PESTICIDE USAGE IN SCOTLAND

SURVEY REPORT 96

PROTECTED CROPS (EDIBLE AND NON-EDIBLE) 1991

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CONTENTS

SUMMARY

This was the 4th survey of protected crops, but only the 3rd where non-edible crops were included. Changes in cropping of edible crops since 1987 included increases in tomatoes and decreases of all the other crops. Areas of flowers remained approximately similar to those in 1981, but pot and bedding plants have increased almost 4-fold.

Significant use of biological control agents was recorded, mainly on tomatoes. Encarsia formosa against whitefly, Bacillus thuringiensis against caterpillar and Phytoseiulus persimilis for red spider mite control were all used. Dicofol/tetradifon, which had been recorded on only small areas in 1987, was applied to almost 190,000 spray sq m in 1991, for control of red spider mite.

Iprodione and benomyl remained the most popular fungicides, although the total spray area with iprodione has declined considerably.

Herbicide usage on edible crops declined, mainly due to the reduced areas of lettuce, but increased on non-edible crops. Paraquat was the principal herbicide in both edible and non-edible crops.

Relative to areas grown, use of soil sterilants declined in edible crops since 1987, but increased considerably in non-edible crops since 1981. Dazomet was the main chemical used. Methyl bromide was not recorded in this survey.

INTRODUCTION

This is the fourth survey of pesticides used on protected crops. The previous three were in 1976, 1981 and 1987 (references 1, 2 and 3). In 1987, only edible crops were included.

DEFINITIONS AND NOTES

The areas of crops grown include successional sowings so that the total areas of all crops grown are larger than the areas of glasshouses and polythene tunnels.

Basic area (or basic sq m) 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 sq m) is the basic area of a crop treated with a given pesticide multiplied by the number of treatments that area received.

Biological control agents introduced on more than one occasion to a given area have been recorded in spray sq m, although their mode of action is different from that of conventional insecticides.

Demeton-S-methyl and oxydemeton-methyl are both referred to as demeton-S-methyl because growers do not always differentiate between the two compounds.

The reasons stated were those given by the growers and occasionally may be inappropriate.

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

METHOD

Using the 1990 Agricultural Census (Reference 4) a sample was drawn from growers returning more than 100 square metres of protected crops. The sample represented the whole of Scotland and was stratified by the 11 land-use regions (Fig 1, reference 5) and size group. Sampling fractions within size groups were based on area rather than numbers of holdings, so that smaller size groups would not dominate the sample.

With a few exceptions, data were collected by personal interviews during visits to the holdings. A small number of growers in outlying areas had to be interviewed by telephone. The survey period was the 1991 calendar year except for treatments of soil sterilants and disinfectants which were carried out at the end of 1990 prior to crops grown in 1991. In all, information was obtained from 66 holdings (Tables 1 and 2).

Sample data were raised to give national estimates of pesticide usage using raising factors (Table 4). These were based on the areas of holdings growing protected crops in the 1991 Agricultural Census (Reference 6) within regions (Table 3). Land-use regions 1, 2 and 3 were amalgamated, as were regions 9, 10 and 11.

PESTICIDE USAGE

The estimated area of each crop grown is shown in Table 5.

The proportions of crops (except pot and bedding plants) not treated with the different groups of pesticides are given in Table 6, and repeated usage data for each crop (again with the exception of pot and bedding plants) are shown in Tables 11, 16, 20 and 25.

A summary of the areas of each crop treated with each formulation is shown in Tables 36-41, and the estimated quantities applied in Tables 42-47. The principal 20 chemicals ordered both by total spray area and by kg of active ingredient are shown in Tables 48 and 49. Regional data are shown in Table 52, and comparisons with previous surveys in Tables 53 and 54.

EDIBLE CROPS

TOMATOES

There has been a 73% increase in area grown to 217,264 sq m since 1987.

Insecticides and molluscicides (Tables 7, 11)

The proportion of the crop treated with insecticides was 97%. Comparisons with 1987 are not possible as most of the data on biological control were omitted from that survey.

The 2 main reasons for insecticides use were against whitefly and red spider mite. The principal control agent for whitefly control was Encarsia formosa (1,862,866 spray sq m, 62% of the crop). Red spider mites were treated with dicofol/tetradifon (188,480 spray sq m, 43% of the crop),

fenbutatin oxide (89,280 spray sq m, 39% of crop) and Phytoseiulus persimilis (204,327 spray sq m, 28% of the crop). Another significant biological control agent was Bacillus thuringiensis used on 85,000 sq m, or 39% of the crop, for caterpillar control.

Fungicides (Table 8)

There has been a slight increase in the proportion of the crop treated from 82% in 1987 to 87% in 1991, but a 12% decline in the total spray area, despite the 73% increase in crop grown, due to less repeated use.

Fungicides were used mainly for Botrytis control, followed by wilt and stem rot. As in 1987, iprodione was the main fungicide, applied to 184,128 sq m, or 28% of the crop, followed by benomyl on 173,403 sq m, or 49% of the crop.

Herbicides and growth regulators (Table 9)

As in 1987, the only herbicide recorded was paraquat (11,713 spray sq m, 5% of the crop).

2-chloroethylphosphonic acid was used on small areas for growth regulation.

Soil sterilants and disinfectants (Table 10)

Dazomet usage has increased from 5% of the crop treated in 1987 to 10% in this survey while the use of steam was recorded on small areas only.

Formaldehyde, as in 1987, was the principal disinfectant, and was used on 13% of the crop.

LETTUCE

The area has declined from 118,737 sq m in the previous survey to only 15,507 in 1991.

Insecticides and molluscicides (Tables 12, 16)

The proportion of the crop treated increased from 71% to 83%.

In 1991, the main pest was slugs, compared with aphids in the previous survey. The main molluscicide was metaldehyde and was applied to 15,843 spray sq m, or 70% of the crop. Pirimicarb, as in 1987, was the most commonly used aphicide, and was applied to 11,610 spray sq m, or 64% of the crop.

Fungicides (Table 13)

The usage of fungicides has declined from 96% of the crop treated in 1987 to only 57% in the present survey.

Botrytis was the main reason for use of fungicides compared with insurance and mildew in 1987. The range of fungicides used was reduced from 9 formulations in 1987 to only 3 in this survey. Iprodione (28,503 spray sq m or 57% of the crop) was the most popular, followed by benomyl (17,867 sq m or 22% of the crop).

Propamocarb hydrochloride, which had not been recorded in 1987, was also popular (8,266 spray sq m, 53% of the crop) for control of damping off and Phytophthora. Neither vinclozolin nor zineb, which had been used on large areas in 1987, was recorded in this survey.

Herbicides (Table 14)

The proportion of the crop treated declined from 50% in 1987 to 23% in 1991.

General weed control was the only recorded reason for herbicide usage. Paraquat and propyzamide were used on roughly similar areas, 3,500 spray sq m. Chlorpropham, which had been commonly used in 1987, was not recorded.

Soil sterilants and disinfectants (Table 15)

The proportion of the crop treated with this group of pesticides increased from 25% in 1987 to 47%.

Dazomet was the only soil sterilant recorded.

Formaldehyde had been used on 9% of the crop in 1987, but none was recorded in this survey.

SEEDLINGS OF EDIBLE CROPS

This crop category contains brassica, lettuce, tomato and vegetable seedlings. Only 7,694 sq m were grown in 1991, a big reduction since the previous survey when there were 68,876 sq m of brassica seedlings and 4,930 sq m of other edible seedlings.

Insecticides and molluscicides (Table 17)

There was a slight drop in the proportion of crop treated, from 77% in 1987 to 65% in the present survey.

The main reason for use of this pesticide group was for slug control, compared with cabbage root fly in 1987. Metaldehyde was the only molluscicide recorded, and was applied to 14,880 spray sq m or 32% of the crop, compared with only 1% in 1987. Pirimicarb, which was the only aphicide used, (2,930 spray sq m or 28% of the crop), had been applied to only small areas in 1987.

Fungicides (Table 18)

The proportion of the crop treated with a fungicide fell dramatically from 96% in the previous survey to 27% in 1991.

The principal usage of fungicides was for damping off control compared with mildew in 1987.

Tolclofos-methyl, applied to 1,240 spray sq m, or 16% of the crop, was the most commonly used fungicide. Dichlofluanid, which had been used on 95% of the crop in 1987, was not recorded in this survey.

Herbicides (Table 19)

As in 1987, no herbicides were recorded.

Soil sterilants and disinfectants (Table 20)

Dazomet was used on 1,811 sq m (24% of the crop area), compared with minimal usage in 1987.

Tar oils were applied to the fabric of 10% of the crop area. None had been recorded in the previous survey.

OTHER EDIBLE CROPS

There has been a large drop in area of these crops. For this survey, all other vegetables (mainly leeks) were amalgamated with small areas of strawberries and exotic fruit, totalling 17,770 sq m. In 1987, there had been 4 separate categories, totalling 44,651 sq m. Because there is a wide range of crops, comparisons of pesticide usage between the 2 surveys should be treated with caution.

Insecticides and molluscicides (Table 22)

47% of the crops received an insecticide or molluscicide, compared with 71% in 1987.

Heptenophos was the most popular insecticide (11,329 sq m, 16% of the crop) and was used for aphid control. In 1987, the principal insecticides had been cypermethrin and malathion.

Metaldehyde and methiocarb were used on small areas.

Fungicides (Table 23)

Only 14% of the crop was treated with fungicides compared with 60% in 1987. The only reasons recorded were for control of Botrytis and mildew. Benomyl, which had been used on only small areas in 1987, was the principal fungicide in this survey (2,752 sq m or 14% of the crop). Iprodione had been the most popular fungicide in 1987.

Herbicides and growth regulators (Table 24)

Forty-five per cent of the crop received a herbicide compared with only 17% in 1987. Glyphosate, which had been used on very small areas in 1987, was the only herbicide recorded (8,003 spray sq m). Paraquat and propachlor had been the principal herbicides used in the previous survey.

As in 1987, no growth regulators were recorded.

Soil sterilants and disinfectants (Table 25)

As in 1987, dazomet was the only soil sterilant recorded, on a very small area.

No disinfectants were recorded.

NON-EDIBLE CROPS

FLOWERS FOR CUTTING

In the present survey, all flowers for cutting, which were mainly chrysanthemums, were amalgamated. In 1981, chrysanthemums had been sub-divided into all year round and seasonal crops. In each of the two surveys, the total areas of flowers grown were roughly similar at around 70,000 sq m.

Insecticides and molluscicides (Table 27)

The proportion of the crop treated was 90%, similar to that in 1981. The main reason for use was for aphid control, and the most popular insecticide was cypermethrin (81,592 spray sq m, or 43% of the crop, followed by deltamethrin (51,555 spray sq m, 19% of crop) and permethrin, either alone or in formulation with thiram (43,403 spray sq m). In 1981, permethrin and malathion had been the most commonly used.

Metaldehyde was the main molluscicide, used on 28,066 sq m, 23% of the crop.

Fungicides (Table 28)

As in 1981, around half the crop received a fungicide.

The main uses were for Botrytis and rust control. The principal fungicides were propiconazole for rust control (38,205 spray sq m, or 25% of the crop) and iprodione against Botrytis (36,718 spray sq m, 19% of the crop). In 1981, iprodione and thiram had been the most commonly used.

Herbicides and growth regulators (Table 29)

The proportion of the crop treated with a herbicide was 40% compared with only 12% in 1981. Paraquat (14,964 spray sq m, or 21% of the crop) and diphenamid (8,996 spray sq m, 12% of the crop) were the most commonly used, compared with chloroxuron in 1981.

As in the previous survey, daminozide was the principal growth regulator, and was applied to 12,000 sq m, 17% of the crop.

Soil sterilants and disinfectants (Table 30)

The use of soil sterilants was higher in this survey than in 1981. Dazomet was the main chemical used. Methyl bromide, which had been the most popular in the previous survey, was not recorded in 1991.

POT AND BEDDINGS PLANTS

The areas of crops grown, which include multiple cropping, increased dramatically from 95,602 sq m in the previous survey to 360,452 sq m in 1991.

Proportions of crops treated with individual pesticides and pesticide groups have not been recorded as the constant throughput of plants throughout the year made it impossible to record the relevant data accurately.

Insecticides and molluscicides (Table 32)

The main reasons for use of insecticides were for aphid control. Pirimicarb was by far the most popular insecticide (240,722 spray sq m), followed by cypermethrin (100,033 spray sq m). In 1981, demeton-S-methyl had been the most popular insecticide, but was used on small areas only in this survey.

Metaldehyde was applied to 126,485 spray sq m for slug control. In 1981, no molluscicides had been recorded.

Fungicides (Table 33)

Botrytis and mildew were the main reasons for fungicide treatments. Iprodione was the most popular and was applied to 125,206 spray sq m, mainly for Botrytis control. Benomyl (67,775 spray sq m) was also mainly used for Botrytis control. Bupirimate, either alone but mostly in formulation with triforine, was used on 62,734 spray sq m. In 1981, etridiazole and benomyl had been the most commonly used active ingredients.

Herbicides and growth regulators (Table 34)

Glyphosate (34,028 spray sq m) and paraquat (26,079 spray sq m) were the most popular herbicides used. In 1981, herbicides had been used on only small areas.

Paclobutrazol (33,721 spray sq m) and 4-indol-3-ylbutyric acid, alone and with 1-naphthylacetic acid and dichlorophen, were the principal growth regulators used. In 1981, chlormequat had been used on very small areas.

Soil sterilants and disinfectants (Table 35)

Dazomet was the only soil sterilant recorded in 1991 and was used on 17,862 sq m or 5% of the crop. In the previous survey, methyl bromide had been the most commonly used.

As in 1981, formaldehyde was the principal disinfectant, and was used on 7,073 sq m, or 2% of the crop.

COMPARISONS WITH PREVIOUS SURVEYS

EDIBLE CROPS (Table 53)

Overall, the area grown of edible crops declined by 29%. Tomatoes increased in area by 72%, but all the other crops, particularly lettuce, showed considerable reductions in areas sown. As a result, tomatoes accounted for 84% of all edible crops grown.

Although comparisons with insecticides between 1987 and 1991 are not possible, there has been a clear increase in usage of biological control agents between 1987 and the present survey.

There has been a large reduction in total spray area of fungicides from over 1,850,000 to around 686,500 spray sq m due mainly to the drop in areas of lettuce grown and less repeated usage on tomatoes.

Reduced herbicide usage is due mainly to the drop in area of lettuce grown.

The overall decline in total weight of pesticides used since 1987 is mainly due to the decrease in use of soil sterilants, particularly methyl bromide, which was not recorded in 1991.

NON-EDIBLE CROPS (Table 54)

The areas in flowers for cutting remained constant at around 70,000 sq m, but that of pot and bedding plants increased almost 4-fold.

If the overall increases in the areas of these crops since 1981 are taken into account, there has been a slight increase in insecticide usage. By insecticide groups, there were relative increases in pyrethroids and decrease in organochlorines. A large increase in molluscicide usage was recorded.

Fungicide usage was also higher in 1991, while usage of herbicides and growth regulators was significantly greater.

Overall, there was a 4-fold increase in spray area of active ingredients of all crops, but only a very slight increase in weight of active ingredients used, due mainly to the demise of methyl bromide which has a high application rate.

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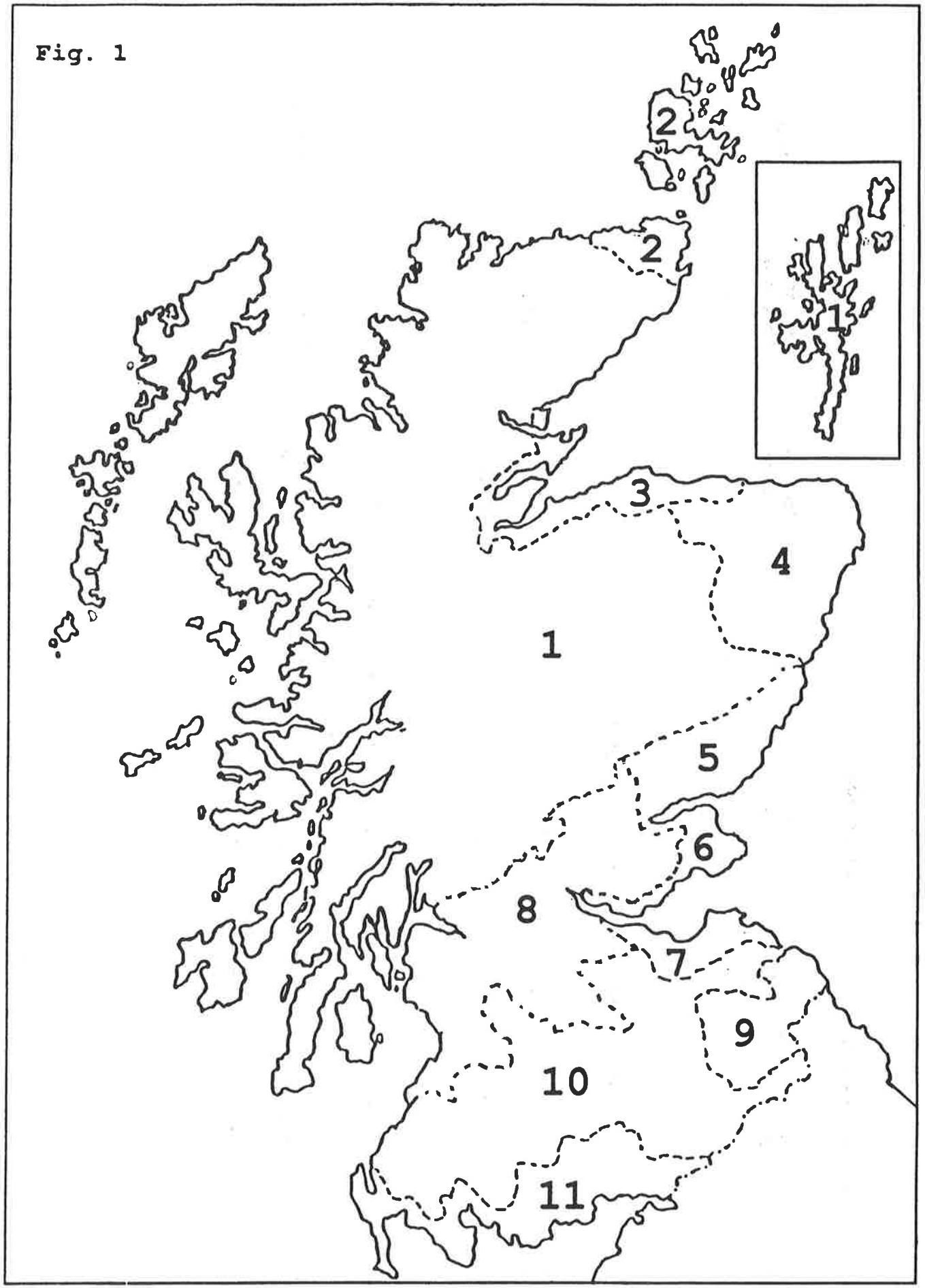
Fig. 1



1. Highlands and Islands
2. Caithness/Orkney
3. Moray Firth
4. Aberdeen
5. Angus
6. E Fife
7. Lothian
8. Central Lowlands
9. Tweed Valley
10. Southern Uplands
11. Solway

TABLE 1: Number of holdings sampled in each region

Northern Scotland	Aber-deen	Angus	East Fife	Lothian	Central Lowland	Southern Scotland	Scotland
8	7	5	5	5	29	7	66

TABLE 2: Area (sq m) of holdings sampled in each region

Northern Scotland	Aber-deen	Angus	East Fife	Lothian	Central Lowland	Southern Scotland	Scotland
12587	16305	4075	5698	7220	122579	21633	190097

TABLE 3: Area (sq m) of holdings growing protected crops in Scotland in 1991

Northern Scotland	Aber-deen	Angus	East Fife	Lothian	Central Lowland	Southern Scotland	Scotland
44517	34003	23255	10198	60119	304264	34771	511127

TABLE 4: Raising factors

Northern Scotland	Aber deen	Angus	East Fife	Lothian	Central Lowland	Southern Scotland
3.54	2.09	5.71	1.79	8.33	2.48	1.61

TABLE 5: Estimated area of protected crops grown in Scotland (sq.m)

	Northern Scotland	Aber deen	Angus	East Fife	Lothian	Central Lowland	Southern Scotland	Scotland	Scotland 1987	
Tomato	11954	16183	457	2278	8343	173162	4886	217264	125565	
Lettuce	1273	1835	0	1643	0	10755	0	15507	118737	
Seedlings of edible crops	0	63	0	1811	450	5354	16	7694	73806	
Other edible crops	2688	63	2511	0	2831	9646	32	17770	44651	
Flowers for cutting	16976	2732	3310	1793	18968	19999	8519	72298	69944	*
Pot and bedding plants	23335	14602	41756	2672	38844	186700	52541	360452	95602	*
All crops	56227	35477	48034	10198	69437	405617	65995	690984		

*Areas grown in 1981

TABLE 6: Proportions of crop grown not treated with pesticides (%)

	Tomatoes	Lettuce	Edible seedlings	Other edible crops	Flowers for cutting
Insecticides, molluscicides etc	3	17	35	53	10
Fungicides	13	43	73	86	50
Herbicides	95	77	100	55	60
Growth regulators	97	100	100	100	83
Other pesticides	10	53	66	100	46
Any pesticide	1	16	2	8	4

TABLE 7: Tomatoes: usage of insecticides, biological agents and molluscicides, the reasons for their use (spray sq m of formulations) and the percentage of crop treated

	Aphids	White fly	Cater-pillar	Leather-jacket	Mealy bug	Red spider mite	Insur-ance	Slugs	Total spray area	% of crop treated
PYRETHROIDS										
Cypermethrin	1416	.	.	.	.	.	.	.	1416	+
Permethrin	.	1250	.	.	.	.	.	.	1250	1
Resmethrin	.	2685	.	.	.	.	.	.	2685	+
ORGANOPHOSPHATES										
Heptenophos	489	.	.	.	.	.	.	.	489	+
Heptenophos/permethrin	.	8749	.	.	.	.	.	.	8749	1
ORGANOCHLORINES										
Dicofol	.	.	.	.	.	8347	.	.	8347	4
Dicofol/tetradifon	.	.	.	.	.	188480	.	.	188480	43
Gamma-HCH	.	134	.	3306	.	.	.	.	3440	2
CARBAMATES										
Aldicarb	.	.	.	.	.	.	4960	.	4960	2
Pirimicarb	17173	.	.	.	.	.	.	.	17173	3
OTHER										
Fatty acids	.	44640	.	.	.	.	.	.	44640	21
Fenbutatin oxide	.	.	.	.	.	89280	.	.	89280	39
Nicotine	.	74	.	.	.	.	.	.	74	+
Unknown insecticide	.	804	4960	.	.	.	.	.	5764	2
BIOLOGICAL										
Bacillus thuringiensis	.	.	85215	.	.	.	.	.	85215	39
Cryptolaemus sp.	.	.	.	.	3220	.	.	.	3220	1
Encarsia formosa	.	1862866	.	.	.	.	.	.	1862866	62
Phytoseiulus persimilis	.	.	.	.	.	204327	.	.	204327	28
MOLLUSCICIDE										
Metaldehyde	.	.	.	.	.	.	.	2124	2124	+
Total insecticide, biological agent and molluscicide	19078	1921202	90175	3306	3220	490434	4960	2124	2534499	97

Area grown = 217,264 sq m

'+' = less than 0.5%

TABLE 8: Tomatoes: usage of fungicides, the reasons for their use (spray sq m of formulations) and the percentage of the crop treated

	Botrytis	Botrytis/ ghostspot	Wilt	Stem rot	Damping off	Phytoph-thora	Insur-ance	Total spray area	% of crop treated
Benomyl	97540	.	74400	1463	.	.	.	173403	49
Carbendazim	16529	.	.	.	.	.	.	16529	3
Chlorothalonil	74400	.	.	.	.	.	.	74400	7
Creosote	.	.	.	744	.	.	.	744	+
Dichlofluanid	49100	4076	.	1101	.	.	.	54277	17
Etridiazole	.	.	.	.	3220	.	.	3220	1
Iprodione	184128	.	.	.	.	.	.	184128	28
Propamocarb hydrochloride	.	.	.	.	21244	5467	31728	58439	21
Vinclozolin	.	2717	.	58520	.	.	.	61237	7
Total fungicide	421697	6793	74400	61828	24464	5467	31728	626377	87

Area grown = 217,264 sq m

'+' = less than 0.5%

TABLE 9: Tomatoes: usage of herbicides and growth regulator, the reasons for their use (spray sq m of formulations) and the percentage of crop treated

	General weed control	Growth regulation	Total spray area	% of crop treated
HERBICIDE				
Paraquat	11713	.	11713	5
GROWTH REGULATOR				
2-chloroethylphosphonic acid	.	6612	6612	3

Area grown = 217,264 sq m

TABLE 10: Tomatoes: usage of soil sterilants and disinfectants, the reasons for their use (spray sq m of formulations) and the percentage of crop treated

	Soil sterilisation	Disinfectant	Total spray area	% of crop treated
SOIL STERILANT				
Dazomet	20935	.	20935	10
Steam	448	.	448	+
DISINFECTANTS				
Formaldehyde	.	28470	28470	13
Peroxyacetic acid	.	19113	19113	9
Tar oils	.	11328	11328	5
Total sterilant and disinfectant	21383	58911	80294	23

Area grown = 217,264 sq m

'+' = less than 0.5%

TABLE 11: Repeated use of pesticides on tomatoes (percentage of the basic area treated more than once)

	Once	Twice	Three times	Four times	Five times	Six or more times	Basic area (sq m)
INSECTICIDES							
Cypermethrin	.	100	.	.	.	.	708
Dicofol/tetradifon	.	100	.	.	.	.	94240
Fenbutatin oxide	94	6	.	.	.	.	84320
Heptenophos/permethrin	.	.	.	.	.	100	1250
Pirimicarb	.	49	49	2	.	.	6773
Resmethrin	.	.	100	.	.	.	895
Unknown insecticide	97	.	.	.	.	3	5094
BIOLOGICAL AGENTS							
Encarsia formosa	22	.	.	.	11	67	135174
Phytoseiulus persimilis	21	.	55	.	.	24	61882
MOLLUSCICIDE							
Metaldehyde	.	.	100	.	.	.	708
FUNGICIDES							
Benomyl	82	3	1	.	14	.	107175
Carbendazim	.	50	50	.	.	.	6612
Chlorothalonil	33	.	.	.	.	67	14880
Dichlofluanid	57	40	4	.	.	.	36930
Iprodione	33	61	1	.	.	5	61290
Propamocarb hydrochloride	89	.	4	7	.	.	45559
Vinclozolin	.	8	.	92	.	.	15988

TABLE 12: Lettuce: usage of insecticides and molluscicides, the reasons for their use (spray sq m of formulations) and the percentage of crop treated

	Aphids	Leather-jacket	Slugs	Total spray area	% of crop treated
ORGANOPHOSPHATE					
Heptenophos	301	.	.	301	2
ORGANOCHLORINE					
Gamma-HCH	.	3306	.	3306	21
CARBAMATE					
Pirimicarb	11610	.	.	11610	64
MOLLUSCICIDE					
Metaldehyde	.	.	15843	15843	70
Methiocarb	.	.	1973	1973	13
Total insecticide and molluscicide	11911	3306	17816	33033	83

Area grown = 15,507 sq m

TABLE 13: Lettuce: usage of fungicides, the reasons for their use (spray sq m of formulations) and the percentage of crop treated

	Botrytis	Damping off	Phytoph-thora	Total spray area	% of crop treated
Benomyl	17867	.	.	17867	22
Iprodione	28503	.	.	28503	57
Propamocarb hydrochloride	.	4960	3306	8266	53
Total fungicide	46370	4960	3306	54636	57

Area grown = 15,507 sq m

TABLE 14: Lettuce: usage of herbicides, the reasons for their use (spray sq m of formulations) and the percentage of crop treated

	General weed control	Total spray area	% of crop treated
Paraquat	3589	3589	23
Propyzamide	3306	3306	21
Total herbicide	6895	6895	23

Area grown = 15,507 sq m

TABLE 15: Lettuce usage of soil sterilant (spray sq m of formulations) and the percentage of crop treated

	Soil sterilant	Total spray area	% of crop treated
Dazomet	7239	7239	47

Area grown = 15,507 sq m

TABLE 16: Repeated use of pesticides on lettuce (percentage of the basic area treated more than once)

	Once	Twice	Three times	Four times	Five times	Six or more times	Basic area (sq m)
INSECTICIDES							
Pirimicarb	83	17	.	.	.	.	9938
MOLLUSCICIDE							
Metaldehyde	54	46	.	.	.	.	10883
FUNGICIDES							
Benomyl	.	.	.	.	95	5	3473
Iprodione	.	60	.	.	38	2	8791

TABLE 17: Seedlings of edible crops: usage of insecticides and molluscicides, the reasons for their use (spray sq m of formulations) and the percentage of crop treated

	Aphids	Insurance	Slugs	Total spray area	% of crop treated
ORGANOCHLORINE					
Gamma-HCH	.	298	.	298	4
CARBAMATES					
Carbofuran	.	248	.	248	3
Pirimicarb	2930	.	.	2930	28
MOLLUSCICIDE					
Metaldehyde	.	.	14880	14880	32
Total insecticide and molluscicide	2930	546	14880	18356	65

Area grown = 7,694 sq m

TABLE 18: Seedlings of edible crops: usage of fungicides, the reasons for their use (spray sq m of formulations) and the percentage of crop treated

	Mildew	Damping off	Phytoph-thora	Total spray area	% of crop treated
Etridiazole	.	322	.	322	4
Fosetyl-aluminium	248	.	.	248	3
Propamocarb hydrochloride	.	332	16	348	5
Quintozene	.	450	.	450	6
Tolclofos-methyl	.	1240	.	1240	16
Total fungicide	248	2344	16	2608	27

Area grown = 7,694 sq m

TABLE 19: Seedlings of edible crops: usage of herbicides, the reasons for their use (spray sq m of formulations) and the percentage of crop treated

None recorded

TABLE 20: Seedlings of edible crops: usage of soil sterilant and disinfectant, the reasons for their use (spray sq m formulations) and the percentage of crop treated

	Soil sterilant	Disinfectant	Total spray area	% of crop treated
SOIL STERILANT				
Dazomet	1811	.	1811	24
DISINFECTANTS				
Peroxyacetic acid	.	63	63	1
Tar oils	.	747	747	10
Total soil sterilant and disinfectant	1811	810	2621	34

Area grown = 7,694 sq m

TABLE 21: Repeated use of pesticides on seedlings of edible crops (percentage of the basic area treated more than once)

	Once	Twice	Three times	Four times	Five times	Six or more times	Basic area (sq m)
INSECTICIDE							
Pirimicarb	66	34	.	.	.	.	2186
MOLLUSCICIDE							
Metaldehyde	.	.	.	.	.	100	2480

TABLE 22: Other edible crops: usage of insecticides, biological agent and molluscicides, the reasons for their use (spray sq m of formulations) and the percentage of crop treated

	Aphids	Red spider mite	Slugs	Insurance	Total spray area	% of crop treated
PYRETHROIDS						
Cypermethrin	2832	.	.	.	2832	8
Pyrethrins/resmethrin	1500	.	.	.	1500	8
ORGANOPHOSPHATES						
Bromophos	.	.	.	2512	2512	14
Heptenophos	11329	.	.	.	11329	16
CARBAMATE						
Pirimicarb	114	.	.	.	114	1
BIOLOGICAL AGENT						
Phytoseiulus persimilis	.	389	.	.	389	1
MOLLUSCICIDES						
Metaldehyde	.	.	2832	.	2832	8
Methiocarb	.	.	2832	.	2832	16
Total insecticide, biological agent and molluscicide	15775	389	5664	2512	24340	47

Area grown = 17,770 sq m

TABLE 23: Other edible crops: usage of fungicides, the reasons for their use (spray sq m of formulations) and the percentage of crop treated

	Botrytis	Mildew	Total spray area	% of crop treated
Benomyl	125	2627	2752	14
Iprodione	125	.	125	+
Total fungicide	250	2627	2877	14

Area grown = 17,770 sq m

'+' = less than 0.5%

TABLE 24: Other edible crops: usage of herbicide, the reasons for use (spray sq m of formulations) and the percentage of crop treated

	Ground clearance	Total spray area	% of crop treated
Glyphosate	8003	8003	45

Area grown = 17,770 sq m

TABLE 25: Other edible crops: usage of soil sterilant (spray sq m of formulations) and the percentage of crop treated

	Soil sterilant	Total spray area	% of crop treated
Dazomet	63	63	+

Area grown = 17,770 sq m

'+' = less than 0.5%

TABLE 26: Repeated use of pesticides on other edible crops (percentage of the basic area treated more than once)

	Once	Twice	Three times	Four times	Five times	Six or more times	Basic area (sq m)
INSECTICIDES							
Cypermethrin	.	100	.	.	.	.	1416
Heptenophos	.	.	.	100	.	.	2832
BIOLOGICAL AGENT							
Phytoseiulus persimilis	.	78	.	.	22	.	146
MOLLUSCICIDE							
Metaldehyde	.	100	.	.	.	.	1416
FUNGICIDES							
Benomyl	93	7	.	.	.	.	2575
Iprodione	.	100	.	.	.	.	63

TABLE 27: Flowers for cutting: usage of insecticides, biological agents and molluscicides, the reasons for their use (spray sq m of formulations) and the percentage of crop treated

	Aphids	Aphids/ whitefly	Mostly leaf miner	Red spider mite	Other	Insur-ance	Slugs	Total spray area	% of crop treated
PYRETHROIDS									
Cypermethrin	50117	4910	26565	.	.	.	.	81592	43
Deltamethrin	24990	.	26565	.	.	.	.	51555	19
Permethrin	.	.	15939	.	.	.	.	15939	7
Permethrin/thiram	21427	.	.	.	3001	.	.	24428	14
Resmethrin	.	13275	.	.	.	.	.	13275	6
ORGANOPHOSPHATES									
Diazinon	21427	.	6113	.	.	.	.	27540	14
Fonofos	.	.	.	.	106	.	.	106	+
Heptenophos	1203	.	.	.	.	.	.	1203	2
Heptenophos/permethrin	.	.	.	.	2855	.	.	2855	4
Malathion	35986	.	.	.	.	.	.	35986	12
ORGANOCHLORINE									
Gamma-HCH	.	.	.	.	.	7440	.	7440	2
CARBAMATES									
Aldicarb	3001	.	591	.	9563	.	.	13155	18
Pirimicarb	3677	4910	.	.	.	.	.	8587	7
OTHER									
Fenbutatin oxide	.	.	.	2424	.	.	.	2424	2
Unknown insecticide	260	.	.	.	.	.	.	260	+
BIOLOGICAL AGENTS									
Dacnusa sibirica/diglyphus isaea	.	.	457	.	.	.	.	457	1
Phytoseiulus persimilis	.	.	.	457	.	.	.	457	1
MOLLUSCICIDES									
Metaldehyde	.	.	.	.	.	.	28066	28066	23
Methiocarb	.	.	.	.	.	.	5313	5313	7
Total insecticide, biological agent and molluscicide	162088	23095	76230	2881	15525	7440	33379	320638	90

Area grown = 72,298 sq m

'+' = less than 0.5%

TABLE 28: Flowers for cutting: usage of fungicide, the reasons for their use (spray sq m of formulations) and the percentage of crop treated

	Botrytis	Rust	Downy mildew	Insurance	Total spray area	% of crop treated
Chlorothalonil	.	.	4180	.	4180	1
Dichlofluanid	.	.	.	14285	14285	10
Iprodione	36318	.	.	.	36318	19
Oxycarboxin	.	1637	.	.	1637	2
Propiconazole	.	38205	.	.	38205	25
Permethrin/thiram	537	.	.	.	537	+
Total fungicide	36855	39842	4180	14285	95162	50

Area grown = 72,298 sq m

'+' = less than 0.5%

TABLE 29: Flowers for cutting: usage of herbicides and growth regulators, the reasons for their use (spray sq m of formulations) and the percentage of crop treated

	General weed control	Ground clearance	Growth regulation	Total spray area	% of crop treated
HERBICIDES					
Diphenamid	8996	.	.	8996	12
Glyphosate	4425	.	.	4425	6
Paraquat	12109	2855	.	14964	21
Propyzamide	6061	.	.	6061	8
Trifluralin	3571	.	.	3571	5
Total herbicide	35162	2855	.	38017	40
GROWTH REGULATORS					
Daminozide	.	.	11999	11999	17
Paclobutrazol	.	.	3220	3220	4
Total growth regulator	.	.	15219	15219	17

Area grown = 72,298 sq m

TABLE 30: Flowers for cutting: usage of soil sterilants and disinfectants, the reasons for their use (spray sq m of formulations) and the percentage of crop treated

	Soil sterilisation	Disinfectant	Total spray area	% of crop treated
SOIL STERILANT				
Dazomet	20107	.	20107	28
Steam	6217	.	6217	9
DISINFECTANTS				
Cresylic acid	.	4425	4425	6
Tar oils	.	1649	1649	2
Total soil sterilant and disinfectant	26324	6074	32398	40

Area grown = 72,298 sq m

TABLE 31: Repeated use of pesticides on flowers for cutting (percentage of the basic area treated more than once)

	Once	Twice	Three times	Four times	Five times	Six or more times	Basic area (sq m)
INSECTICIDES							
Cypermethrin	27	19	37	.	17	.	31152
Deltamethrin	.	.	61	.	39	.	13643
Diazinon	12	.	88	.	.	.	9982
Fenbutatin oxide	.	100	.	.	.	.	1212
Gamma-HCH	.	.	.	.	.	100	1240
Malathion	.	.	.	100	.	.	8996
Permethrin	.	.	100	.	.	.	5313
Pirimicarb	69	.	31	.	.	.	5314
Resmethrin	.	.	100	.	.	.	4425
Permethrin/thiram	29	3	69	.	.	.	39239
MOLLUSCICIDE							
Metaldehyde	66	.	34	.	.	.	16738
FUNGICIDES							
Chlorothalonil	.	.	.	100	.	.	1045
Dichlofluanid	.	100	.	.	.	.	7142
Iprodione	.	40	60	.	.	.	13994
Propiconazole	18	50	32	.	.	.	17880

TABLE 32: Pot and bedding plants: usage of insecticides, biological agents and molluscicides, the reasons for their use (spray sq m of formulations)

	Aphids	Aphids/ whitefly	White fly	Red spider mite	Insur-ance	Slugs	Other	Total spray area
PYRETHROIDS								
Cypermethrin	62565	35414	2053	.	.	.	.	100032
Deltamethrin	50259	.	.	.	.	.	6440	56699
Permethrin	580	.	2326	.	5402	.	.	8308
Pyrethrins/resmethrin	.	.	42755	.	.	.	.	42755
Resmethrin	.	8928	1536	.	.	.	22939	33403
ORGANOPHOSPHATES								
Bromophos	62	.	.	.	.	.	744	806
Chlorpyrifos	.	.	.	.	1672	.	.	1672
Diazinon	.	.	.	.	.	.	6691	6691
Demeton-S-methyl	11944	.	.	.	.	.	.	11944
Dimethoate	2060	.	.	.	.	.	.	2060
Fenitrothion	2892	.	.	.	.	.	.	2892
Fonofos	.	.	.	.	.	.	19318	19318
Heptenophos	1425	.	.	.	.	.	.	1425
Heptenophos/permethrin	10207	459	4568	.	4568	.	1199	21001
Malathion	25647	.	.	.	.	.	8050	33697
Pirimiphos-methyl	2228	.	.	.	.	.	.	2228
Vamidothion	.	.	.	.	.	.	39680	39680
ORGANOCHLORINES								
Dicofol	.	.	.	28966	.	.	.	28966
Gamma-HCH	.	.	.	.	6547	.	2326	8873
Tetradifon	.	.	.	1771	.	.	.	1771
CARBAMATES								
Aldicarb	107	.	.	.	.	.	48	155
Carbaryl	.	.	1254	.	.	.	.	1254
Pirimicarb	231631	3561	5580	.	.	.	.	240772

TABLE 32 (Cont'd): Pot and bedding plants: usage of insecticides, biological agents and molluscicides, the reasons for their use (spray sq m of formulations)

	Aphids	Aphids/ whitefly	White fly	Red spider mite	Insur-ance	Slugs	Other	Total spray area
OTHER								
Fenbutatin oxide	.	.	.	49600	.	.	.	49600
Nicotine	358	13504	13957	.	.	.	.	27819
Teflubenzuron	.	.	6440	.	.	.	.	6440
BIOLOGICAL AGENT								
Phytoseiulus persimilis	.	.	.	322	.	.	.	322
MOLLUSCICIDE								
Metaldehyde	.	.	.	.	.	126485	.	126485
Methiocarb	.	.	.	.	.	14915	.	14915
Total insecticide, biological agent and molluscicide	419965	61866	80469	80659	18189	141400	107435	891983

Area grown = 360,452 sq m

'*' = basic area

TABLE 33: Pot and bedding plants: usage of fungicide, the reason for their use (spray sq m of formulations)

	Mosses & liverwort	Leaf spot	Black spot	Mildew	Botrytis	Damping off	Insurance	Total spray area
Benomyl	.	.	.	8218	56792	2348	418	67776
Bupiramte	.	.	.	1045	.	.	.	1045
Bupirimate/triforine	.	.	4960	50015	.	.	6714	61689
Captan	.	.	.	.	7023	1345	5793	14161
Chlorothalonil	10032	2897	.	.	13868	1274	.	28071
Chlorothalonil/metalaxyl	.	.	.	7440	.	.	.	7440
Dichlorophen	11494	.	.	.	.	.	.	11494
Dinocap/permethrin/sulphur/ triforine	.	.	699	.	.	.	.	699
Etridiazole	.	.	.	.	.	10651	.	10651
Furalaxyl	.	.	.	.	.	16125	.	16125
Imazalil	.	.	.	8190	.	.	.	8190
Iprodione	.	.	.	6230	105897	1274	11805	125206
Mancozeb/metalaxyl	.	.	.	19623	.	.	.	19623
Myclobutanil	.	.	.	6372	.	.	.	6372
Prochloraz	.	.	.	418	627	.	6372	7417
Propamocarb hydrochloride	.	.	.	25	.	20466	652	21143
Quinonamid	1133	.	.	.	.	.	.	1133
Tolclofos-methyl	.	.	.	.	.	16421	.	16421
Triadimenol/tridemorph	.	.	.	668	.	.	.	668
Vinclozolin	.	.	.	.	104	.	.	104
Zineb-poly.complex	.	668	.	.	4960	.	.	5628
Unknown fungicide	.	.	.	.	4568	.	.	4568
Total fungicide	22659	3565	5659	108244	193839	69904	31754	435624

Area grown = 360,452 sq m

TABLE 34: Pot and bedding plants: usage of herbicides and growth regulators, the reason for their use (spray sq m of formulations)

	General weed control	Chickweed	Clear ground	Annual weeds /grasses	Growth regulation	Total spray area
HERBICIDES						
Diphenamid	13138	1343	.	.	.	14481
Glyphosate	31744	.	2284	.	.	34028
Isoxaben	4180	.	.	.	.	4180
Oryzalin	57	.	.	.	.	57
Oxadiazon	1488	.	.	2004	.	3492
Paraquat	26079	.	.	.	.	26079
Simazine	14696	.	.	.	.	14696
Total herbicide	91382	1343	2284	2004	.	97013
GROWTH REGULATORS						
1-naphl./4-indol-3-y./dichlorophen	.	.	.	.	3993	3993
4-indol-3-ylbutyric acid	.	.	.	.	13639	13639
Chloromequat	.	.	.	.	9075	9075
Daminozide	.	.	.	.	8318	8318
Paclobutrazol	.	.	.	.	33721	33721
Total growth regulator	.	.	.	.	68746	68746

Area grown = 360,452 sq m

TABLE 35: Pot and bedding plants: usage of soil sterilant and disinfectants, the reason for their use (spray sq m of formulations)

	Soil sterilant	Disinfectant	Total spray area
SOIL STERILANT			
Dazomet	17862	.	17862
DISINFECTANTS			
Formaldehyde	.	7073	7073
Tar oils	.	1197	1197
Total soil sterilant and disinfectant	17862	8270	26132

Area grown = 360,452 sq m

TABLE 36: Usage of insecticides, biological agents and molluscicides on protected EDIBLE crops (spray sq m of formulations)

	Tomatoes	Lettuce	Seedlings of edible crops	Other edible crops	All crops	All crops 1987
PYRETHROIDS						
Cypermethrin	1416	.	.	2832	4248	46118
Permethrin	1250	.	.	.	1250	87410
Pyrethrins/resmethrin	.	.	.	1500	1500	32252
Resmethrin	2685	.	.	.	2685	17746
ORGANOPHOSPHATES						
Bromophos	.	.	.	2512	2512	.
Heptenophos	489	301	.	11329	12119	21142
Heptenophos/permethrin	8749	.	.	.	8749	972
ORGANOCHLORINES						
Dicofol	8347	.	.	.	8347	841
Dicofol/tetradifon	188480	.	.	.	188480	1642
Gamma-HCH	3440	3306	298	.	7044	4637
CARBAMATES						
Aldicarb	4960	.	.	.	4960	2405
Carbofuran	.	.	248	.	248	.
Pirimicarb	17173	11610	2930	114	31827	127389
OTHER						
Fatty acids	44640	.	.	.	44640	.
Fenbutatin oxide	89280	.	.	.	89280	73966
Nicotine	74	.	.	.	74	4836
Unknown insecticides	5764	.	.	.	5764	88
Total insecticides	376747	15217	3476	18287	413727	
BIOLOGICAL AGENTS						
Bacillus thuringiensis	85215	.	.	.	85215	1785
Cryptolaemus sp.	3220	.	.	.	3220	.
Encarsia formosa	1862866	.	.	.	1862866	1396
Phytoseiulus persimilis	204327	.	.	389	204716	.
Total biological agents	2155628	.	.	389	2156017	.
MOLLUSCICIDES						
Metaldehyde	2124	15843	14880	2832	35679	21321
Methiocarb	.	1973	.	2832	4805	2551
Total molluscicides	2124	17816	14880	5664	40484	

TABLE 37: Usage of fungicide on protected EDIBLE crops (spray sq m of formulations)

	Tomatoes	Lettuce	Seedlings of edible crops	Other edible crops	All crops	All crops 1987
Benomyl	173403	17867	.	2752	194022	165267
Carbendazim	16529	.	.	.	16529	10502
Chlorothalonil	74400	.	.	.	74400	79
Creosote	744	.	.	.	744	433
Dichlofluanid	54277	.	.	.	54277	561281
Etridiazole	3220	.	322	.	3542	34285
Fosetyl-aluminium	.	.	248	.	248	222
Iprodione	184128	28503	.	125	212756	475788
Propamocarb hydrochloride	58439	8266	348	.	67053	78749
Quintozene	.	.	450	.	450	578
Tolclofos-methyl	.	.	1240	.	1240	80994
Vinclozolin	61237	.	.	.	61237	259956
Total fungicide	626377	54636	2608	2877	686498	

TABLE 38: Usage of herbicides, growth regulators, soil sterilants and disinfectants on protected EDIBLE crops (spray sq m of formulations)

	Tomatoes	Lettuce	Seedlings of edible crops	Other edible crops	All crops	All crops 1987
HERBICIDES						
Glyphosate	.	.	.	8003	8003	12
Paraquat	11713	3589	.	.	15302	8289
Propyzamide	.	3306	.	.	3306	34637
Total herbicide	11713	6895	.	8003	26611	
GROWTH REGULATOR						
2-chloroethylphosphonic acid	6612	.	.	.	6612	6921
Total growth regulator	6612	.	.	.	6612	
SOIL STERILANTS						
Dazomet	20935	7239	1811	63	30448	40515
Steam	447	.	.	.	447	1281
DISINFECTANT						
Formaldehyde	28470	.	.	.	28470	21919
Tar oils	11328	.	747	.	12075	399
Peroxyacetic acid	19113	.	63	.	19176	.
Total soil sterilant and disinfectant	80293	7239	2621	63	90216	

TABLE 39: Usage of insecticides, biological agents and molluscicides on protected NON-EDIBLE crops (spray sq m of formulations)

	Flowers for cutting	Pot & bedding plants	All crops	All crops 1981
PYRETHROIDS				
Cypermethrin	81592	100033	181625	.
Deltamethrin	51555	56699	108254	.
Permethrin	15939	8308	24247	22971
Pyrethrins/resmethrin	.	42755	42755	.
Resmethrin	13275	33403	46678	10260
ORGANOPHOSPHATES				
Bromophos	.	806	806	.
Chlorpyrifos	.	1672	1672	.
Demeton-S-methyl	.	11944	11944	8696
Diazinon	27540	6691	34231	115
Dimethoate	.	2060	2060	1340
Fenitrothion	.	2892	2892	.
Fonofos	106	19318	19424	.
Heptenophos	1203	1425	2628	256
Heptenophos/permethrin	2855	21001	23856	.
Malathion	35986	33697	69683	13295
Pirimiphos-methyl	.	2228	2228	2701
Vamidothion	.	39680	39680	.
ORGANOCHLORINES				
Dicofol	.	28966	28966	880
Gamma-HCH	7440	8873	16313	4776
Tetradifon	.	1771	1771	36
CARBAMATES				
Aldicarb	13155	156	13311	.
Carbaryl	.	1254	1254	.
Pirimicarb	8587	240772	249359	104956

TABLE 39 (Cont'd): Usage of insecticides, biological agents and molluscicides on protected NON-EDIBLE crops (spray sq m of formulations)

	Flowers for cutting	Pot & bedding plants	All crops	All crops 1981
OTHER				
Fenbutatin oxide	2424	49600	52024	.
Nicotine	.	27820	27820	6983
Teflubenzuron	.	6440	6440	.
Unknown insecticide	260	.	260	.
Total insecticide	261917	750071	1011988	
BIOLOGICAL AGENTS				
Dacnusa sibirica/diglyphus isaea	457	.	457	.
Phytoseiulus persimilis	457	322	779	20579
Total biological agent	914	322	1236	
MOLLUSCICIDES				
Metaldehyde	28066	126485	154551	1687
Methiocarb	5313	14915	20228	900
Total molluscicide	33379	141593	174972	

TABLE 40: Usage of fungicide on protected NON-EDIBLE crops (spray sq m of formulations)

	Flowers for cutting	Pot & bedding plants	All crops	All crops 1981
Benomyl	.	67775	67775	17488
Bupirimate	.	1045	1045	1886
Bupirimate/triforine	.	61689	61689	.
Captan	.	14162	14162	2164
Chlorothalonil	4180	28072	32252	.
Chlorothalonil/metalaxyl	.	7440	7440	.
Dichlofluanid	14285	.	14285	.
Dichlorophen	.	11494	11494	.
Etridiazole	.	10651	10651	19502
Furalaxyl	.	16125	16125	.
Imazalil	.	8190	8190	.
Iprodione	36318	125206	161524	59405
Mancozeb/metalaxyl	.	19623	19623	.
Myclobutanil	.	6372	6372	.
Oxycarboxin	1637	.	1637	.
Prochloraz	.	7417	7417	.
Propamocarb hydrochloride	.	21142	21142	.
Propiconazole	38205	.	38205	.
Quinonamid	.	1133	1133	.
Tolclofos-methyl	.	16421	16421	.
Triadimenol/tridemorph	.	668	668	.
Vinclozolin	.	104	104	.
Zineb-poly.complex	.	5628	5628	10980
Unknown fungicide	.	4568	4568	.
Total fungicide	94625	434925	529550	

TABLE 41: Usage of herbicides, growth regulators, soil sterilants and disinfectants on protected NON-EDIBLE crops (spray sq m of formulations)

	Flowers for cutting	Pot & bedding plants	All crops	All crops 1981
HERBICIDES				
Diphenamid	8996	14480	23476	.
Glyphosate	4425	34028	38453	.
Isoxaben	.	4180	4180	.
Oryzalin	.	57	57	.
Oxadiazon	.	3492	3492	.
Paraquat	14964	26079	41043	2194
Propyzamide	6061	.	6061	257
Simazine	.	14696	14696	.
Trifluralin	3571	.	3571	.
Total herbicide	38017	97012	135029	
GROWTH REGULATORS				
1-naphl./4-indol-3-y./dichlorophen	.	3993	3993	.
4-indol-3-ylbutyric acid	.	13639	13639	.
Chlormequat	.	9075	9075	171
Daminozide	11999	8318	20317	9923
Paclobutrazol	3220	33721	36941	.
Total growth regulator	15219	68746	83965	
SOIL STERILANTS				
Dazomet	20107	17862	37969	9138
Steam	6217	.	6217	4149
DISINFECTANT				
Cresylic acid	4425	.	4425	.
Formaldehyde	.	7073	7073	5999
Tar oils	1649	1197	2846	993
Total soil sterilant and disinfectant	32398	26132	58530	
OTHER FORMULATIONS				
Dinocap/permethrin/sulphur/triforine	.	699	699	.
Permethrin/thiram	24965	.	24965	.

TABLE 42: Quantity (kg) of insecticides and molluscicides used on protected EDIBLE crops (active ingredients)

	Tomatoes	Lettuce	Seedlings of edible crops	Other edible crops	All crops	All crops 1987
PYRETHROID						
Permethrin	0.1	.	.	.	0.1	0.5
ORGANOPHOSPHATE						
Bromophos	.	.	.	0.4	0.4	.
Heptenophos	0.1	.	.	0.5	0.6	1.1
ORGANOCHLORINES						
Dicofol	8.4	.	.	.	8.4	0.1
Gamma-HCH	0.1	0.1	0.1	.	0.3	0.4
CARBAMATES						
Aldicarb	1.7	.	.	.	1.7	1.0
Pirimicarb	0.4	0.3	0.1	.	0.8	4.2
OTHER						
Fatty acids	24.8	.	.	.	24.8	.
Fenbutatin oxide	2.2	.	.	.	2.2	4.3
Nicotine	0.4	.	.	.	0.4	2.3
Tetradifon	2.9	.	.	.	2.9	+
Total insecticide	41.1	0.4	0.2	0.9	42.6	
MOLLUSCICIDE						
Metaldehyde	0.2	1.4	1.4	0.3	3.3	2.0
Total molluscicide	0.2	1.4	1.4	0.3	3.3	

'+' = less than 0.05 kg in 1987

Use of active ingredients of less than 0.05 kg were carbofuran, cypermethrin, methiocarb and resmethrin.

TABLE 43: Quantity (kg) of fungicides used on protected EDIBLE crops (active ingredients)

	Tomatoes	Lettuce	Seedlings of edible crops	Other edible crops	All crops	All crops 1987
FUNGICIDES						
Benomyl	18.2	0.6	.	1.5	20.3	11.8
Carbendazim	0.5	.	.	.	0.5	1.2
Chlorothalonil	18.1	.	.	.	18.1	+
Creosote	0.4	.	.	.	0.4	+
Dichlofluanid	7.5	.	.	.	7.5	43.5
Etridiazole	1.1	.	0.8	.	1.9	54.4
Fosetyl-aluminium	.	.	1.0	.	1.0	0.9
Iprodione	21.8	0.8	.	.	22.6	41.3
Propamocarb hydrochloride	35.2	8.4	1.2	.	44.8	400.9
Quintozene	.	.	3.1	.	3.1	4.0
Tolclofos-methyl	.	.	1.2	.	1.2	81.0
Vinclozolin	8.3	.	.	.	8.3	15.5
Total fungicide	111.1	9.8	7.3	1.5	129.7	

'+' = less than 0.05 kg

TABLE 44: Quantity (kg) of herbicides, growth regulators, soil sterilant and disinfectants used on protected EDIBLE crops (active ingredients)

	Tomatoes	Lettuce	Seedlings of edible crops	Other edible crops	All crops	All crops 1987
HERBICIDES						
Glyphosate	.	.	.	1.5	1.5	+
Paraquat	1.0	0.4	.	.	1.4	0.2
Propyzamide	.	0.5	.	.	0.5	4.9
Total herbicide	1.0	0.9	.	.	1.9	
GROWTH REGULATOR						
2-chloroethylphosphonic acid	0.3	.	.	.	0.3	0.3
Total growth regulator	0.3	.	.	.		0.3
SOIL STERILANT						
Dazomet	1000.8	269.0	68.1	2.4	1340.3	1733.9
DISINFECTANTS						
Formaldehyde	133.9	.	.	.	133.9	45.7
Peroxyacetic acid	47.8	.	0.2	.	48.0	.
Tar oils	20.8	.	2.8	.	23.6	+
Total disinfectant	202.5	.	3.0	.	205.5	

'+' = less than 0.05 kg

TABLE 45: Quantity (kg) of insecticides and molluscicides used on protected NON-EDIBLE crops (active ingredients)

	Flowers for cutting	Pot & bedding plants	All crops	All crops 1981
PYRETHROIDS				
Cypermethrin	0.3	0.2	0.5	.
Deltamethrin	0.1	0.8	0.9	.
Permethrin	1.0	0.2	1.2	0.3
Pyrethrin	.	0.2	0.2	.
Resmethrin	.	1.4	1.4	0.1
ORGANOPHOSPHATES				
Chlorpyrifos	.	0.1	0.1	.
Demeton-S-methyl	.	0.3	0.3	0.6
Diazinon	0.4	0.1	0.5	+
Dimethoate	.	0.1	0.1	0.1
Fenitrothion	.	0.2	0.2	.
Fonofos	0.1	20.9	21.0	.
Heptenophos	0.1	0.2	0.3	+
Malathion	6.0	5.2	11.2	3.7
Pirimiphos-methyl	.	0.2	0.2	0.4
Vamidothion	.	17.8	17.8	.
ORGANOCHLORINES				
Dicofol	.	4.4	4.4	+
Gamma-HCH	3.1	1.0	4.1	0.4
CARBAMATES				
Aldicarb	5.5	0.1	5.6	32.3
Carbaryl	.	0.3	0.3	.
Pirimicarb	0.2	18.1	18.3	4.7
OTHER				
Fenbutatin oxide	0.1	13.6	13.7	.
Nicotine	.	13.2	13.2	6.8
Total insecticide	16.9	98.6	115.5	

TABLE 45 (Cont'd): Quantity (kg) of insecticides and molluscicides used on protected NON-EDIBLE crops (active ingredients)

	Flowers for cutting	Pot & bedding plants	All crops	All crops 1981
MOLLUSCICIDES				
Metaldehyde	2.4	8.5	10.9	0.2
Methiocarb	0.1	0.3	0.4	+
Total molluscicide	2.5	8.8	11.3	

'+' = less than 0.05 kg in 1981

Use of active ingredients of less than 0.05 kg were bromophos, teflubenzuron and tetradifon.

TABLE 46: Quantity (kg) of fungicides used on protected NON-EDIBLE crops (active ingredients)

	Flowers for cutting	Pot & bedding plants	All crops	All crops 1981
FUNGICIDES				
Benomyl	.	7.5	7.5	1.0
Bupirimate	.	1.0	1.0	0.2
Captan	.	3.2	3.2	0.4
Chlorothalonil	0.3	8.4	8.7	.
Dichlofluanid	1.4	.	1.4	.
Dichlorophen	.	17.6	17.6	.
Etridiazole	.	36.7	36.7	14.4
Furalaxyl	.	20.2	20.2	.
Imazalil	.	0.2	0.2	.
Iprodione	3.3	5.9	9.2	0.1
Mancozeb	.	4.3	4.3	.
Metalaxyl	.	0.7	0.7	.
Oxycarboxin	0.1	.	0.1	.
Prochloraz	.	0.4	0.4	.
Propamocarb hydrochloride	.	69.0	69.0	.
Propiconazole	0.5	.	0.5	.
Quinonamid	.	0.9	0.9	.
Thiram	1.4	.	1.4	1.4
Tolclofos-methyl	.	16.4	16.4	.
Triforine	.	1.0	1.0	.
Zineb-poly.complex	.	0.9	0.9	2.0
Total fungicide	7.0	194.3	201.3	

Use of active ingredients of less than 0.05 kg were myclobutanil, triadimenol, tridemoroph and vinclozolin.

TABLE 47: Quantity (kg) of herbicides growth regulators, soil sterilants and disinfectants used on protected NON-EDIBLE crops (active ingredients)

	Flowers for cutting	Pot & bedding plants	All crops	All crops 1981
HERBICIDES				
Diphenamid	4.9	4.3	9.2	.
Glyphosate	0.8	6.5	7.3	.
Oxadiazon	.	0.7	0.7	.
Paraquat	1.4	2.7	4.1	0.2
Propyzamide	0.8	.	0.8	+
Simazine	.	0.9	0.9	.
Trifluralin	0.4	.	0.4	.
Total herbicide	8.3	15.1	23.4	
GROWTH REGULATORS				
Chlormequat	.	1.9	1.9	+
Daminozide	16.7	15.9	32.6	0.3
Total growth regulator	16.7	17.8	34.5	
SOIL STERILANT				
Dazomet	820.2	609.1	1429.3	343.8
DISINFECTANT				
Cresylic acid	5.3	.	5.3	.
Formaldehyde	.	78.5	78.5	19.3
Tar oils	8.7	22.1	30.8	
Total disinfectants	14.0	100.6	114.6	

'+' = less than 0.05 kg

Use of active ingredients of less than 0.05 kg were isoxaben, oryzalin, 1-naphthylacetic acid, 4-indol-3-ylbutyric acid and paclobutrazol.

TABLE 48: Estimated area (spray sq m) treated with the 20 most used active ingredients, on all EDIBLE crops surveyed

		1991	1987
1	Encarsia formosa	1862866	*
2	Iprodione	212756	475788
3	Phytoseiulus persimilis	204716	*
4	Benomyl	194022	165267
5	Dicofol	196827	2483
6	Tetradifon	188480	1642
7	Fenbutatin oxide	89280	73966
8	Bacillus thuringiensis	85215	*
9	Chlorothalonil	74400	79
10	Propamocarb hydrochloride	67053	78749
11	Vinclozolin	61237	259956
12	Dichlofluanid	54277	561281
13	Fatty acids	44640	.
14	Metaldehyde	35679	21321
15	Pirimicarb	31827	127389
16	Dazomet	30496	40515
17	Formaldehyde	28470	21919
18	Peroxyacetic acid	19176	.
19	Carbendazim	16529	10502
20	Paraquat	15302	8289

TABLE 49: Estimated amount (kg) treated with the 20 most used active ingredients, on all EDIBLE crops surveyed

		1991	1987
1	Dazomet	1340.3	1733.9
2	Formaldehyde	133.9	45.7
3	Peroxyacetic acid	48.0	.
4	Propamocarb hydrochloride	44.8	400.9
5	Fatty acids	24.8	.
6	Tar oils	23.6	+
7	Iprodione	22.6	41.3
8	Benomyl	20.3	11.8
9	Chlorothalonil	18.1	+
10	Dicofol	8.4	0.1
11	Vinclozolin	8.3	15.5
12	Dichlofluanid	7.5	43.5
13	Metaldehyde	3.3	2.0
14	Quintozene	3.1	4.0
15	Tetradifon	2.9	+
16	Fenbutatin oxide	2.2	4.3
17	Etridiazole	1.9	54.4
18	Aldicarb	1.7	1.0
19	Glyphosate	1.5	+
20	Paraquat	1.4	0.2

'*' = most biological control agent treatments omitted from 1987 survey.

'+' = less than 0.05 kg

TABLE 50: Estimated area (spray sq m) treated with the 20 most used active ingredients, on all NON-EDIBLE crops surveyed

		1991	1981
1	Pirimicarb	249359	21787
2	Cypermethrin	181625	.
3	Iprodione	161524	59405
4	Metaldehyde	154551	1687
5	Deltamethrin	108254	.
6	Resmethrin	89433	36170
7	Malathion	69683	41287
8	Benomyl	67775	17488
9	Bupirimate	61689	1886
10	Triforine	61689	.
11	Fenbutatin oxide	52024	.
12	Pyrethrins	42755	.
13	Paraquat	41043	2194
14	Vamidothion	39680	.
15	Glyphosate	38453	.
16	Propiconazole	38205	.
17	Dazomet	37969	9138
18	Paclobutrazol	36941	.
19	Diazinon	34231	230
20	Chlorothalonil	32252	.

TABLE 51: Estimated amount (kg) treated with the 20 most used active ingredients, on all NON-EDIBLE crops surveyed

		1991	1981
1	Dazomet	1429.3	343.8
2	Formaldehyde	78.5	19.3
3	Propamocarb hydrochloride	69.0	.
4	Etridiazole	36.7	14.4
5	Daminozide	32.6	0.3
6	Tar oils	30.8	.
7	Fonofos	21.0	.
8	Furalaxyl	20.2	.
9	Pirimicarb	18.3	4.7
10	Vamidothion	17.8	.
11	Dichlorophen	17.6	.
12	Tolclofos-methyl	16.4	.
13	Fenbutatin oxide	13.7	.
14	Nicotine	13.2	6.8
15	Malathion	11.2	3.7
16	Metaldehyde	10.9	0.2
17	Diphenamid	9.2	.
18	Iprodione	9.2	0.1
19	Chlorothalonil	8.7	.
20	Benomyl	7.5	1.0

TABLE 52: Usage of pesticides on protected crops in Scotland in 1991 (spray sq m of formulations)

	Northern Scotland	Abdn	Angus	East Fife	Lothian	Central Lowland	Southern Scotland	Scotland
Insecticides, molluscicides	112101	51736	52989	13280	171315	3193710	203295	3798426
Fungicides	101647	228541	37303	2071	74087	628764	143633	1216046
Herbicides	16178	16791	7200	1342	8996	108259	2874	161641
Growth regulators	2736	1254	1913	243	9580	61648	13202	90576
Other pesticides	56853	17076	0	5773	18792	53264	23103	174861
All pesticides	289515	315398	99405	22710	282770	4045645	386107	5441550

TABLE 53: Comparison of pesticide usage on EDIBLE crops 1981-1991, spray sq m of formulations, spray sq m of active ingredients and quantities used (kg)

	1981		1987			1991		
	Spray sq m of a.i.'s	Kg	Spray sq m of formulations	Spray sq m of a.i.'s	Kg	Spray sq m of formulations	Spray sq m of a.i.'s	Kg
INSECTICIDES								
Pyrethroids	110650	0.6	257535	290385	2.0	9683	11183	0.1
Organophosphates	186320	9.4	120206	120206	7.2	23380	32129	0.6
Organochlorines	240296	14.6	7120	8762	0.5	203871	392351	8.7
Carbamates	207097	79.9	130730	130730	6.2	37035	37035	2.5
Others	96138	20.0	131617	133293	10.5	139758	139758	30.7
Total insecticides	840501	124.5	647208	683376	26.4	413727	612456	42.6
BIOLOGICAL AGENTS	36156	.	3181	3181	.	2156017	2156017	.
MOLLUSCICIDES	14188	0.9	21228	21228	2.1	40484	40484	3.3
FUNGICIDES	1655527	344.9	1783666	1854797	675.6	686498	686498	129.7
HERBICIDES	60897	9.4	75390	75390	14.0	26611	26611	3.4
OTHER PESTICIDES								
Disinfectants	19950	55.5	22318	22318	45.7	59721	59721	205.5
Growth regulators	3085	0.1	6921	6921	0.3	6612	6612	0.3
Soil sterilants	140507	4267.4	53979	53979	2282.5	30943	30943	1340.3
Mixed formulations	.	.	356	712	.	.	.	.
Total other pesticides	118542	4323.0	83574	83930	2338.5	97276	97276	1546.1
Total pesticides	2604017	4802.7	2598935	2706590	3056.4	3420613	3619342	1808.8
Area grown (sq m)	570179		362366			258234		

TABLE 54: Comparison of pesticide usage on NON-EDIBLE crops 1981-1991, spray sq m of formulations, spray sq m of active ingredients and quantities used (kg)

	1981		1991		
	Spray sq m of a.i.'s	Kg	Spray sq m of formulations	Spray sq m of a.i.'s	Kg
INSECTICIDES					
Pyrethroids	88232	0.2	403559	446314	4.2
Organophosphates	81146	4.3	211104	234960	51.7
Organochlorines	50863	3.1	47050	47050	8.5
Carbamates	77473	29.8	263924	263924	24.2
Others	8655	1.7	86544	86544	26.9
Total insecticides	306369	39.1	1012181	1078792	115.5
BIOLOGICAL AGENTS	.	.	1236	1693	.
MOLLUSCICIDES	2588	0.2	174779	174779	11.3
FUNGICIDES	161439	33.7	529550	618970	201.3
HERBICIDES	14829	5.4	135029	135029	23.4
OTHER PESTICIDES					
Disinfectants	6992	19.5	14344	14344	114.6
Growth regulators	10094	0.4	83965	87958	34.5
Soil sterilants	18136	1700.8	44186	44186	1429.3
Total other pesticides	35222	1720.7	142495	146488	1578.4
Total pesticides	520447	1799.1	1995270	2125751	1929.9
Area grown (sq m)	165546		432750		

PESTICIDE USAGE IN SCOTLAND

SURVEY REPORT 97

MUSHROOMS 1991

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East Craigs, Edinburgh

Scottish Office Agriculture and Fisheries Department

CONTENTS

INTRODUCTION AND METHOD

This was the third survey of mushrooms in Scotland. Previous mushroom surveys were carried out in 1976 and 1981 (refs. 1 & 2).

With the help of the Horticultural Unit of SOAFD, 14 mushroom growers were identified as operating in Scotland. As far as could be ascertained these were all the growers in business during the full survey period 1 January 1991 to 31 December 1991. As a consequence the figures represent national usage. All growers were visited and information was obtained on the use of pesticides.

PESTICIDE USAGE

Slightly more than 25 hectares of crop was grown in Scotland representing an approximate 6 fold increase since 1981. Tables 1 and 2 show the use of insecticides and fungicides respectively.

Insecticides were applied to 81% of the crop. The proportion of crop treated with any insecticide in 1981 had not been recorded. As in 1981 the insecticides were used to control both sciarid and phorid flies. Diazinon was the main chemical, with 54% of the crop being treated (42% in 1981). In addition permethrin was used on 45% of the crop area (none recorded in 1981). Pyrethrin and resmethrin, both alone and in formulation, were also popular.

All crops received a fungicide. These were used as a precaution against Verticilium and Mycogene spp.. The main chemicals were prochloraz, on 85% of crop (none recorded 1981) and benomyl, 48% (18% in 1981). The proportion of crop treated in 1981 was not detailed, but it was less than 50%.

Table 4 shows the repeated use of insecticides and fungicides.

All growers used some form of disinfectant (table 3) mainly for general cleansing of houses, trays and use in footbaths. The main disinfectant active ingredients used were 2-phenylphenol and sodium o-benzyl p-chlorophenoxide.

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TABLE 1: Usage of insecticides on mushrooms (spray square metres of formulations and weight (kg) of active ingredients) and the percentage of the crop treated

	Treated area	Kg	% of crop treated	1981 (kg)
PYRETHROIDS				
Permethrin	114206	2.0	45	.
Pyrethrin	65678	94.9	26	.
Pyrethrin/resmethrin	115044	0.6/5.7	33	.
Resmethrin	10000	0.24	2	.
ORGANOPHOSPHATES				
Chlorfenvinphos	38544	58.0	15	.
Diazinon	232880	224.9	54	68
Dichlorvos	9460	6.8	2	.
Pirimiphos-methyl	38544	2.4	15	.
ORGANOCHLORINES				
Dicofol	39594	3.3	16	.
Gamma-HCH	29000	6.1	7	1
OTHER				
Diflubenzuron	19250	21.3	6	6
Total insecticide	712200	426.2	81	

Area of crop = 252,696 sq m

'+' = less than 0.5%

TABLE 2: Usage of fungicides on mushrooms (spray square metres of formulation and weight (kg) of active ingredients and the percentage of the crop treated

	Treated area	Kg	% of crop treated	1981 (kg)
Benomyl	120078	147.1	48	8
Chlorothalonil	38544	40.0	15	2
Dichlorophen	42294	28.6	17	.
Prochloraz	227066	148.7	85	.
Total fungicide	427982	364.4	100	

Area of crop = 252,696 sq m

TABLE 3: Usage of disinfectants (kg of active ingredients)

2-phenylphenol	662.6
Benzyl chloro phenols }	80.4
Benzyl phenols }	
Dichlorophen	28.6
Ortho benzyl parachloro phenol	40.0
Sodium dichloro-isocyanurate	0.4
Sodium hypochlorite	96.1
Sodium o-benzyl p-chlorophenoxide	368.0
Sodium p-tertiary amyl phenoxide	90.0
Tar acids	0.1
Xylenols	37.8
Total disinfectant	1404.0

TABLE 4: Repeated use of pesticides on mushrooms (percentage of the basic area treated more than once)

	Once	Twice	Three times
Diazinon	76	6	18
Dichlorvos	98	1	1
Diflubenzuron	98	.	2
Gamma-HCH	98	.	2
Pyrethrin/resmethrin	93	1	6
Permethrin	98	2	.
Prochloraz	96	4	.
Resmethrin	98	2	.

TABLE 5: Comparison of pesticide usage 1981-91, area treated (spray sq m of formulations) and quantities used (kg of active ingredients)

	1981		1991	
	spray sq. metres	Kg	Spray sq. metres	Kg
INSECTICIDES				
Pyrethroids	7400	+	304928	103.4
Organophosphates	26100	72.0	319428	292.1
Organochclorines	<1000	1.0	68594	9.4
Other insecticides	5600	6.0	19250	21.3
All insecticides	40100	79.0	712200	426.2
FUNGICIDES	21600	24.0	427982	364.4
All pesticides	61700	103.0	1140182	790.6
Area of crop (square metres)	42000		252696	

'+' = <0.5 kg