PESTICIDE USAGE IN SCOTLAND

POTATO STORES
1992, 1994 & 1996

Scottish Agricultural Science Agency

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POTATO STORES 1992

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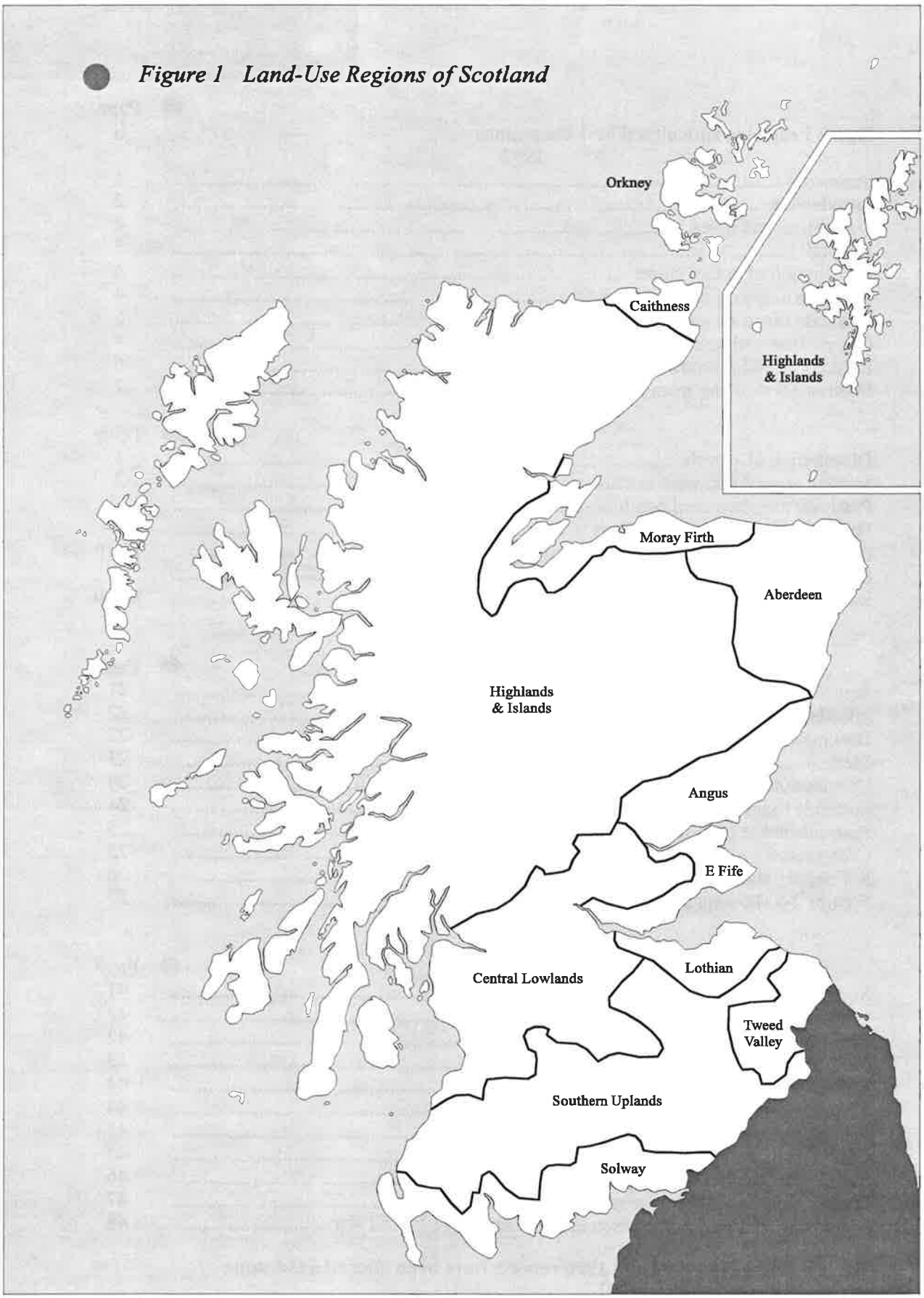
Table numbers for 1994 and 1996 reports have been allocated the same numbering system as for 1992.

Figure 1 Land-Use Regions of Scotland



SUMMARY

This is the fifth survey covering the use of pesticides on potatoes in store by growers and licensed merchants in Scotland.

Of the total quantity of stored potatoes in 1992, 87% (986,465 tonnes) were stored on farms, whilst the remainder (142,800 tonnes) were held in merchant stores. Of those farm-stored potatoes designated as seed, over one third (37%) were treated with pesticides, whilst only 21% designated as ware were treated. Thiabendazole was the most popular chemical used on seed potatoes, whilst tecnazene, used mainly for sprout suppression, was the principal pesticide used on those potatoes designated as ware.

Only a small proportion of potatoes (approximately 8%) in merchant stores was treated.

INTRODUCTION

This is the fifth survey concerned with the use of pesticides on stored potatoes in Scotland. The previous four covered crops harvested in 1973, 1975, 1976 and 1986 (References 1-4).

This survey differed in three ways from the previous survey. Firstly, all the data collected were obtained by personal interview, there being no supplementary postal questionnaires. Secondly, information collected at each holding referred solely to those potatoes which had been grown on that holding and not to the total quantity of potatoes in store if the farmer was a grower-dealer or merchant. Lastly, the data were raised to national levels of tonnages stored in Scotland estimated by the Potato Marketing Board (PMB), as opposed to all the potatoes harvested. For this reason, the data presented in this report cannot strictly be compared with previous reports.

DEFINITIONS AND NOTES

Basic tonnage is the quantity of potatoes treated with a pesticide, irrespective of the number of times they were treated or the number of pesticides used.

Tonnes treated is the basic tonnage multiplied by the number of treatments those potatoes received.

Seed potatoes refer to those designated as such and do not include any which were initially grown as seed but later sold as ware.

Ware potatoes are those ending up as ware and include a proportion of potatoes originally grown for seed.

Farm stores includes grower-dealers and merchants who own agricultural land and are therefore covered in the Agricultural Census.

Merchant stores refers to those merchants who do not possess agricultural land and are not included in the Agricultural Census, but who do store potatoes.

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

METHOD

The samples selected for interview for this survey were the same as those employed in the Arable Crops 1992 report (Reference 5), and were drawn from the 1991 Agricultural Census (Reference 6). The principal sample was selected from holdings growing any of the combinable crops and potatoes, and a smaller sample from holdings growing potatoes.

The country was divided into 11 land-use regions (Fig 1, reference 7), and the samples were drawn from Census returns of holdings growing at least 1 hectare of the relevant crops. Holdings were stratified by land-use region and by farm size group. Sampling fractions within both regions and 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 samples. Land-use regions Caithness/Orkney, Highlands & Islands and Moray Firth were amalgamated, as were regions Tweed Valley, Southern Uplands and Solway Firth due to low sample populations in these areas.

Information was obtained on the quantities of potatoes stored, their method of storage and on treatments with pesticides. Treatments with fungicides prior to planting in 1993 were omitted, as these would duplicate data recorded on field crops in the Arable Crop reports.

Sample data were raised to give national estimates of pesticide usage using raising factors (Table 18) based on the areas growing potatoes in the 1992 Agricultural Census (Reference 8) within regions. Adjustments (Table 19) were made to the ware fraction to take into account the fact that a proportion of potatoes grown for seed ended up as ware. A second adjustment (Table 20) was made after comparing estimated tonnages of stored potatoes with those provided by the PMB.

DISTRIBUTION OF STORES

Information was obtained from a total of 106 farm stores. Their distribution is shown in Table 1, and regional data on tonnages stored and treated with pesticides are shown in Table 2. Information was also collected from the 11 merchants identified by the PMB.

SEED POTATOES

The quantity of seed potatoes stored on Scottish farms from the 1992 crop was 340,000 tonnes, as estimated by the PMB. Only 6,800 tonnes were stored in merchant stores.

Storage Methods (Tables 3, 4)

On farms, nearly all (98%) were stored in boxes, as opposed to bulk. Two-thirds (66%) were in ventilated stores and 31% in unventilated stores. Only 4% were refrigerated. All seed potatoes in merchant stores were boxed and were either ventilated (56%) or refrigerated (44%)

Use of pesticides (Tables 3-8)

The proportion of seed potatoes stored on farms treated with pesticides was 37%, but only 230 tonnes (3%) of those stored in bulk were treated.

The principal pesticide used was thiabendazole, both alone and in mixtures, on about 61,000 tonnes (18%), followed by 2-aminobutane on 41,666 tonnes (12%) and imazalil on over 25,000 tonnes (7%). By comparison in 1986, 2-aminobutane was applied to 79,820 tonnes and was more commonly used than thiabendazole, applied to about 69,000 tonnes; imazalil had not been available in 1986. There were no instances recorded of multiple treatments with the same formulation.

As in the previous survey, most growers treated their potatoes for precaution against general diseases and for insurance purposes, as opposed to specific disease treatment.

Nearly all seed potatoes (96%) stored in the merchant stores was treated. Only two formulations were recorded, thiabendazole on 78% and imazalil on 18%.

WARE POTATOES

The PMB estimated that 646,465 tonnes of ware potatoes were stored on farms following the 1992 harvest.

Storage methods (Tables 9, 10)

Seventy-six percent of ware potatoes stored on farms were in boxes and 24% in bulk.

Ventilated stores (61%) were the most popular type, followed by unventilated (31%), and refrigerated (7%).

Use of pesticides (Tables 9-14)

Twenty-one percent of ware potatoes (138,700 tonnes) in farm stores were treated with pesticides. As in the previous survey, the most commonly used was tecnazene, both alone and in formulations, on about 64,500 tonnes (10%), mainly for sprout suppression. In 1986, more than 146,000 tonnes had been treated with tecnazene. Thiabendazole applied to 45,589 tonnes (7%) and chlorpropham on 38,639 tonnes (4%) were also popular. Chlorpropham was applied twice to about half of the tonnage of ware potatoes (over 13,000 tonnes).

Only 2% of ware potatoes stored in merchant stores were treated, the most popular being chlorpropham which was applied three times to 1,000 tonnes (1%) of the stored crop.

COMPARISONS WITH PREVIOUS SURVEYS (TABLE 17)

As in 1986, most pesticide treatments were applied to stored potatoes on farms as opposed to merchant stores. Since the previous survey, there had been a reduction of 23% in the tonnage of potatoes treated on farms. The total weight of pesticides more than halved, partly due to the reduction in use of 2-aminobutane which is no longer approved for use on ware potatoes and which is applied at relatively high dosage rates.

As in the previous survey, only a small proportion of potatoes stored by merchants were treated.

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Figure 2 *Storage methods of seed potatoes in farm stores*

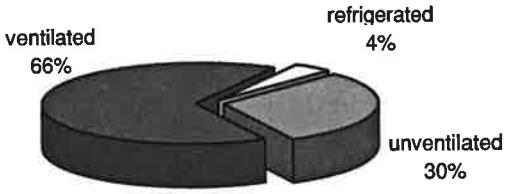

Figure 3 *Storage methods of ware potatoes in farm stores*

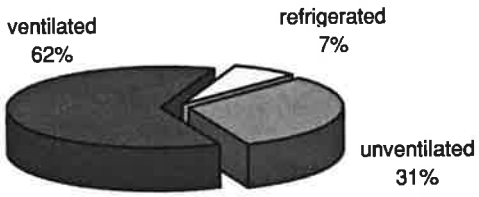

Figure 4 *Storage methods of seed potatoes in merchant stores*

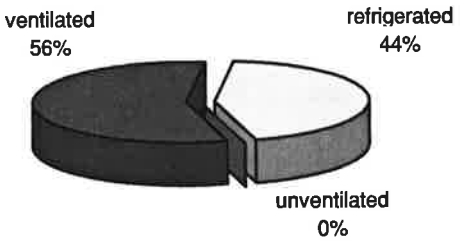

Figure 5 *Storage methods of ware potatoes in merchant stores*

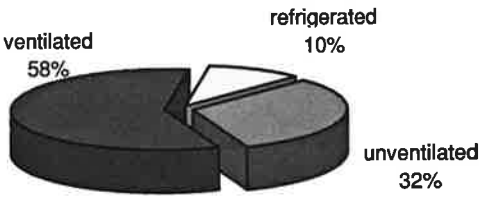

TABLE 1 Distribution of sample

Region	*Number of stores*
Caithness/Orkney, Highlands & Islands, Moray Firth	9
Aberdeen	18
Angus	33
East Fife	13
Lothian	11
Central Lowlands	14
Solway, Southern Uplands, Tweed Valley	8
Scotland	**106**

TABLE 2 Storage of seed and ware potatoes

Estimated quantities (tonnes) and percentages (%) of potatoes stored on farms in Scotland and basic tonnage treated with pesticides

Region	*Seed*	*%*	*Ware*	*%*	*All potatoes*	*%*
Caithness/Orkney, Highlands & Islands, Moray Firth	35,390	4	25,245	3	**60,635**	6
Aberdeen	53,974	5	48,562	5	**102,536**	10
Angus	184,768	19	188,308	19	**373,076**	38
East Fife	16,606	2	99,387	10	**115,993**	12
Lothian	5,776	1	83,617	8	**89,393**	9
Central Lowlands	27,931	3	113,820	12	**141,751**	14
Southern Uplands, Solway, Tweed Valley	15,554	2	87,527	9	**103,081**	10
Scotland	**340,000**	**34**	**646,465**	**66**	**986,465**	100
Basic tonnage treated	127,380		138,729		266,109	

TABLE 3 Seed potatoes

Storage methods in farm stores

	Outdoor	Unventilated		Ventilated		Refrigerated		Total		Total
	Clamp	Bulk	Boxed	Bulk	Boxed	Bulk	Boxed	Bulk	Boxed	All methods
Tonnes stored		2,240	101,119	5,451	216,969		14,220	7,691	332,309	**340,000**
% stored		1	30	2	64		4	2	98	**100**
Basic tonnage treated		230	18,764		102,298		6,087	230	127,149	**127,379**
% treated		10	19		47		43	3	38	**37**

TABLE 4 Seed potatoes

Storage methods in merchant stores

	Outdoor	Unventilated		Ventilated		Refrigerated		Total		Total
	Clamp	Bulk	Boxed	Bulk	Boxed	Bulk	Boxed	Bulk	Boxed	All methods
Tonnes stored					3,785		3,015		6,800	**6,800**
% stored					56		44		100	**100**
Basic tonnage treated					3,485		3,015		6,500	**6,500**
% treated					92		100		96	**96**

TABLE 5 Seed potatoes

Pesticides used and storage methods in farm stores (tonnes treated)

Formulations	Outdoor	Unventilated		Ventilated		Refrigerated		Total		Total
	Clamp	Bulk	Boxed	Bulk	Boxed	Bulk	Boxed	Bulk	Boxed	All methods
2-aminobutane			2,775		32,804		6,087		41,666	**41,666**
Imazalil			9,217		15,828				25,045	**25,045**
Imazalil/thiabendazole					426				426	**426**
Iprodione					285				285	**285**
Nonylphenoxypoly complex/thiabendazole					2,471				2,471	**2,471**
Thiabendazole		230	6,771		51,431			230	58,202	**58,432**
All formulations		**230**	**18,763**		**103,235**		**6,087**	230	128,095	**128,325**
Not treated		2,010	82,352	5,452	114,665		8,133	7,462	205,150	212,612

TABLE 6 Seed potatoes

Pesticides used and storage methods in merchant stores (tonnes treated)

Formulations	Outdoor	Unventilated		Ventilated		Refrigerated		Total		Total
	Clamp	Bulk	Boxed	Bulk	Boxed	Bulk	Boxed	Bulk	Boxed	All methods
Imazalil					1,200				1,200	**1,200**
Thiabendazole					2,285		3,015		5,300	**5,300**
All formulations					**3,485**		**3,015**		**6,500**	**6,500**
Not treated					300				300	**300**

TABLE 7 Seed potatoes

Reasons for use of pesticides in farm stores (tonnes treated)

Formulations	*Gangrene*	*Contractual requirement*	*No reason given*	*Total*	*% treated*
2-aminobutane			41,666	**41,666**	12
Imazalil		9,723	15,322	**25,045**	7
Imazalil/thiabendazole		260	166	**426**	+
Iprodione		285		**285**	+
Nonylphenoxypoly complex/thiabendazole	1,995	476		**2,471**	1
Thiabendazole		31,546	26,887	**58,433**	17
All formulations	**1,995**	**42,290**	**84,041**	**128,326**	**37**
Tonnes stored					340,000

'+' = < 0.5%

TABLE 8 Seed potatoes

Reasons for use of pesticides in merchant stores (tonnes treated)

Formulations	*Gangrene, silver scurf & dry rot*	*Contractual requirement*	*Total*	*% treated*
Imazalil		1,200	**1,200**	18
Thiabendazole	4,500	800	**5,300**	78
All formulations	**4,500**	**2,000**	**6,500**	**96**
Tonnes stored				6,800

TABLE 9 Ware potatoes

Storage methods in farm stores

	Outdoor	Unventilated		Ventilated		Refrigerated		Unspecified		Total		Total
	Clamp	Bulk	Boxed	Bulk	Boxed	Bulk	Boxed	Bulk	Boxed	Bulk	Boxed	All methods
Tonnes stored	1,164	51,552	150,051	98,380	294,610		47,839	2,151	719	153,247	493,218	**646,465**
% stored	+	8	23	15	46		7	+	+	24	76	**100**
Basic tonnage treated		9,786	8,745	20,218	99,979					30,004	108,724	**138,728**
% treated		19	6	21	34					20	22	**21**

'+' = < 0.5%

TABLE 10 Ware potatoes

Storage methods in merchant stores

	Outdoor	Unventilated		Ventilated		Refrigerated		Unspecified		Total		Total
	Clamp	Bulk	Boxed	Bulk	Boxed	Bulk	Boxed	Bulk	Boxed	Bulk	Boxed	All methods
Tonnes stored			44,000	1,000	77,850		13,150			1,000	135,000	**136,000**
% stored			32	1	57		10			1	99	**100**
Basic tonnage treated				1,000	1,500					1,000	1,500	**2,500**
% treated				100	2					100	1	**2**

TABLE 11 Ware potatoes

Pesticides used and storage methods in farm stores (tonnes treated)

Formulations	Outdoor	Unventilated		Ventilated		Refrigerated		Unspecified		Total		Total
	Clamp	Bulk	Boxed	Bulk	Boxed	Bulk	Boxed	Bulk	Boxed	Bulk	Boxed	All methods
Chlorpropham				12,171	26,468					12,171	26,468	**38,639**
Nonylphenoxypoly complex/tecnazene				4,411	2,940					4,411	2,940	**7,351**
Tecnazene		9,786	8,745	3,635	35,041					13,421	43,786	**57,207**
Thiabendazole					45,589					0	45,589	**45,589**
Unspecified fungicide					3,174					0	3,174	**3,174**
All formulations		**9,786**	**8,745**	**20,217**	**139,757**					30,003	148,502	**151,960**
Not treated	1,164	41,765	141,304	78,161	194,627		47,838	2,151	719	123,241	384,488	507,729

TABLE 12 Ware potatoes

Pesticides used and storage methods in merchant stores (tonnes treated)

Formulations	Outdoor	Unventilated		Ventilated		Refrigerated		Unspecified		Total		Total
	Clamp	Bulk	Boxed	Bulk	Boxed	Bulk	Boxed	Bulk	Boxed	Bulk	Boxed	All methods
Chlorpropham				3,000						3,000		**3,000**
Nonylphenoxypoly complex/tecnazene					1,500						1,500	**1,500**
Tecnazene				1,000						1,000	0	**1,000**
All formulations				**4,000**	**1,500**					4,000	1,500	**5,500**
Not treated			44,000		76,350		13,150				133,500	133,500

TABLE 13 Ware potatoes

Reasons for use of pesticides in farm stores (tonnes treated)

Formulations	Sprout suppression	Dry rot & sprout suppression	Contractual requirement	No reason given	Total	% treated
Chlorpropham	38,639				**38,639**	4
Nonylphenoxypoly complex/tecnazene	7,352				**7,352**	1
Tecnazene	32,254	4,721	12,122	8,109	**57,206**	9
Thiabendazole				45,589	**45,589**	7
Unspecified fungicide				3,174	**3,174**	+
All formulations	**78,245**	**4,721**	**12,122**	**56,872**	**151,960**	**21**
Tonnes stored						646,465

'+' = <0.5%

TABLE 14 Ware potatoes

Reasons for use of pesticides in merchant stores (tonnes treated)

Formulations	Dry rot	Sprout suppression	Total	% treated
Chlorpropham		3,000	**3,000**	1
Nonylphenoxypoly complex/tecnazene		1,500	**1,500**	1
Tecnazene	1,000		**1,000**	1
All formulations	**1,000**	**4,500**	**5,500**	**2**
Tonnes stored				136,000

TABLE 15 Seed potatoes

Active ingredients and quantities (kg) for all stores

Active ingredients	Farm stores		Merchant stores		Total	
	Tonnes treated	kg	Tonnes treated	kg	Tonnes treated	kg
2-aminobutane	41,666	6,000			**41,666**	**6,000**
Imazalil	25,472	254	1,200	12	**26,672**	**266**
Iprodione	285	29			**285**	**29**
Nonylphenoxypoly complex	2,471	22			**2,471**	**22**
Thiabendazole	61,332	2,778	5,300	224	**66,632**	**3,002**
All active ingredients	**131,226**	**9,083**	**6,500**	**236**	**137,726**	**9,319**

TABLE 16 Ware potatoes

Active ingredients and quantities (kg) for all stores

Active ingredients	Farm stores		Merchant stores		Total	
	Tonnes treated	kg	Tonnes treated	kg	Tonnes treated	kg
Chlorpropham	38,639	831	3,000	65	**41,639**	**896**
Nonylphenoxypoly complex	7,352	38	1,500	28	**8,852**	**66**
Tecnazene	64,560	4,576	2,500	255	**67,060**	**4,831**
Thiabendazole	45,589	2,077			**45,589**	**2,077**
All active ingredients	**156,140**	**7,521**	**7,000**	**348**	**163,140**	**7,869**

TABLE 17 All potatoes

Comparison of pesticide usage 1986 - 1992, tonnes treated and quantities (kg) used

	1986		1992	
	Tonnes treated	*kg*	*Tonnes treated*	*kg*
Farm Stores				
Seed	154,576	19,307	128,326	9,083
Ware	204,641	17,304	148,502	7,521
All potatoes	**359,217**	**36,611**	**276,828**	**16,604**
Merchant stores				
Seed	5,636	346	6,500	236
Ware	8,681	684	5,500	348
All potatoes	**14,317**	**1,030**	**12,000**	**584**
All stored potatoes	**373,534**	**37,641**	**288,828**	**17,188**

TABLE 18 Raising factors

Region	Seed	Ware
Caithness/Orkney, Highlands & Islands, Moray Firth	19.10	36.10
Aberdeen	55.14	6.69
Angus	13.98	17.91
East Fife	14.83	10.72
Lothian	8.57	3.73
Central Lowlands	28.41	19.55
Southern Uplands, Solway, Tweed Valley	12.85	14.43

TABLE 19 First adjustment factors for ware potatoes

Region	Ware
Caithness/Orkney, Highlands & Islands, Moray Firth	1.14
Aberdeen	0.21
Angus	1.05
East Fife	0.93
Lothian	0.95
Central Lowlands	0.96
Southern Uplands, Solway, Tweed Valley	1.01

TABLE 20 Second adjustment factors

Seed potatoes	0.69
Ware potatoes	0.90

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POTATO STORES 1994

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SUMMARY

This is the sixth survey relating to the use of pesticides on potatoes stored on both farms and licensed merchant stores in Scotland.

The total quantity of potatoes stored in both farm and merchant stores following the 1994 harvest was 883,679 tonnes, a reduction of more than 10% since 1992, mainly due to a fall in ware potatoes. As in the previous survey, the majority of potatoes (91%) were stored on farms.

The principal pesticide applied to potatoes designated for the seed market was 2-aminobutane, to more than 85,000 tonnes, or 22% of the total stored. Usage of thiabendazole had declined since 1992, from over 66,500 tonnes treated to less than 30,000 tonnes in 1994.

As in the previous two surveys, tecnazene was the principal pesticide applied to ware potatoes (over 57,500 tonnes) mainly for sprout suppression.

INTRODUCTION

This is the sixth survey of the use of pesticides on stored potatoes in Scotland which records the usage of pesticides on the 1994 crop. The previous five covered crops harvested in 1973, 1975, 1976, 1986 and 1992 (References 1-5).

Data collection and processing methods were the same as those used in the previous survey and as such the data are not comparable with that presented in reports prior to 1992. All the data collected were obtained by personal interview. Farm stores data were raised to national levels for Scotland using figures provided by the Potato Marketing Board (PMB). No raising of data for merchants stores was necessary, this being a one hundred percent sample using a list of licensed dealers provided by the PMB.

DEFINITIONS AND NOTES

Basic tonnage is the quantity of potatoes treated with a pesticide, irrespective of the number of times they were treated or the number of pesticides used.

Tonnes treated is the basic tonnage multiplied by the number of treatments those potatoes received.

Seed potatoes refer to those designated as such and do not include any which were initially grown as seed but later sold as ware.

Ware potatoes are those ending up as ware and include a proportion of potatoes originally planted for seed.

Farm stores includes grower-dealers and merchants who own agricultural land and are therefore included in the Agricultural Census.

Merchant stores refers to those merchants who do not possess agricultural land and are therefore not included in the Agricultural Census but who do store potatoes.

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

METHOD

The sample selected for this survey of farm stores was the same as that for the Arable Crops 1994 report (Reference 6) and was drawn from the 1993 Agricultural Census (Reference 7). All the merchants known to the PMB were surveyed.

The country was divided into 11 land use regions (Fig. 1, page ii, reference 8), and the farm store sample was drawn from Census returns of holdings growing any of the combine crops. The sample was stratified by land use region and size of holding. Sampling fractions within region and size group depended on area of crops grown rather than number of farms so that smaller size groups would not dominate the sample. The three most northerly land-use regions (Caithness/Orkney, Highlands & Islands and Moray Firth) and three most southerly (Tweed Valley, Southern Uplands and Solway Firth) were amalgamated due to low sample populations in these areas.

Information was collected on quantities of potatoes stored, the storage environment, methods of storage and on storage chemicals applied. Fungicidal seed treatments prior to planting in 1995 were not recorded as this usage is covered by the Arable Crop reports.

National estimates of storage chemical usage were produced from the sample data by applying raising factors (Table 18) based on the areas of potatoes grown in 1994 (Reference 9). An adjustment was made to the ware fraction to allow for the potatoes grown as seed that ended up as ware (Table 19). A second adjustment (Table 20) was made to the survey estimates of stored potatoes to bring them into line with the actual potato movement figures provided by the PMB.

DISTRIBUTION OF STORES

Information was obtained from a total of 66 farm stores. Their distribution is shown in Table 1, and regional data on tonnages stored and percentage treated with pesticides are shown in Table 2. In addition, information was collected from the 18 merchants identified by the PMB.

SEED POTATOES

The quantity of seed potatoes stored on Scottish farms was similar to that in 1992, at around 340,000 tonnes, as estimated by the PMB. In contrast, potatoes in merchant stores had risen from only 6,800 tonnes in 1992 to almost 52,000 tonnes in the present survey.

Storage methods (Tables 3, 4)

Storage methods of seed potatoes on farms were fairly similar to those recorded in the previous survey in 1992. Nearly all (99%) were stored in boxes. Over three-quarters (76%) were in ventilated stores, either modified or purpose-built, whilst only 5% were refrigerated.

All potatoes in merchant stores were boxed: 75% in conventionally ventilated stores and 25% in refrigerated.

Use of pesticides (Tables 3-8)

Of those seed potatoes stored on farms, 32% were treated, slightly lower than the 37% recorded in 1992.

The principal pesticide used in farm stores was 2-aminobutane, applied to almost 75,000 tonnes (22%), an increase on the 12% recorded in 1992. The usage of thiabendazole declined from 17% in 1992 to 7% in the present survey and also that of imazalil from 7% to only 2%.

Unlike in the previous survey when nearly all seed potatoes in merchant stores had been treated, only 41% were treated during the storage period following the 1994 harvest. The three most commonly used pesticides were the same as those recorded in farm stores: 2-aminobutane (20%), thiabendazole (11%) and imazalil (10%).

As in previous surveys, most of the potatoes treated were for general disease precaution as opposed to the control of specific diseases.

WARE POTATOES

Since the previous survey, there had been a marked reduction in tonnage of ware potatoes stored on farms, from 646,465 tonnes in 1992 to below 460,000 tonnes in 1994. Tonnages in merchant stores were also lower, from 136,000 tonnes in the previous survey to less than 31,000 tonnes in the present survey.

Storage methods (Tables 9, 10)

Storage methods of ware potatoes on farms were similar to those recorded in the previous survey, 80% were boxed and the remaining 20% bulk. Conventionally ventilated stores accounted for 68% of all potatoes stored on farms, followed by unventilated on 26%, and refrigerated 6%.

In the merchant stores, all ware potatoes were boxed, 71% in refrigerated and 29% in conventionally ventilated stores.

Use of pesticides (Tables 9-14)

The proportion of ware potatoes treated in farm stores declined from 21% in 1992 to 13% in the present survey. As in the previous two surveys, tecnazene was the most popular pesticide applied, both alone, to 9% of stored ware potatoes, and in formulation with nonylphenoxypoly complex, to 4%, used mainly for sprout suppression. Chlorpropham was applied to 2% of the stored tonnage, also for sprout suppression.

As in 1992, only a small proportion of ware potatoes (5%) were treated in merchant stores. Chlorpropham, on 3%, and the formulation nonylphenoxypoly complex/tecnazene on 2% were the only pesticides recorded, both for sprout suppression.

COMPARISONS WITH PREVIOUS SURVEYS (Table 17)

Although the tonnage of seed potatoes remained fairly constant since 1992, the quantity of ware potatoes fell by 29% on farms, and by 77% in merchant stores.

Despite the 16% decline in the tonnage of seed potatoes treated since 1992, the total quantities of pesticides applied increased by 32%, due mainly to the increased usage of 2-aminobutane which is applied at relatively high dosage rates.

The tonnage of ware potatoes treated with pesticides more than halved, a greater fall than the total tonnage stored.

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Figure 2 *Storage methods of seed potatoes in farm stores*

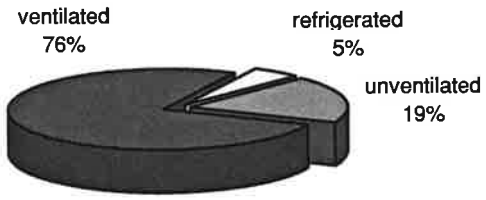

Figure 3 *Storage methods of ware potatoes in farm stores*

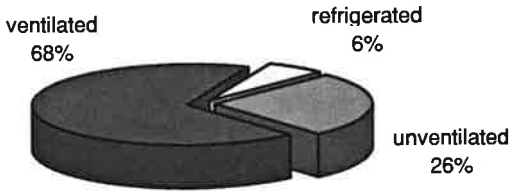

Figure 4 *Storage methods of seed potatoes in merchant stores*

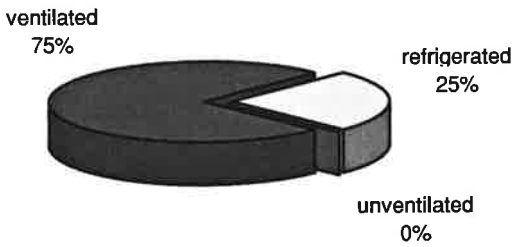

Figure 5 *Storage methods of ware potatoes in merchant stores*

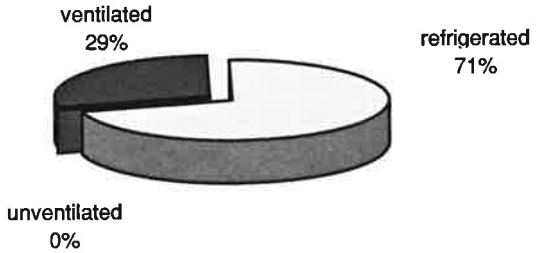

TABLE 1 Distribution of sample

Region	Number of stores
Caithness/Orkney, Highlands & Islands, Moray Firth	5
Aberdeen	7
Angus	26
East Fife	9
Lothian	11
Central Lowlands	3
Solway, Southern Uplands, Tweed Valley	5
Scotland	**66**

TABLE 2 Storage of seed and ware potatoes

Estimated quantities (tonnes) and percentages (%) of potatoes stored on farms in Scotland and basic tonnage treated with pesticides

Region	*Seed*	*%*	*Ware*	*%*	*All potatoes*	*%*
Caithness/Orkney, Highlands & Islands, Moray Firth	45,250	6	25,329	3	70,579	9
Aberdeen	51,036	6	18,870	2	69,906	9
Angus	158,012	20	137,900	17	295,912	37
East Fife	23,654	3	63,761	8	87,415	11
Lothian	4,238	1	62,222	8	66,460	8
Central Lowlands	37,891	5	86,424	11	124,316	16
Solway, Southern Uplands, Tweed Valley	21,665	3	64,797	8	86,462	11
Scotland	**341,747**	**43**	**459,302**	**57**	**801,049**	**100**
Basic tonnage treated	107,895		59,272		167,167	

TABLE 3 Seed potatoes

Storage methods in farm stores

	Outdoor	Unventilated		Ventilated		Refrigerated		Total		Total
	Clamp	Bulk	Boxed	Bulk	Boxed	Bulk	Boxed	Bulk	Boxed	All methods
Tonnes stored		2,471	64,083		258,449		16,744	2,471	339,276	**341,747**
% stored		1	19		76		5	1	99	**100**
Basic tonnage treated			14,228		78,173		15,494		107,895	**107,895**
% treated			22		30		93		32	**32**

TABLE 4 Seed potatoes

Storage methods in merchant stores

	Outdoor	Unventilated		Ventilated		Refrigerated		Total		Total
	Clamp	Bulk	Boxed	Bulk	Boxed	Bulk	Boxed	Bulk	Boxed	All methods
Tonnes stored					39,102		12,740		51,842	**51,842**
% stored					75		25		100	**100**
Basic tonnage treated					10,633		10,394		21,027	**21,027**
% treated					21		20		41	**41**

TABLE 5 Seed potatoes

Pesticides used and storage methods in farm stores (tonnes treated)

Formulations	Outdoor	Unventilated		Ventilated		Refrigerated		Total		Total
	Clamp	Bulk	Boxed	Bulk	Boxed	Bulk	Boxed	Bulk	Boxed	All methods
2-aminobutane			8,986		50,368		15,494		74,848	**74,848**
Imazalil					8,329				8,329	**8,329**
Nonylphenoxypoly complex/tecnazene					1,158				1,158	**1,158**
Thiabendazole			5,242		18,318				23,560	**23,560**
All formulations			**14,228**		**78,173**		**15,494**		**107,895**	**107,895**
Not treated		2,471	49,856		180,276		1,249	2,471	231,381	**233,852**

TABLE 6 Seed potatoes

Pesticides used and storage methods in merchant stores (tonnes treated)

Formulations	Outdoor	Unventilated		Ventilated		Refrigerated		Total		Total
	Clamp	Bulk	Boxed	Bulk	Boxed	Bulk	Boxed	Bulk	Boxed	All methods
2-aminobutane					5,825		4,650		10,475	**10,475**
Imazalil					4,533		800		5,333	**5,333**
Imazalil/thiabendazole					25		0		25	**25**
Iprodione					50		0		50	**50**
Thiabendazole					200		5,594		5,794	**5,794**
All formulations					**10,633**		**11,044**		**21,677**	**21,677**
Not treated					28,469		2,346		30,815	**30,815**

TABLE 7 Seed potatoes

Reasons for use of pesticides in farm stores (tonnes treated)

Formulations	Gangrene & skin spot	Skin spot	Gangrene, silver scurf & skin spot	Dry rot & sprout suppression	Disease precaution	No reason given	Total	% treated
2-aminobutane	15,962	15,233			36,636	7,017	**74,848**	22
Imazalil						8,329	**8,329**	2
Nonylphenoxypoly complex/tecnazene				1,158			**1,158**	+
Thiabendazole			5,242		18,318		**23,560**	7
All formulations	**15,962**	**15,233**	**5,242**	**1,158**	**54,955**	**15,346**	**107,895**	**32**
Tonnes stored								341,747

TABLE 8 Seed potatoes

Reasons for use of pesticides in merchant stores (tonnes treated)

Formulations	Skin spot	Contractual requirement	Disease precaution	Total	% treated
2-aminobutane	3,200	2,650	4,625	**10,475**	20
Imazalil		3,333	2,000	**5,333**	10
Imazalil/thiabendazole		25		**25**	+
Iprodione		50		**50**	+
Thiabendazole		200	5,594	**5,794**	11
All formulations	**3,200**	**6,258**	**12,219**	**21,677**	**41**
Tonnes stored					51,842

'+' = < 0.5%

TABLE 9 Ware potatoes

Storage methods in farm stores

	Outdoor	Unventilated		Ventilated		Refrigerated		Total		Total
	Clamp	Bulk	Boxed	Bulk	Boxed	Bulk	Boxed	Bulk	Boxed	All methods
Tonnes stored		54,071	64,688	39,347	272,587		28,608	93,419	365,883	**459,302**
% stored		12	14	9	59		6	20	80	**100**
Basic tonnage treated		6,357	5,677	39,347	7,890			45,704	13,568	**59,272**
% stored		12	9	100	3			10	3	**13**

TABLE 10 Ware potatoes

Storage methods in merchant stores

	Outdoor	Unventilated		Ventilated		Refrigerated		Total		Total
	Clamp	Bulk	Boxed	Bulk	Boxed	Bulk	Boxed	Bulk	Boxed	All methods
Tonnes stored					8,820		21,968		30,788	**30,788**
% stored					29		71		100	**100**
Basic tonnage treated					1,470				1,470	**1,470**
% stored					5				5	**5**

TABLE 11 Ware potatoes

Pesticides used and storage methods in farm stores (tonnes treated)

Formulations	Outdoor	Unventilated		Ventilated		Refrigerated		Total		Total
	Clamp	Bulk	Boxed	Bulk	Boxed	Bulk	Boxed	Bulk	Boxed	All methods
Chlorpropham				10,429				10,429		10,429
Nonylphenoxypoly complex/tecnazene			430	16,555				16,555	430	16,985
Tecnazene		6,357	5,247	20,640	7,890			26,997	13,138	40,134
All formulations		**6,357**	**5,678**	**47,624**	**7,890**			**53,980**	**13,568**	**67,548**
Not treated		47,714	59,011		264,699		28,608	47,714	352,317	400,030

TABLE 12 Ware potatoes

Pesticides used and storage methods in merchant stores (tonnes treated)

Formulations	Outdoor	Unventilated		Ventilated		Refrigerated		Total		Total
	Clamp	Bulk	Boxed	Bulk	Boxed	Bulk	Boxed	Bulk	Boxed	All methods
Chlorpropham					3,200				3,200	**3,200**
Nonylphenoxypoly complex/tecnazene					670				670	**670**
All formulations					**3,870**				**3,870**	**3,870**
Not treated					7,350		21,968		29,318	**29,318**

TABLE 13 Ware potatoes

Reasons for use of pesticides in farm stores (tonnes treated)

Formulations	Sprout suppression	Dry rot & sprout suppression	Precaution	No reason given	Total	% treated
Chlorpropham	10,429				**10,429**	2
Nonylphenoxypoly complex/tecnazene	16,985				**16,985**	4
Tecnazene	21,867	8,277	5,793	4,197	**40,134**	9
All formulations	**49,281**	**8,277**	**5,793**	**4,197**	**67,548**	**13**
Tonnes stored						459,302

TABLE 14 Ware potatoes

Reasons for use of pesticides in merchant stores (tonnes treated)

Formulations	Sprout suppression	Total	% treated
Chlorpropham	3,200	**3,200**	3
Nonylphenoxypoly complex/tecnazene	670	**670**	2
All formulations	**3,870**	**3,870**	**5**
Tonnes stored			30,788

TABLE 15 Seed potatoes

Active ingredients and quantities (kg) for all stores

Active ingredients	Farm stores		Merchant stores		Total	
	Tonnes treated	kg	Tonnes treated	kg	Tonnes treated	kg
2-aminobutane	74,848	14,137	10,475	2,112	**85,323**	**16,249**
Imazalil	8,329	55	5,358	54	**13,688**	**109**
Iprodione			50	5	**50**	**5**
Nonylphenoxypoly complex	1,158	5			**1,158**	**5**
Tecnazene	1,158	36			**1,158**	**36**
Thiabendazole	23,560	954	5,819	235	**29,379**	**1,189**
All active ingredients	**109,053**	**15,187**	**21,702**	**2,406**	**130,756**	**17,593**

TABLE 16 Ware potatoes

Active ingredients and quantities (kg) for all stores

Active ingredients	Farm stores		Merchant stores		Total	
	Tonnes treated	kg	Tonnes treated	kg	Tonnes treated	kg
Chlorpropham	10,427	133	3,200	69	**13,627**	**202**
Nonylphenoxypoly complex	16,980	108	670	13	**17,650**	**121**
Tecnazene	57,105	4,519	670	84	**57,775**	**4,603**
All active ingredients	**84,512**	**4,760**	**4,540**	**165**	**89,052**	**4,925**

TABLE 17 All potatoes

Comparison of pesticide usage 1986 - 1994, tonnes treated and quantities (kg) used

	1986		1992		1994	
	Tonnes treated	*kg*	*Tonnes treated*	*kg*	*Tonnes treated*	*kg*
Farm Stores						
Seed	154,576	19,307	128,325	11,483	107,895	15,187
Ware	204,641	17,304	148,502	7,521	67,548	4,760
All potatoes	**359,217**	**36,611**	**276,828**	**19,004**	**175,443**	**19,947**
Merchant stores						
Seed	5,636	346	6,500	236	21,677	2,406
Ware	8,681	684	5,500	348	3,870	165
All potatoes	**14,317**	**1,030**	**12,000**	**584**	**25,547**	**2,571**
All stored potatoes	**373,534**	**37,641**	**288,828**	**19,588**	**200,990**	**22,518**

TABLE 18 Raising factors

Region	Seed	Ware
Caithness/Orkney, Highlands & Islands, Moray Firth	15.21	65.76
Aberdeen	31.12	21.62
Angus	12.18	6.42
East Fife	7.03	7.45
Lothian	9.68	8.07
Central Lowlands	111.93	54.65
Southern Uplands, Solway, Tweed Valley	10.95	14.49

TABLE 19 First adjustment factors for ware potatoes

Region	Ware
Caithness/Orkney, Highlands & Islands, Moray Firth	1.00
Aberdeen	1.00
Angus	1.11
East Fife	1.00
Lothian	1.00
Central Lowlands	1.06
Southern Uplands, Solway, Tweed Valley	1.00

TABLE 20 Second adjustment factors

Seed potatoes	0.68
Ware potatoes	1.02

PESTICIDE USAGE IN SCOTLAND

POTATO STORES 1996

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SUMMARY

This is the seventh survey on the use of pesticides on potatoes stored on both farms and licensed merchant stores in Scotland, the last survey concerned potatoes harvested during 1994 and the results are reported in this publication.

The total quantity of potatoes stored on both farm and merchant stores following the 1996 harvest was 1,267,729 tonnes, a considerable increase of 43% compared with 1994. As in the previous two surveys, the majority of potatoes (90%) were stored on farms.

Overall, the principal pesticide applied to potatoes was tecnazene, applied to over 96,500 tonnes, almost exclusively to potatoes designated for the ware market. The fungicide imazalil was the second highest used storage chemical being applied to almost 70,000 tonnes of predominantly seed potatoes, followed by 2-aminobutane to over 43,000 tonnes of seed potatoes.

No thiabendazole was recorded in this survey probably due to resistance to some diseases, in particular, skin spot and silver scurf.

INTRODUCTION

This is the seventh survey of the use of pesticides on stored potatoes in Scotland. The previous six covered crops harvested in 1973, 1975, 1976, 1986, 1992 and 1994 (References 1-6).

Data collection and processing methods were the same as those used in the previous two surveys. All the data collected were obtained by personal interview. Farm stores data were raised to national levels for Scotland using figures provided by the British Potato Council. No raising of data for merchant stores was necessary, this being a one hundred percent sample using a list of licensed dealers provided by the British Potato Council.

DEFINITIONS AND NOTES

Basic tonnage is the quantity of potatoes treated with a pesticide, irrespective of the number of times they were treated or the number of pesticides used.

Tonnes treated is the basic tonnage multiplied by the number of treatments those potatoes received.

Seed potatoes are those designated as seed, after dressing and removal of the ware fraction.

Ware potatoes include those grown for the ware market plus the proportion of potatoes originally planted for seed but later sold as ware. The tonnage is that going into store following the harvest and will include soil, wastage, and those potatoes downgraded to animal feed.

Farm stores includes grower-dealers, i.e. those who grow and trade in potatoes, and merchants who own agricultural land and are therefore included in the Agricultural Census.

Merchant stores refers only to those merchants who do not possess agricultural land and are therefore not included in the Agricultural Census but who do store potatoes.

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

METHOD

The sample for this survey of farm stores was the same as that for the Arable Crops 1996 survey (Reference 7) and was drawn from the 1995 Agricultural Census (Reference 8). All the potato merchants known to the British Potato Council were surveyed.

The country was divided into 11 land use regions (Fig. 1, page ii, reference 9), and the farm store sample was drawn from Census returns of holdings growing any of the combine crops. The sample was stratified by land use region and size of holding. Sampling fractions within region and size group depended on area of crops grown rather than number of farms so that smaller size groups would not dominate the sample. The three most northerly land-use regions (Caithness/Orkney, Highlands & Islands and Moray Firth) and three most southerly (Tweed Valley, Southern Uplands and Solway Firth) were amalgamated due to low sample populations in these areas.

Information was collected on quantities of potatoes stored, the storage environment, methods of storage and on storage chemicals applied. Fungicidal seed treatments prior to planting in 1997 were not recorded as this usage is covered by the Arable Crop reports.

National estimates of storage chemical usage were produced from the sample data by applying raising factors (Table 18) based on the areas of potatoes grown in 1996 (Reference 10). An adjustment was made to the ware fraction to allow for the potatoes grown for seed that were designated as ware (Table 19). A second adjustment (Table 20) was made to the survey estimates of stored potatoes to bring them into line with the actual potato movement figures provided by the British Potato Council.

DISTRIBUTION OF STORES

Information was obtained from a total of 79 farm stores. Their distribution throughout Scotland is shown in Table 1, and regional data on tonnages stored and percentage treated with pesticides are shown in Table 2. In addition, information was collected from the 13 merchants identified by the British Potato Council.

SEED POTATOES

The quantity of seed potatoes stored on Scottish farms was 17% less than in 1994, at around 284,000 tonnes, as estimated by the British Potato Council. Similarly, the tonnage stored by merchants fell by 30% from around 52,000 tonnes in the previous survey to less than 36,500 tonnes in 1996.

Storage methods (Tables 3, 4)

Storage methods of seed potatoes on farms were fairly similar to those recorded in the previous two surveys in 1992 and 1994. As in 1994, nearly all seed potatoes were stored in boxes, and again, about three-quarters (74%) were in ventilated stores, either modified or purpose-built, whilst those in refrigerated stores increased from 5% to 21% in 1996. There was a corresponding decrease in potatoes in unventilated stores to only 5%.

As in 1994, all potatoes in merchant stores were boxed. Those refrigerated increased from 25% in 1994 to 50% in the present survey.

Use of pesticides (Tables 3-8)

On farms, the proportion of seed potatoes treated in store was 28%, slightly lower than the 32% recorded in 1994.

The principal pesticide used in farm stores was imazalil, applied to over 50,000 tonnes (18%), a large increase on the 2% recorded in 1994. Usage of 2-aminobutane for the control of gangrene and skin spot declined from 22% of the total tonnage stored to only 13% in 1996. In the previous survey, thiabendazole had been applied to 7% of seed potatoes, but none was recorded in 1996 probably due to resistance to diseases, in particular skin spot and silver scurf.

There was a slight increase in the proportion of seed potatoes treated in merchant stores, from 41% in 1994 to 53% in 1996. Imazalil (on 33%) and 2-aminobutane (on 20%) were the only chemicals recorded.

As in previous surveys, most of the potatoes treated were for general disease precaution as opposed to the control of specific diseases.

WARE POTATOES

There was a large increase in the tonnage of ware potatoes stored on farms, from below 460,000 tonnes in 1994 to almost 860,000 tonnes in 1996. Tonnages in merchant stores were also higher, from less than 31,000 tonnes in the previous survey to over 88,000 tonnes in 1996.

Storage methods (Tables 9, 10)

A higher proportion of potatoes stored on farms were boxed, rising from 80% in 1994 to 92% in the present survey. Conventionally ventilated stores accounted for 79% of all potatoes stored on farms, followed by unventilated, on 12%, and refrigerated, 9%.

Unlike the results from the previous survey, 20 % of ware potatoes in merchant stores were unventilated. The remainder were either in conventionally ventilated stores (40%) or refrigerated (41%).

Use of pesticides (Tables 9-14)

The proportion of ware potatoes treated in farm stores fell slightly from 13% in 1994 to 11% in the present survey. As in the previous three surveys, tecnazene was the most popular pesticide used, applied to 11% of ware potatoes, used mainly for sprout suppression. Chlorpropham, which had been used on 2% in the previous survey, was not recorded in this survey. Imazalil, which was not approved for use on ware potatoes before 1996, was used on 1%.

As in 1992 and 1994, only a small proportion of ware potatoes (5%) were treated in merchant stores. Tecnazene on 5% and chlorpropham, on 1%, were the only pesticides recorded, both for sprout suppression.

COMPARISONS WITH PREVIOUS SURVEYS (Table 17)

The tonnage of all stored seed potatoes had fallen by 19%, compared with 1994, whilst the quantity of ware potatoes almost doubled to 950,000 tonnes.

The overall tonnage of combined seed and ware potatoes treated with pesticides rose by only 5%, considerably less than the increase in tonnage stored. The total weight of all pesticides applied fell by 3%, due mainly to the lower usage of 2-aminobutane which is applied at relatively high dosage rates.

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Figure 2 *Storage methods of seed potatoes in farm stores*

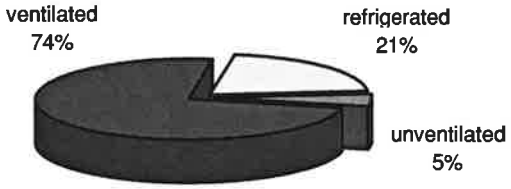


Figure 3 *Storage methods of ware potatoes in farm stores*

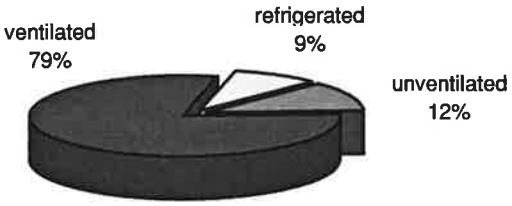


Figure 4 *Storage methods of seed potatoes in merchant stores*

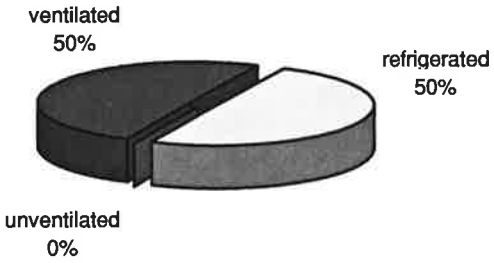
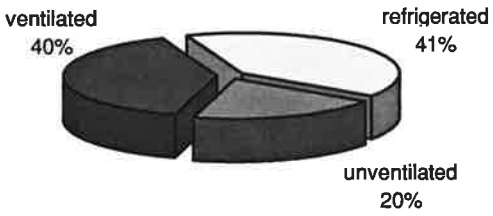
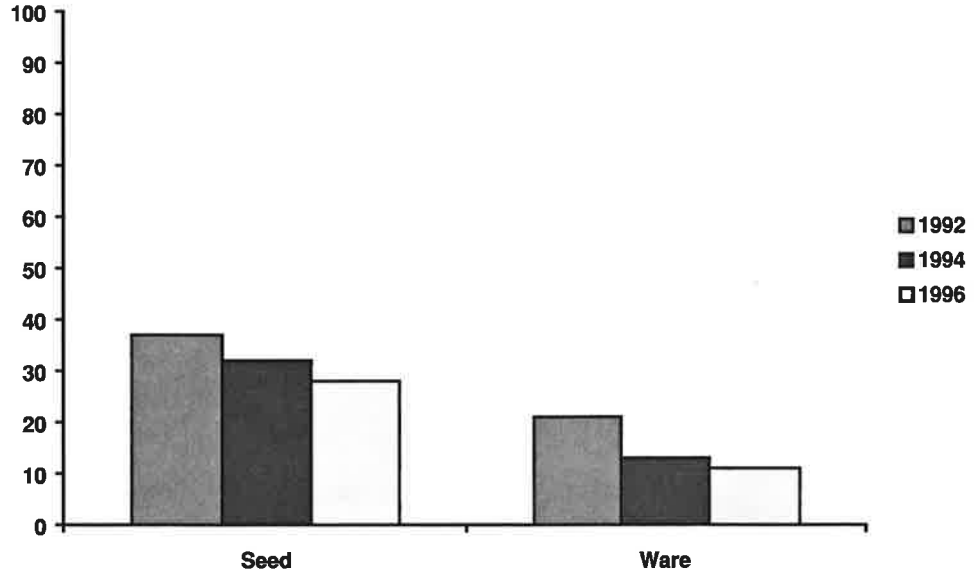


Figure 5 *Storage methods of ware potatoes in merchant stores*



● ***Figure 6 Comparison of pesticide usage 1992-96 in farm stores***
Percentage of potatoes treated.



● ***Figure 7 Comparison of pesticide usage 1992-96 in merchant stores***
Percentage of potatoes treated.

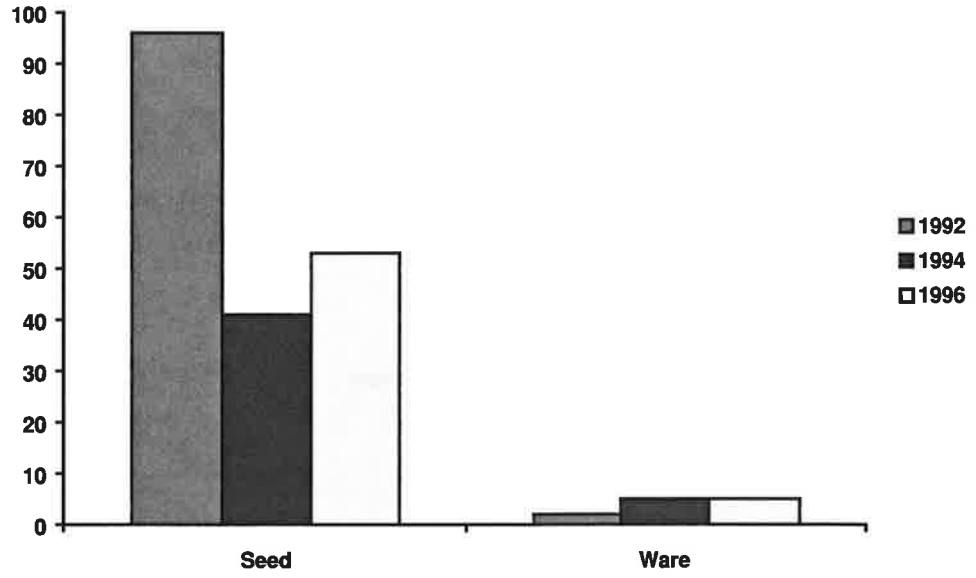


TABLE 1 Distribution of sample

Region	*Number of stores*
Caithness/Orkney, Highlands & Islands, Moray Firth	9
Aberdeen	18
Angus	20
East Fife	10
Lothian	4
Central Lowlands	10
Solway, Southern Uplands, Tweed Valley	8
Scotland	**79**

TABLE 2 Storage of seed and ware potatoes

Estimated quantities (tonnes) and percentages (%) of potatoes stored on farms in Scotland and basic tonnage treated with pesticides

Region	Seed	%	Ware	%	All potatoes	%
Caithness/Orkney, Highlands & Islands, Moray Firth	34,174	12	122,470	14	156,644	14
Aberdeen	57,269	20	94,401	11	151,670	13
Angus	117,518	41	188,457	22	305,975	27
East Fife	19,269	7	114,741	13	134,011	12
Lothian	2,910	1	101,269	12	104,178	9
Central Lowlands	29,225	10	163,658	19	192,883	17
Solway, Southern Uplands, Tweed Valley	23,444	8	74,275	9	97,719	9
Scotland	**283,809**	**25**	**859,271**	**75**	1,143,080	**100**
Basic tonnage treated	78,124	28	98,084	11	**176,208**	15

TABLE 3 Seed potatoes

Storage methods in farm stores

	Outdoor	Unventilated		Ventilated		Refrigerated		Total		Total
	Clamp	Bulk	Boxed	Bulk	Boxed	Bulk	Boxed	Bulk	Boxed	All methods
Tonnes stored			14,887	408	209,075		59,438	408	283,401	**283,809**
% stored			5	+	74		21	+	100	**100**
Basic tonnage treated			6,379		31,693		40,051		78,124	**78,124**
% treated			43		15		67		28	**28**

'+' = < 0.5%

TABLE 4 Seed potatoes

Storage methods in merchant stores

	Outdoor	Unventilated		Ventilated		Refrigerated		Total		Total
	Clamp	Bulk	Boxed	Bulk	Boxed	Bulk	Boxed	Bulk	Boxed	All methods
Tonnes stored					18,060		18,360		36,420	**36,420**
% stored					50		50		100	**100**
Basic tonnage treated					3,050		16,150		19,200	**19,200**
% treated					17		88		53	**53**

TABLE 5 Seed potatoes

Pesticides used and storage methods in farm stores (tonnes treated)

Formulations	Outdoor	Unventilated		Ventilated		Refrigerated		Total		Total
	Clamp	Bulk	Boxed	Bulk	Boxed	Bulk	Boxed	Bulk	Boxed	All methods
2-aminobutane					6,135		29,761		35,896	**35,896**
Imazalil			6,379		28,659		15,092		50,130	**50,130**
Tecnazene					1,173				1,173	**1,173**
All formulations			**6,379**		**35,967**		**44,853**		**87,199**	**87,199**
Not treated			8,508	408	177,382		19,387	408	205,277	**205,685**

TABLE 6 Seed potatoes

Pesticides used and storage methods in merchant stores (tonnes treated)

Formulations	Outdoor	Unventilated		Ventilated		Refrigerated		Total		Total
	Clamp	Bulk	Boxed	Bulk	Boxed	Bulk	Boxed	Bulk	Boxed	All methods
2-aminobutane					750		6,450		7,200	**7,200**
Imazalil					2,300		9,700		12,000	**12,000**
All formulations					**3,050**		**16,150**		**19,200**	**19,200**
Not treated					15,010		2,210		17,220	**17,220**

TABLE 7 Seed potatoes

Reasons for use of pesticides in farm stores (tonnes treated)

Formulations	Gangrene & skin spot	Gangrene & dry rot	Skin spot	Dry rot	Silver scurf & skin spot	Increase tuber nos & sprout suppression	No specified reason	Total	% treated
2-aminobutane	19,391		2,311				14,194	**35,896**	13
Imazalil		1,099	2,981	10,290	5,357		30,403	**50,130**	18
Tecnazene						1,173		**1,173**	+
All formulations	**19,391**	**1,099**	**5,292**	**10,290**	**5,357**	**1,173**	**44,597**	**87,199**	**28**
Tonnes stored									283,809

'+' = < 0.5%

TABLE 8 Seed potatoes

Reasons for use of pesticides in merchant stores (tonnes treated)

Formulations	Skin spot	Silver scurf	Contractual requirement	Disease precaution	Total	% treated
2-aminobutane	2,000		1,800	3,400	**7,200**	20
Imazalil		4,700	4,800	2,500	**12,000**	33
All formulations	**2,000**	**4,700**	**6,600**	**5,900**	**19,200**	**53**
Tonnes stored						36,420

TABLE 9 Ware potatoes

Storage methods in farm stores

	Outdoor	Unventilated		Ventilated		Refrigerated		Total		Total
	Clamp	Bulk	Boxed	Bulk	Boxed	Bulk	Boxed	Bulk	Boxed	All methods
Tonnes stored		12,768	88,001	57,366	620,139		80,996	70,134	789,137	**859,271**
% stored		1	10	7	72		9	8	92	**100**
Basic tonnage treated					95,566		2,518		98,084	**98,084**
% treated					15		3		12	**11**

TABLE 10 Ware potatoes

Storage methods in merchant stores

	Outdoor	Unventilated		Ventilated		Refrigerated		Total		Total
	Clamp	Bulk	Boxed	Bulk	Boxed	Bulk	Boxed	Bulk	Boxed	All methods
Tonnes stored			17,500		34,889		35,840		88,229	**88,229**
% stored			20		40		41		100	**100**
Basic tonnage treated					2,359		2,000		4,359	**4,359**
% treated					7		6		5	**5**

TABLE 11 Ware potatoes

Pesticides used and storage methods in farm stores (tonnes treated)

Formulations	Outdoor	Unventilated		Ventilated		Refrigerated		Total		Total
	Clamp	Bulk	Boxed	Bulk	Boxed	Bulk	Boxed	Bulk	Boxed	All methods
Imazalil					4,569		2,518		7,087	**7,087**
Tecnazene					90,996				90,996	**90,996**
All formulations					**95,565**		**2,518**		**98,084**	**98,084**
Not treated		12,768	88,001	57,366	524,573		78,478	70,134	691,053	**761,187**

TABLE 12 Ware potatoes

Pesticides used and storage methods in merchant stores (tonnes treated)

Formulations	Outdoor	Unventilated		Ventilated		Refrigerated		Total		Total
	Clamp	Bulk	Boxed	Bulk	Boxed	Bulk	Boxed	Bulk	Boxed	All methods
Chlorpropham					3,000				3,000	**3,000**
Tecnazene					2,359		2,000		4,359	**4,359**
All formulations					**3,870**				**3,870**	**7,359**
Not treated			17,500		32,530		33,840		83,870	**83,870**

TABLE 13 Ware potatoes

Reasons for use of pesticides in farm stores (tonnes treated)

Formulations	Sprout suppression	Disease precaution	No reason given	Total	% treated
Imazalil		2,518	4,569	**7,087**	1
Tecnazene	90,996			**90,996**	11
All formulations	**90,996**	**2,518**	**4,569**	**98,084**	**11**
Tonnes stored					859,271

TABLE 14 Ware potatoes

Reasons for use of pesticides in merchant stores (tonnes treated)

Formulations	Sprout suppression	Total	% treated
Chlorpropham	3,000	**3,000**	1
Tecnazene	4,359	**4,359**	5
All formulations	**7,359**	**7,359**	**5**
Tonnes stored			88,229

TABLE 15 Seed potatoes

Active ingredients and quantities (kg) for all stores

Active ingredients	Farm stores		Merchant stores		Total	
	Tonnes treated	kg	Tonnes treated	kg	Tonnes treated	kg
2-aminobutane	35,896	7,214	7,200	1,452	**43,096**	**8,666**
Imazalil	50,130	496	12,000	120	**62,130**	**616**
Tecnazene	1,173	73			**1,173**	**73**
All active ingredients	**87,199**	**7,783**	**19,200**	**1,572**	**106,400**	**9,355**

TABLE 16 Ware potatoes

Active ingredients and quantities (kg) for all stores

Active ingredients	Farm stores		Merchant stores		Total	
	Tonnes treated	kg	Tonnes treated	kg	Tonnes treated	kg
Chlorpropham			3,000	65	**3,000**	**65**
Imazalil	7,087	71			**7,087**	**71**
Tecnazene	90,996	5,687	4,359	442	**95,355**	**6,129**
All active ingredients	**98,084**	**5,758**	**7,359**	**507**	**105,442**	**6,265**

TABLE 17 All potatoes

Comparison of pesticide usage 1992 - 1996, tonnes treated and quantities (kg) used

	1992		1994		1996	
	Tonnes treated	*kg*	*Tonnes treated*	*kg*	*Tonnes treated*	*kg*
Farm Stores						
Seed	128,325	11,483	107,895	15,187	87,199	7,783
Ware	148,502	7,521	67,548	4,760	98,084	5,758
All potatoes	**276,828**	**19,004**	**175,443**	**19,947**	**185,283**	**13,541**
Merchant stores						
Seed	6,500	236	21,677	2,406	19,200	1,572
Ware	5,500	348	3,870	165	7,359	507
All potatoes	**12,000**	**584**	**25,547**	**2,571**	**26,559**	**2,079**
All stored potatoes	**288,828**	**19,588**	**200,990**	**22,518**	**211,842**	**15,620**

TABLE 18 Raising factors

Region	Seed	Ware
Caithness/Orkney, Highlands & Islands, Moray Firth	65.23	154.46
Aberdeen	4.29	16.31
Angus	25.16	7.80
East Fife	13.54	21.80
Lothian	10.72	17.29
Central Lowlands	15.57	80.15
Southern Uplands, Solway, Tweed Valley	4.78	48.30

TABLE 19 First adjustment factors for ware potatoes

Region	Ware
Caithness/Orkney, Highlands & Islands, Moray Firth	0.70
Aberdeen	0.55
Angus	1.00
East Fife	0.94
Lothian	0.94
Central Lowlands	0.61
Southern Uplands, Solway, Tweed Valley	0.70

TABLE 20 Second adjustment factors

Seed potatoes	0.66
Ware potatoes	1.47

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