

PESTICIDE USAGE IN SCOTLAND

***HARDY NURSERY
STOCK 1997***

J P Snowden

Scottish Agricultural Science Agency

East Craigs, Edinburgh EH12 8NJ

E-mail: Jeremy.Snowden@sasa.gov.uk



Scottish Agricultural Science Agency

*Scottish Executive Rural Affairs Department, East Craigs, Edinburgh EH12 8NJ
Telephone : 0131 244 8862*

© Crown copyright reserved 1999

	● <i>Page</i>
Summary.....	1
Introduction	2
Definitions and notes.....	2
Method	3
Fruit stocks	4
Roses and rose stocks.....	5
Ornamental trees and shrubs	6
Other nursery stock	7
Comparisons with previous surveys.....	8
References	9
Acknowledgements	9
Figure 1 land-use regions of Scotland	10
Figure 2 hardy nursery stock crop areas in 1997	11
Figure 3 percentage of crop areas treated with pesticides	11
Table 1 crop areas 1997	12
Table 2 areas of crops and numbers of holdings surveyed	12
Table 3 proportions of crops treated with pesticides	13
Table 4 fruit stocks: insecticides and fungicides	14
Table 5 fruit stocks: herbicides	15
Table 6 roses and rose stocks: insecticides and fungicides.....	16
Table 7 roses and rose stocks: herbicides	17
Table 8 ornamental trees and shrubs: insecticides	18
Table 9 ornamental trees and shrubs: fungicides and soil sterilants.....	19
Table 10 ornamental trees and shrubs: herbicides	20
Table 11 other hardy nursery stock: insecticides, molluscicides, fungicides and herbicides	21
Table 12 all hardy nursery stock: insecticides and molluscicides, active ingredients	22
Table 13 all hardy nursery stock: usage of fungicides and soil sterilants, active ingredients	23
Table 14 all hardy nursery stock: usage of herbicides, active ingredients.....	24
Table 15 all hardy nursery stock: quantities of insecticides and molluscicides	25
Table 16 all hardy nursery stock: quantities of fungicides and soil sterilants	26
Table 17 all hardy nursery stock: quantities of herbicides.....	27
Table 18 principal active ingredients: 20 most used active ingredients (area)	28
Table 19 principal active ingredients:20 most used active ingredients (quantity).....	28
Table 20 all hardy nursery stock: comparison of pesticide usage 1981 - 1997	29



This report presents information from a survey of pesticide usage on hardy nursery stocks grown in Scotland in 1997. Since the previous survey in 1993, the total area of hardy nursery stocks had fallen by 25% to 341 hectares.

Pesticide usage, as measured by the proportion of the area of all field-grown hardy nursery stock treated, was roughly similar to that recorded in 1993, with insecticides applied to 58%, fungicides 34%, and herbicides 83% of the treated area.

The principal insecticides recorded were deltamethrin (94 spray hectares), demeton-S-methyl (51 spray hectares) and permethrin (50 spray hectares). Molluscicide usage was very low.

The most popular fungicides employed were bupirimate (80 spray hectares), chlorothalonil (72 spray hectares) and myclobutanil (41 spray hectares).

The most widely used herbicide was glyphosate (122 spray hectares). Paraquat (56 spray hectares) and glufosinate-ammonium (48 spray hectares) were also popular.

INTRODUCTION

This was the fourth survey of pesticide usage on hardy nursery stock crops. The previous three were in 1976, 1981 and 1993 (References 1, 2 & 3). Crops surveyed included fruit stocks, roses and rose stocks, ornamental trees and shrubs, and other nursery stocks comprising herbaceous plants and heathers.

DEFINITIONS AND NOTES

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

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

The crops within the category 'Ornamental trees and shrubs' includes all trees and shrubs, including conifers.

The crops within the category 'Other hardy nursery stock' excludes all trees and comprise herbaceous plants and heathers.

Although most of the crops were field-grown, small areas, in particular, ornamental trees and shrubs, were grown in containers. It was not possible to calculate the proportion of these crops treated with individual pesticides or pesticide groups as the continuous throughput of plants does not allow accurate recording of the appropriate data. In this report therefore, where the proportions treated with individual pesticides or pesticide groups are recorded, they refer solely to field-grown crops.

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

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

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

Data from the 1993 survey are provided for comparison purposes in some of the tables, although it should be borne in mind that there may be minor differences in the range of crops surveyed, together with changes in areas of each of the crops grown.

Using the 1996 Agricultural Census (Reference 4), a sample was drawn representing the whole of Scotland and was selected from holdings growing any of the hardy nursery stock crops.

The country was divided into 11 land-use regions (Fig 1, Reference 5). Holdings were stratified by land-use region and by size group. Sampling fractions within size groups were based on the areas of the relevant crops grown rather than number of holdings, so that smaller size groups would not dominate the sample.

Information on pesticide usage was collected by personal interview. The survey period was the 12 months from September 1996 to September 1997. Total areas of crops surveyed, together with the number of holdings visited are presented in Table 2. A more detailed breakdown involving the land-use regions and size-groups cannot be published in this report as, in many instances, fewer than 5 holdings are involved.

For all crops, sample data were raised to give estimates of national pesticide usage using raising factors. These were based on the areas growing hardy nursery crops in the 1997 Agricultural Census (Reference 6) within regions and size groups. Land-use regions 1, 2, 3 and 4 were amalgamated (Northern Scotland), as were regions 5 & 6 (Angus & East Fife), and regions 7, 9, 10 and 11 (South & South-East Scotland). Adjustments were made for each crop within each region by applying the raising factors to the sample area of each crop grown and comparing this with the area from the 1997 Agricultural Census. A second adjustment was made for crops where no holdings were sampled in one or more regions. Because of possible confusion of growers over where to record some types of hardy nursery stock in the Agricultural Census, in particular those assigned to either the 'Ornamental trees and shrubs' or 'Other hardy nursery stock' categories, the areas were amalgamated and estimates of the areas of crops as defined earlier in this report (Definitions, Page 2) were obtained. In order to prevent disclosure of information about individual holdings where there are fewer than 5 in any sampling unit, raising factors are not published in this report.

The area of fruit stocks in 1997 was 31.3 hectares, a 5% increase since the previous survey. It was estimated that nearly all (29.7 hectares) was raspberry spawn, whilst the remaining small area was made up of a mixture of soft and top fruits, mainly in containers.

● *Insecticides (Table 4)*

Eighty-seven percent of fruit stocks were treated with insecticide, compared with 66% in 1993. Demeton-S-methyl was the predominant insecticide recorded, applied to 41 spray hectares of raspberry spawn, for aphid control. The other insecticides recorded were applied to small areas of container-grown stock.

● *Fungicides (Table 4)*

The proportion of the crop treated with fungicide was 56%, similar to that recorded in 1993. As then, the main reason for its use was for mildew control on raspberry spawn. The principal fungicide was bupirimate, applied to 16 spray hectares treating 37% of the area of fruit stocks, followed by triadimefon, applied to 6 spray hectares covering 19% of the crop.

● *Herbicides (Table 5)*

As in the previous survey, nearly all the crop was treated with herbicide. The two principal herbicides recorded were bromacil and isoxaben, each applied to 15 spray hectares, 50% of the area of fruit stocks, for general weed control. In 1993, the most commonly used herbicide had been propachlor, which was not recorded in the present survey.

The area of roses grown in 1997 was 23.7 hectares, a 24% increase on the area recorded in 1993. It was estimated that over 80% of roses were field-grown, with the remainder in containers.

● ***Insecticides (Table 6)***

Just under half the area of roses was treated with insecticide, similar to the figure recorded in the previous survey. Nearly all insecticide usage was for aphid control, with only small areas treated for other pests (caterpillars, whitefly and vine weevil).

As in the previous survey, pirimicarb was the principal insecticide used, and was applied to 11 spray hectares, 38% of the crop area.

● ***Fungicides (Table 6)***

Nearly all the crop received a fungicide, compared with 85% in 1993. Reasons for use of fungicides were for the control of mildew, black spot and rust.

Myclobutanil was the most commonly used fungicide, applied to 32 spray hectares, 90% of the crop area, followed by fenpropimorph to 6 spray hectares, (11%). In the previous survey, benomyl, which had been the principal fungicide recorded, was not recorded in 1997 as it was no longer approved for use on hardy nursery stock.

● ***Herbicides (Table 7)***

As in the previous survey, nearly all the crop was treated with herbicide. Both atrazine and metazachlor were applied to 10 spray hectares, 52% of the crop area. Simazine which had been the most widely used herbicide in 1993, was also popular in the present survey and was applied to 9 spray hectares (48% of the crop).

This is the main category of hardy nursery stocks in Scotland. The area grown in 1997 was estimated to be 260.5 hectares, a significant 22% decrease since 1993. Because of multiple cropping of some of the container-grown stocks, the total throughput of ornamental trees and shrubs was an estimated 317.2 hectares.

● *Insecticides (Table 8)*

As in 1993, the proportion of crop receiving insecticide was around 55%, and again, the main reasons for its use were for aphid and caterpillar control.

The most commonly used insecticide was deltamethrin, applied to 88 spray hectares, 30% of the field-grown crop, followed by permethrin and dimethoate, applied to 48 and 47 spray hectares respectively. Oxydemeton-methyl, which had been the principal insecticide in 1993, was not recorded in the present survey and is no longer approved for use.

● *Fungicides and soil sterilants (Table 9)*

The proportion of crop treated with fungicide was 25%, slightly less than the 33% recorded in 1993. As then the most popular reason for the use of fungicides was against mildew.

As measured by the total area treated, chlorothalonil was the principal fungicide recorded, applied to 72 spray hectares, but to only 3% of field-grown crops, the apparent disparity being due to the large number of repeated treatments on a relatively small area. On the other hand, when the area of the crop treated is taken into account, benomyl was the most commonly used fungicide, applied to 10% of the crop, but to only 21 spray hectares.

● *Herbicides (Table 10)*

Seventy-nine percent of field-grown ornamental trees and shrubs were treated with herbicide, compared with 94% in 1993.

Glyphosate was the most commonly used herbicide, applied to 120 spray hectares, 29% of the crop. The usage of simazine and paraquat, which had been the principal herbicides recorded in the previous survey, was much reduced in 1997.

The estimated area of this category comprising herbaceous plants and heathers was only 25.2 hectares, of which nearly all were grown in containers. There were instances of multiple cropping, but the areas involved were insignificant.

● ***Insecticides and molluscicides (Table 11)***

Only very small areas of the crop was treated with insecticide, and usage was considerably less than that recorded in the previous survey. Three formulations were recorded, each applied to less than 0.5 hectare. Pirimicarb, which had been the most popular insecticide recorded in 1993, was not recorded in the present survey.

The molluscicides, metaldehyde and methiocarb, were used on small areas for slug control.

● ***Fungicides (Table 11)***

Iprodione was the only fungicide recorded in the present survey, and was used on less than 0.5 hectare. Benomyl, which had been the principal fungicide in 1993, is no longer approved for use.

● ***Herbicides (Table 11)***

Herbicide usage was restricted to the use of four formulations, each applied to less than 0.5 hectare.

COMPARISONS WITH PREVIOUS SURVEYS

The total area of hardy nursery stocks grown in 1997 was 341 hectares, a 25% reduction since the previous survey, although the areas of both fruit stocks and roses increased slightly.

Comparisons in the usage of pesticides in terms of weight and spray hectares of active ingredients applied between the current and previous surveys are presented in Table [20](#).

Usage of insecticides, as measured by both spray hectares of active ingredients and weight applied, fell to about a third of that recorded in 1993. Pyrethroids replaced organophosphates as the most commonly used insecticide group. The principal insecticides recorded were deltamethrin, demeton-S-methyl and permethrin. In the previous survey, oxydemeton-methyl had been the most commonly used. As in 1993, molluscicide usage was very low.

Even when the 25% reduction in area of crops grown is taken into account, usage of fungicides, as measured by spray hectares of active ingredients, almost halved compared with that in 1993. The most popular fungicides employed were bupirimate, chlorothalonil and myclobutanil. Benomyl, which had been widely used in the previous survey, was not recorded in 1997. The total weight of fungicides recorded was considerably less than in 1993, because in the previous survey, the figures had been inflated by the relatively large areas treated with propamocarb hydrochloride which had been applied at exceptionally high dose rates.

Usage of soil sterilants decreased, but from a low base; weights applied were high compared with other pesticides due to their relatively high rate of application.

Herbicide usage also showed a real reduction, although it was not quite as marked as with the other two major pesticide groups, insecticides and fungicides. The three most popular herbicides were glyphosate, paraquat and glufosinate-ammonium. Usage of simazine, which had been the principal herbicide in 1993, showed a considerable decline in the present survey.

The total spray area of all pesticide active ingredients fell by 23%, compared with 1993, even after the reduction in area grown is taken into account.



REFERENCES

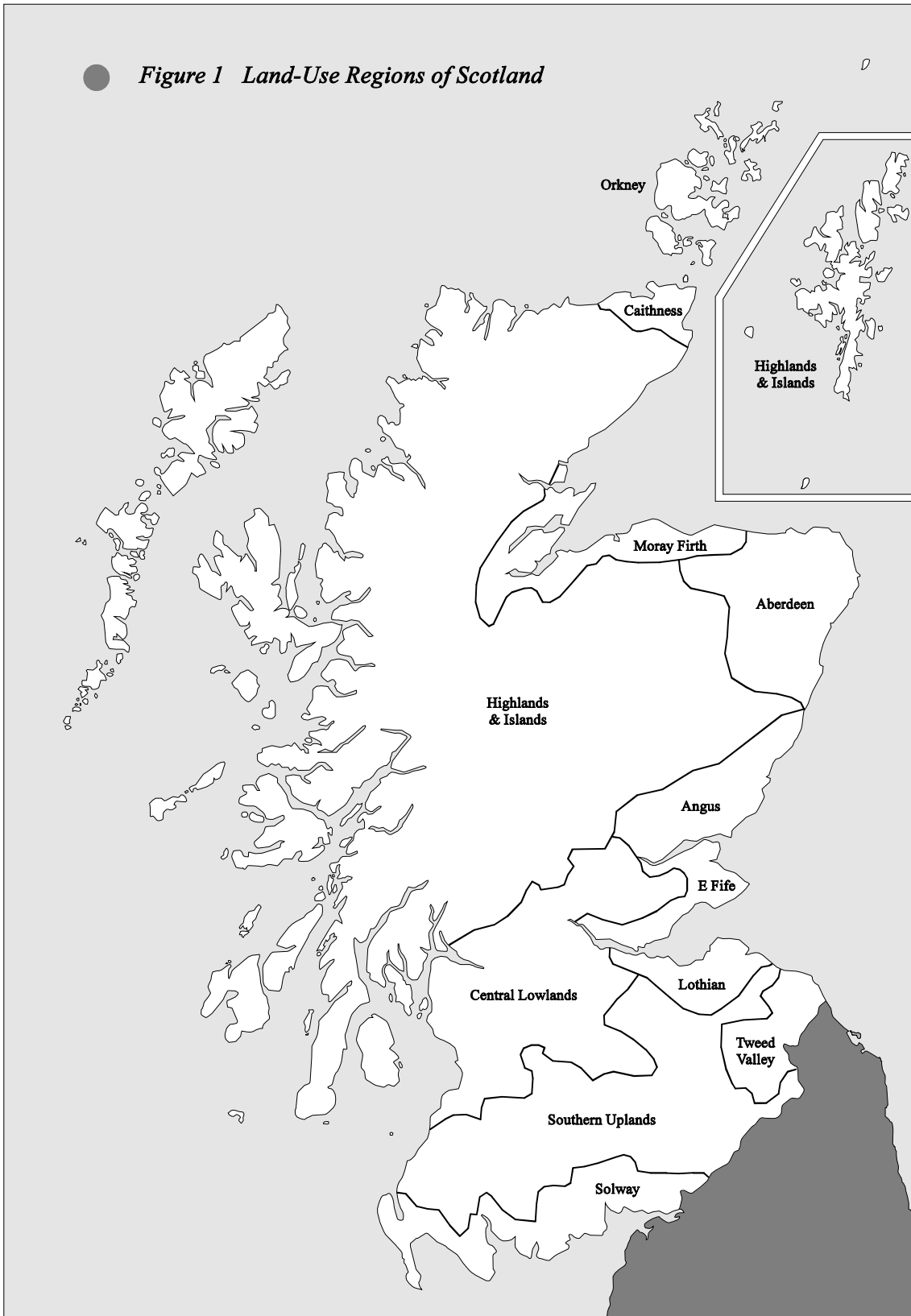
1. Greaves, D.A., Sly, J.M.A. and Cutler, J.R. Pesticide usage survey report 14, Hardy Nursery Stock 1976, London: MAFF 1979.
2. McNeil, Helen B. Pesticide usage survey report 43, Hardy Nursery Stock 1981, DAFS, Edinburgh 1985.
3. Snowden, J.P. Pesticide usage survey report, Hardy Nursery Stock 1993, SOAFD, Edinburgh 1997.
4. Agricultural Statistics, Scotland 1996; HMSO, Edinburgh 1997.
5. Wood, H.J. An Agricultural Atlas of Scotland. George Gill and Sons, London 1931.
6. Agricultural Statistics, Scotland 1997; HMSO, Edinburgh 1998.



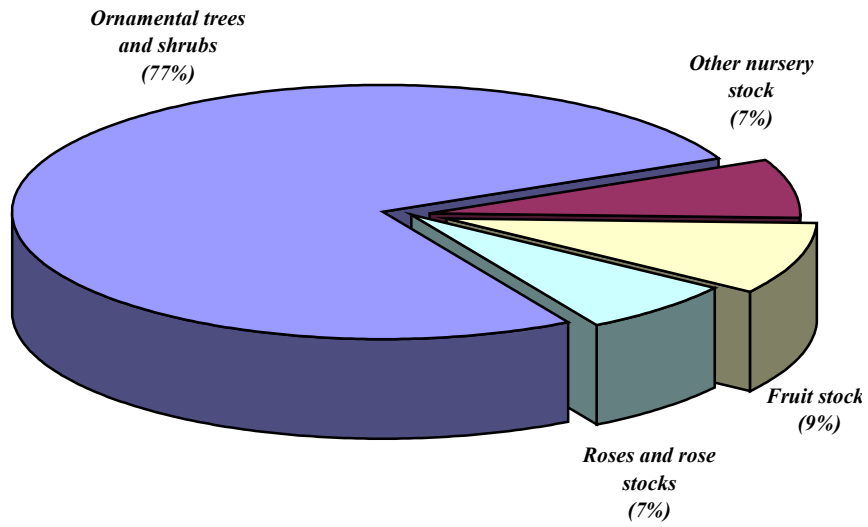
ACKNOWLEDGEMENTS

The author wishes to thank the growers who provided the information for this report. Thanks are also given to Mr L A Thomas and Miss M McCreath who collected some of the data, and to Dr C J Griffiths for providing editorial assistance. In addition, the author is most grateful for support from Information Technology Section, SASA, and to Mr I Nevison of Biomathematics & Statistics Scotland.

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



● **Figure 2 Hardy nursery stock crop areas in 1997**



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

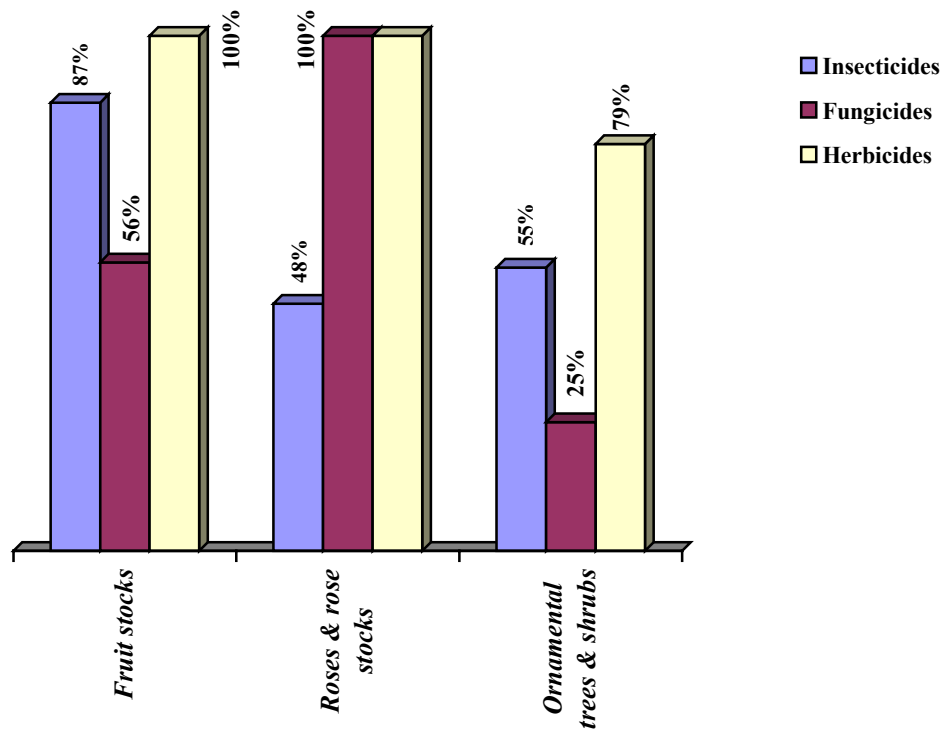


TABLE 1 Crop Areas 1997 (hectares)

	<i>Scotland 1997</i>	<i>Scotland 1993</i>	<i>% change</i>
Fruit stocks	31.3	29.8	5
Roses and rose stocks	23.7	19.1	24
Ornamentals and other stock *	286.1	406.8	-30
All hardy nursery stock	341.1	455.7	-25

*' It was estimated that 260.5 ha were ornamental trees and shrubs (including conifers), and 25.2 ha of other hardy nursery stock (herbaceous plants, alpine etc).

TABLE 2 Areas of crops and numbers of holdings surveyed

	<i>Sampled area (ha)</i>	<i>Census area (ha)</i>
Fruit stocks	14.9	31.3
Roses and rose stocks	11.7	23.7
Ornamentals and other stock	208.0	286.1
All crops	234.6	341.1
Number of holdings	28	140

TABLE 3 Proportions of crops treated with pesticides

	<i>Fruit stocks</i>	<i>Roses & rose stocks</i>	<i>Ornamental trees & shrubs</i>	<i>All field-grown crops</i>
Insecticide	87	48	55	58
Fungicide	56	100	25	34
Soil sterilant			+	+
Herbicide	100	100	79	83
<i>Any pesticide</i>	100	100	93	95

'+' = <0.5%.

TABLE 4 Fruit stocks*Insecticides and fungicides, the reasons for their use (spray hectares of formulations) and percentage of field-grown crop treated*

<i>Insecticides</i>	<i>Aphids</i>	<i>Gooseberry sawfly</i>	<i>Vine weevil</i>	<i>Mildew</i>	<i>Mildew & botrytis</i>	<i>Total spray area</i>	<i>% crop treated</i>
Chlorpyrifos			+			+	++
Demeton-S-methyl	41					41	87
Heptenophos/permethrin	+	+				+	++
Pirimicarb	+					+	++
Pirimiphos-methyl		+				+	++
<i>All insecticides</i>	41	+	+			41	87
<i>Fungicides</i>							
Bupirimate				16		16	37
Bupirimate/triforine					+	+	++
Triadimefon				6		6	19
<i>All fungicides</i>				22	+	22	56
Area planted (ha)							31

‘+’ = <0.5 ha or <0.5%

‘++’ = not recorded on field-grown crops

TABLE 5 Fruit stocks*Herbicides, the reasons for their use (spray hectares of formulations) and percentage of field-grown crop treated*

Herbicides	Annual bl & grass weeds	Couch	General weed control	Total spray area	% crop treated
Bromacil			15	15	50
Diquat/paraquat	6			6	19
Glyphosate			+	+	+
Isoxaben			15	15	50
Napropamide	6			6	19
Oxadiazon			1	1	++
Paraquat			6	6	18
Pendimethalin	6			6	18
Propaquizafop		6		6	18
Propyzamide	6			6	18
Simazine			5	5	18
All herbicides	23	6	43	71	100
Area planted (ha)					31

‘+’ = <0.5 ha or <0.5%

‘++’ = not recorded on field-grown crops

TABLE 6 Roses and rose stocks*Insecticides and fungicides, the reasons for their use (spray hectares of formulations) and percentage of field-grown crop treated*

<i>Insecticides</i>	<i>Aphids</i>	<i>Other pests</i>	<i>Mildew & rust</i>	<i>Black spot & rust</i>	<i>Mildew</i>	<i>Aphids & black spot</i>	<i>No reason given</i>	<i>Total spray area</i>	<i>% crop treated</i>
Chlorpyrifos	+	+						+	++
Cypermethrin	1	+						1	++
Deltamethrin	1							1	++
Malathion	+							+	++
Permethrin	2							2	11
Pirimicarb	11							11	38
<i>All insecticides</i>	14	+						15	48
<i>Fungicides</i>									
Bupirimate/triforine					1		1	1	++
Fenpropimorph					6			6	11
Furalaxyl							2	2	11
Imazalil							1	1	++
Iprodione					+			+	++
Myclobutanil			20	11	+			32	90
Triforine							1	1	++
<i>All fungicides</i>			20	11	7		4	42	100
<i>Mixed formulations</i>									
Bupirimate/pirimicarb /triforine						8		8	++
Area planted (ha)									24

‘+’ = <0.5 ha

‘++’ = not recorded on field-grown crops

TABLE 7 Roses and rose stocks*Herbicides, the reasons for their use (spray hectares of formulations) and percentage of field-grown crop treated*

Herbicides	Annual bl & grass weeds	Couch	General weed control	Total spray area	% crop treated
Atrazine			10	10	52
Dichlobenil			+	+	++
Glyphosate			1	1	++
Isoxaben			+	+	++
Metazachlor			10	10	52
Napropamide	2			2	11
Oxadiazon			+	+	++
Paraquat			1	1	++
Propyzamide		4		4	19
Simazine			9	9	48
All herbicides	2	4	32	38	100
Area planted (ha)					24

‘+’ = <0.5 ha

‘++’ = not recorded on field-grown crops

TABLE 8 Ornamental trees and shrubs*Insecticides, the reasons for their use (spray hectares of formulations) and percentage of field-grown crop treated*

<i>Insecticides</i>	<i>Aphids</i>	<i>Aphids & caterpillars</i>	<i>Caterpillars</i>	<i>Pine beetle</i>	<i>Red spider mite</i>	<i>Springtails</i>	<i>Vine weevil</i>	<i>No reason given</i>	<i>Total spray area</i>	<i>% crop treated</i>
Chlorpyrifos	+			3		12		14	29	8
Clofentezine					24				24	11
Cypermethrin	8	25							32	3
Deltamethrin	5	59	24						88	30
Deltamethrin/heptenophos	5								5	3
Demeton-S-methyl	7	3							10	5
Dicofol/tetradifon					+				+	++
Dimethoate	42					5			47	7
Fatty acids	+								+	++
Gamma-HCH	+						+		+	+
Heptenophos/permethrin	+								+	++
Malathion	7								7	1
Permethrin	8			39					48	16
Pirimicarb	1								1	++
All insecticides	83	87	24	43	24	17	+	14	292	55
Area planted (ha)										261

‘+’ = <0.5 ha or <0.5%

‘++’ = not recorded on field-grown crops

TABLE 9 Ornamental trees and shrubs*Fungicides and soil Sterilants, the reasons for their use (spray hectares of formulations) and percentage of field-grown crop treated*

Fungicides	Mildew	Mildew & rust	Botrytis	Disease precaution	Sterilisation	Total spray area	% crop treated
Benomyl	21					21	10
Bupirimate	29					29	3
Bupirimate/triforine	27		+			27	++
Chlorothalonil	72					72	3
Chlorothalonil/metalaxyl	+					+	++
Fenpropimorph	25					25	4
Furalaxyl				3		3	1
Iprodione	+					+	++
Mancozeb	+			12		12	3
Mancozeb/metalaxyl	+					+	++
Myclobutanil	1	8				9	2
Prochloraz	+					+	++
Propamocarb hydrochloride			+			+	++
Pyrifenoxy	22					22	++
Sulphur				2		2	+
All fungicides	196	8	+	17		222	25
Soil sterilants							
Dazomet					1	1	+
All soil sterilants					1	1	+
Area planted (ha)							261

‘+’ = <0.5 ha or <0.5%

‘++’ = not recorded on field-grown crops

TABLE 10 Ornamental trees and shrubs*Herbicides, the reasons for their use (spray hectares of formulations) and percentage of field-grown crop treated*

Herbicides	Annual bl weeds	Annual bl & grass weeds	Annual grass weeds	Ann. & perenn. grass weeds	Perennial bl weeds	General weed control	Total spray area	% crop treated
Clopyralid	4						4	2
Dichlobenil					+	11	11	5
Diquat/paraquat						6	6	3
Glufosinate-ammonium		6	1			41	48	21
Glyphosate					1	119	120	29
Isoxaben	7					26	33	8
Metazachlor		11				8	19	7
Napropamide		34				4	38	15
Oxadiazon	2					28	30	++
Paraquat		16				20	36	7
Pendimethalin						17	17	8
Propyzamide				13			13	6
Simazine		5				19	24	8
All herbicides	13	72	1	13	1	301	401	79
Area planted (ha)								261

‘+’ = <0.5 ha

‘++’ = not recorded on field-grown crops

TABLE 11 Other hardy nursery stock*Insecticides, molluscicides, fungicides and herbicides, the reasons for their use (spray hectares of formulations)*

<i>Insecticides</i>	<i>Aphids</i>	<i>Vine weevil</i>	<i>Slugs</i>	<i>Mildew</i>	<i>General weed control</i>	<i>Total spray area</i>
Chlorpyrifos	+	+				+
Heptenophos/permethrin	+					+
Malathion	+					+
<i>All insecticides</i>	+	+				+
<i>Molluscicides</i>						
Metaldehyde			+			+
Methiocarb			1			1
<i>All molluscicides</i>			1			1
<i>Fungicides</i>						
Iprodione				+		+
<i>All fungicides</i>				+		+
<i>Herbicides</i>						
Dichlobenil					+	+
Glyphosate					+	+
Isoxaben					+	+
Paraquat					+	+
<i>All herbicides</i>					+	+
Area planted (ha)						25

‘+’ = <0.5 ha

TABLE 12 All hardy nursery stock*Usage of insecticides and molluscicides (spray hectares of active ingredients)*

<i>Insecticides</i>	<i>Fruit stocks</i>	<i>Roses & rose stocks</i>	<i>Ornamental trees & shrubs</i>	<i>Other nursery stock</i>	<i>Total spray area</i>	<i>Spray area 1993</i>
<i>Pyrethroids</i>						
Cypermethrin		1	32		33	173
Deltamethrin		1	93		94	
Permethrin	+	2	48	+	50	27
<i>Carbamates</i>						
Pirimicarb	+	19	1		20	187
<i>Organophosphates</i>						
Chlorpyrifos	+	+	29	+	29	17
Demeton-S-methyl	41		10		51	87
Dimethoate			47		47	218
Heptenophos	+		6	+	6	2
Malathion		+	7	+	7	10
Pirimiphos-methyl	+				+	5
<i>Organochlorines</i>						
Dicofol			+		+	
Gamma-HCH			+		+	
<i>Other insecticides</i>						
Clofentezine			24		24	
Fatty acids			+		+	4
Tetradifon			+		+	
<i>All insecticides</i>	41	23	297	+	361	
<i>Molluscicides</i>						
Metaldehyde				+	+	2
Methiocarb				1	1	
<i>All molluscicides</i>				1	1	

‘+’ = <0.5 ha

TABLE 13 All hardy nursery stock*Usage of fungicides and soil sterilants (spray hectares of active ingredients)*

Fungicides	Fruit stocks	Roses & rose stocks	Ornamental trees & shrubs	Other nursery stock	Total spray area	Spray area 1993
Benomyl			21		21	189
Bupirimate	16	9	55		80	224
Chlorothalonil			72		72	23
Fenpropimorph		6	25		31	4
Furalaxyl		2	3		5	
Imazalil		1			1	43
Iprodione		+	+	+	+	
Mancozeb			13		13	5
Metalaxyl			+		+	
Myclobutanil		32	9		41	10
Prochloraz			+		+	3
Propamocarb hydrochloride			+		+	38
Pyrifenoxy			22		22	
Sulphur			2		2	58
Triadimefon	6				6	16
Triforine	+	10	27		36	167
All fungicides	22	59	249	+	330	
Soil sterilants						
Dazomet			1		1	4
All soil sterilants			1		1	

‘+’ = <0.5 ha

TABLE 14 All hardy nursery stock*Usage of herbicides (spray hectares of active ingredients)*

<i>Herbicides</i>	<i>Fruit stocks</i>	<i>Roses & rose stocks</i>	<i>Ornamental trees & shrubs</i>	<i>Other nursery stock</i>	<i>Total spray area</i>	<i>Spray area 1993</i>
Atrazine		10			10	
Bromacil	15				15	5
Clopyralid			4		4	3
Dichlobenil		+	11	+	11	1
Diquat	6		6		12	5
Glufosinate-ammonium			48		48	
Glyphosate	+	1	120	+	122	132
Isoxaben	15	+	33	+	48	66
Metazachlor		10	19		29	73
Napropamide	6	2	38		46	6
Oxadiazon	1	+	30		31	104
Paraquat	12	1	42	+	56	205
Pendimethalin	6		17		23	4
Propaquizafop	6				6	
Propyzamide	6	4	13		23	21
Simazine	5	9	24		39	375
All herbicides	77	38	408	+	523	

‘+’ = <0.5 ha

TABLE 15 All hardy nursery stock
Quantities (kg) of insecticides and molluscicides used

<i>Insecticides</i>	<i>Fruit stocks</i>	<i>Roses & rose stocks</i>	<i>Ornamental trees & shrubs</i>	<i>Other nursery stock</i>	<i>Total spray area</i>	<i>Spray area 1993</i>
<i>Pyrethroids</i>						
Cypermethrin		+	+		+	4
Deltamethrin		+	1		1	
Permethrin		+	1		1	1
<i>Carbamates</i>						
Pirimicarb	+	3	+		4	10
<i>Organophosphates</i>						
Chlorpyrifos	+	1	61	+	63	11
Demeton-S-methyl	10		2		12	19
Dimethoate			16		16	70
Heptenophos	+		1		1	+
Malathion		1	11	+	12	25
Pirimiphos-methyl	+				+	4
<i>Organochlorines</i>						
Dicofol			+		+	
Gamma-HCH			+		+	
<i>Other insecticides</i>						
Clofentezine			5		5	
Fatty acids			1		1	21
Tetradifon			+		+	
<i>All insecticides</i>	10	5	99	1	115	
<i>Molluscicides</i>						
Metaldehyde				+	+	2
Methiocarb				+	+	
<i>All molluscicides</i>				1	1	

'+' = <0.5 kg

TABLE 16 All hardy nursery stock
Quantities (kg) of fungicides and soil sterilants used

Fungicides	Fruit stocks	Roses & rose stocks	Ornamental trees & shrubs	Other nursery stock	Total weight (kg)	kg 1993
Benomyl			5		5	101
Bupirimate	4	1	10		16	14
Chlorothalonil			27		27	76
Fenpropimorph		3	13		17	3
Furalaxyl					+	
Imazalil		+			+	9
Iprodione		1	+	+	1	7
Mancozeb			27		27	
Metalaxyl			2		2	
Myclobutanil		+	2		2	1
Prochloraz			+		+	1
Propamocarb hydrochloride			1		1	4,176
Pyrifenox			2		2	
Sulphur			20		20	583
Triadimefon					+	+
Triforine		1	1		4	8
All fungicides	4	12	111		127	
Soil sterilants						
Dazomet			487		487	487
All soil sterilants			487		487	487

'+' = <0.5 kg

TABLE 17 All hardy nursery stock
Quantities (kg) of herbicides used

<i>Herbicides</i>	<i>Fruit stocks</i>	<i>Roses & rose stocks</i>	<i>Ornamental trees & shrubs</i>	<i>Other nursery stock</i>	<i>Total</i>	<i>kg 1993</i>
Atrazine		18			18	
Bromacil	16				16	6
Clopyralid			1		1	+
Dichlobenil		1	25	2	28	5
Diquat	3		1		4	1
Glufosinate-ammonium			38		38	
Glyphosate	+	2	173	+	176	143
Isoxaben	3	+	4	+	8	10
Metazachlor		11	24		34	63
Napropamide	18	2	70		90	16
Oxadiazon	4	1	86		92	360
Paraquat	6	1	39	+	46	118
Pendimethalin	11		6		16	6
Propaquizafop	1				1	
Propyzamide	2	5	19		25	9
Simazine	11	18	44		73	366
All herbicides	75	58	530	2	648	

‘+’ = <0.5 kg

TABLE 18 Principal active ingredients*Area (spray hectares) treated with the 20 most used active ingredients on all hardy nursery crops*

	1997	1993
1 Glyphosate	122	132
2 Deltamethrin	94	
3 Bupirimate	80	224
4 Chlorothalonil	72	23
5 Paraquat	56	205
6 Demeton-S-methyl	51	87
7 Permethrin	50	27
8 Glufosinate-ammonium	48	
9 Isoxaben	48	66
10 Dimethoate	47	218
11 Napropamide	46	6
12 Myclobutanil	41	10
13 Simazine	39	375
14 Triforine	36	167
15 Cypermethrin	33	173
16 Fenpropimorph	31	4
17 Oxadiazon	31	104
18 Metazachlor	29	73
19 Chlorpyrifos	29	17
20 Clofentezine	24	

TABLE 19 Principal active ingredients*Quantity of the 20 most used active ingredients on all hardy nursery crops*

	1997	1993
1 Dazomet	487	1,529
2 Glyphosate	175	143
3 Oxadiazon	92	360
4 Napropamide	90	16
5 Simazine	73	566
6 Chlorpyrifos	63	11
7 Paraquat	46	118
8 Glufosinate-ammonium	38	
9 Metazachlor	34	63
10 Dichlobenil	28	5
11 Chlorothalonil	27	76
12 Mancozeb	27	7
13 Propyzamide	25	9
14 Sulphur	20	583
15 Atrazine	18	
16 Fenpropimorph	17	3
17 Bromacil	16	6
18 Pendimethalin	16	6
19 Dimethoate	16	70
20 Bupirimate	16	14

TABLE 20 All hardy nursery stock

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

	1981		1993			1997		
	<i>sp ha of a.i.'s</i>	<i>kg</i>	<i>sp ha of formulations</i>	<i>sp ha of a.i.'s</i>	<i>kg</i>	<i>sp ha of formulations</i>	<i>sp ha of a.i.'s</i>	<i>kg</i>
<i>Insecticides</i>								
Pyrethroids	6		198	202	6	171	177	2
Organophosphates	288	488	712	715	276	134	140	103
Organochlorines	13	4				+	+	+
Carbamates	12	4	49	187	10	12	20	4
Mixed & other insecticides	8	379	13	10	21	30	24	5
<i>All insecticides</i>	327	875	971	1,114	314	348	361	115
<i>Molluscicides</i>			2	2	2	2	2	1
<i>Fungicides</i>	474	320	521	827	5,712	286	330	127
<i>Mixed insecticide/fungicide</i>			139			8		
<i>Herbicides</i>	434	849	1,107	1,113	1,646	511	523	665
<i>Soil sterilants</i>	6	2,823*	4	4	1,529	1	1	487
<i>All pesticides</i>	1,240	2,044	2,744	3,060	9,204	1,503	1,578	1,509
Area planted (ha)	444			456			341	

‘+’ = <0.5 ha or <0.5 kg

‘*’ = weight estimated