, J. M. A. & Umpelby, R. A. (1983) *Pesticide Usage Survey Report 30 - Hardy Nursery Stock 1981*. London: MAFF.

Thomas, M. R. (2001) *Pesticide usage monitoring in the United Kingdom*. *Annals of Occupational Hygiene*, **45** (supplement 1): S87-S93.

Wood, H. J. (1931) *An Agricultural Atlas of Scotland*. London: George Gill & Sons.

Surveys which include data relating to Scotland are marked with *

Surveys which include data relating to Northern Ireland are marked with #

PUBLISHED REPORTS¹

171	Arable farm crops in Great Britain 2000*	PB 8014	£2.00
172	Orchards and fruit stores in Great Britain 2000*	PB 6168	£1.50
173	Hops in Great Britain 2000	PB 6169	£1.00
174	Potato stores in Great Britain 2000*	PB 8015	£1.50
175	Rodenticide usage on farms in Great Britain growing arable crops 2000*	PB 8016	£1.50
176	Aerial applications, Great Britain 2000*	PB 8152	£1.50
177	Arable crops, Northern Ireland 2000 [#]	ISBN 1 85527 670 4	
178	Top fruit crops, Northern Ireland 2002 [#]	ISBN 1 85527 618 6	
179	Farm grain stores in Great Britain 1998/99*	PB 6170	£1.00
180	Commercial grain stores in Great Britain 1998/99*	PB 6171	£1.00
181	Soft fruit crops in Great Britain 2001*	PB 8017	£1.50
182	Hardy nursery stock in Great Britain 2001*	PB 8177	£1.50
183	Outdoor bulbs and flowers in Great Britain 2001*	PB 8153	£2.00
184	Aerial applications, Great Britain 2001*	PB 8154	£1.50
185	Rodenticide usage by Local Authorities in Great Britain 2001*	PB 10194	£2.50
186	Aerial applications, Great Britain 2002*	PB 8176	£1.50
187	Arable crops in Great Britain 2002*	PB 9148	£4.00
188	Grassland & fodder crops in Great Britain 2002*	PB 10195	£3.00
189	Potato stores in Great Britain 2002*	PB 10196	£1.50
192	Farm grain stores in Great Britain 2002/03*	PB 10342	£5.00
193	Commercial grain stores in Great Britain 2002/03*	PB 10343	£5.00
194	Arable crops, Northern Ireland 2002 [#]	ISBN 1 85527 674 7	
195	Outdoor vegetable crops in Great Britain 2003*	PB 10344	£6.50
196	Protected crops (edible and ornamental) in Great Britain 2003*	PB 10798	£11.50
197	Mushroom crops in Great Britain 2003*	PB 10345	£5.00
198	Grassland & fodder crops, Northern Ireland 2003 [#]	ISBN 1 85527 797 2	
201	Protected ornamental crops, Northern Ireland [#]	ISBN 1 85527 739 5	
202	Arable crops in Great Britain 2004*	See website below	
203	Orchards and fruit stores in Great Britain 2004	See website below	
204	Hops in Great Britain 2004	See website below	
205	Potato stores in Great Britain 2004*	See website below	
206	Arable crops, Northern Ireland 2004 [#]	ISBN 1 85527 833 2	
207	Vegetable crops, Northern Ireland 2004 [#]	ISBN 1 85527 869 3	
210	Grassland & fodder crops in Great Britain 2005*	See website below	
211	Hardy nursery stock in Great Britain 2005*	See website below	
212	Outdoor bulbs and flowers in Great Britain 2005*	See website below	

Copies of reports categorised PB may be purchased from Defra Publications, Admail 6000, London SW1A 2XX

Tel: 08459 556000

Copies of reports categorised ISBN may be obtained through Her Majesty's Stationery Office.

¹For information on reports prior to number 171 consult our website at: <http://www.csl.gov.uk/pus>