

# PESTICIDE USAGE SURVEY REPORT 189

## POTATO STORES IN GREAT BRITAIN 2002



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## DEFINITIONS

- a) 'Applications' is used throughout this report to refer to the number of pesticide treatments applied to a store (whole or part).
- b) 'Basic tonnes treated' is the gross weight of potatoes treated with pesticides excluding repeat applications, i.e. the total tonnes stored minus tonnes receiving no treatment.
- c) 'Tonnage treated' is the gross weight of potatoes treated with pesticides including repeat applications, i.e. basic tonnes treated x number of applications.
- d) 'Bulk stores' include loose potatoes in a variety of stores, as opposed to those stored in boxes or bags.
- e) 'Outdoor clamps' include potatoes stored in the field in a temporary structure. These structures are often constructed from straw bales or soil.
- f) 'Unventilated stores' include structures which are naturally ventilated and rely on convective ventilation.
- g) 'Ventilated stores' include structures using forced air ventilation. They do not use refrigeration methods.
- h) 'Refrigerated stores' include structures using refrigeration; they may also have forced air ventilation.
- i) 'Merchant' is a BPC registered purchaser, a merchant or processor who has traded 100 tonnes of potatoes or more in the most recent full crop year and therefore qualifies for payment of British Potato Council levy (British Potato Council List of Registered Purchasers July 2001).
- j) 'Farm Store' holds only potatoes from a single holding, where the store is located, for a period of more than 2 months.
- k) In this report the term 'formulation(s)' is used to describe the pesticide active substance or mixture of active substances in a product(s).
- l) 'Seed potatoes' are those stored and used for planting the next season's crop. Prior to planting, seed potatoes are placed in a 'chitting house' where the tuber can develop/germinate prior to planting.
- m) "Ware potatoes" are those used for human consumption, either prior to or after processing.
- n) The 'Advisory Committee on Pesticides' is a statutory body set up by ministers under section 16 (7) of the Food & Environment Protection Act 1985 to advise on all matters relating to the control of pesticides. For further information visit the website – [www.pesticides.gov.uk/committees/acp/acp.htm](http://www.pesticides.gov.uk/committees/acp/acp.htm)
- o) 'Arable crops' include cereals, combinable peas & beans, oilseed rape, linseed, potatoes and sugar beet.

## QUALITY CONTROL OF DATA

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

## SUMMARY

This report presents information on all aspects of pesticide usage during storage of potatoes harvested in 2002 and stored during 2002/03. Data were collected from visits to 93 holdings in Great Britain and by post from 64 merchants.

The total weight of **ware** potatoes stored from the 2002 harvest was 4.69 million tonnes, of which this survey estimated that 49% received no treatment. The basic tonnage treated was 2.4 million tonnes, though some potatoes received multiple treatments. The active substance chlorpropham, a potato sprout suppressant, accounted for 94% of the total tonnage treated, while 3% were treated with thiabendazole and 2% with dichlorophen. Imazalil or tecnazene were used on less than one percent. Seventy nine tonnes of active substances were used to treat ware potatoes. Chlorpropham (91%), thiabendazole (6%), tecnazene (1%) and dichlorophen (1%) accounted for nearly all of the weight of active substances used.

From this survey, it is estimated that 39% of the 456,000 tonnes of **seed** potatoes stored were treated with pesticide, generally receiving one application. The formulations recorded were imazalil and 2-aminobutane, accounting for 97% and 3% of the total tonnage treated respectively. Just over two and a half tonnes of active substances were used, principally imazalil (64% of the total weight).

A comparison is made between this survey and a similar one conducted in 2000. The tonnage of **ware** potatoes stored was 15% more than in 2000, but the total tonnage treated was 39% more. Chlorpropham usage on ware potatoes, in terms of tonnage treated, increased by 46% since the last survey and by 42% in terms of weight applied. Almost all applications to ware potatoes stored on-farm, and over 90% of merchant applications, were made by fumigation. This was also the preferred application method in 2000.

The tonnage of stored **seed** potatoes in Great Britain increased by 6% between the two surveys while the basic tonnage treated more than doubled. Overall, there was a doubling between 2000 and 2002 in the amount of active substances applied to seed potatoes.

## INTRODUCTION

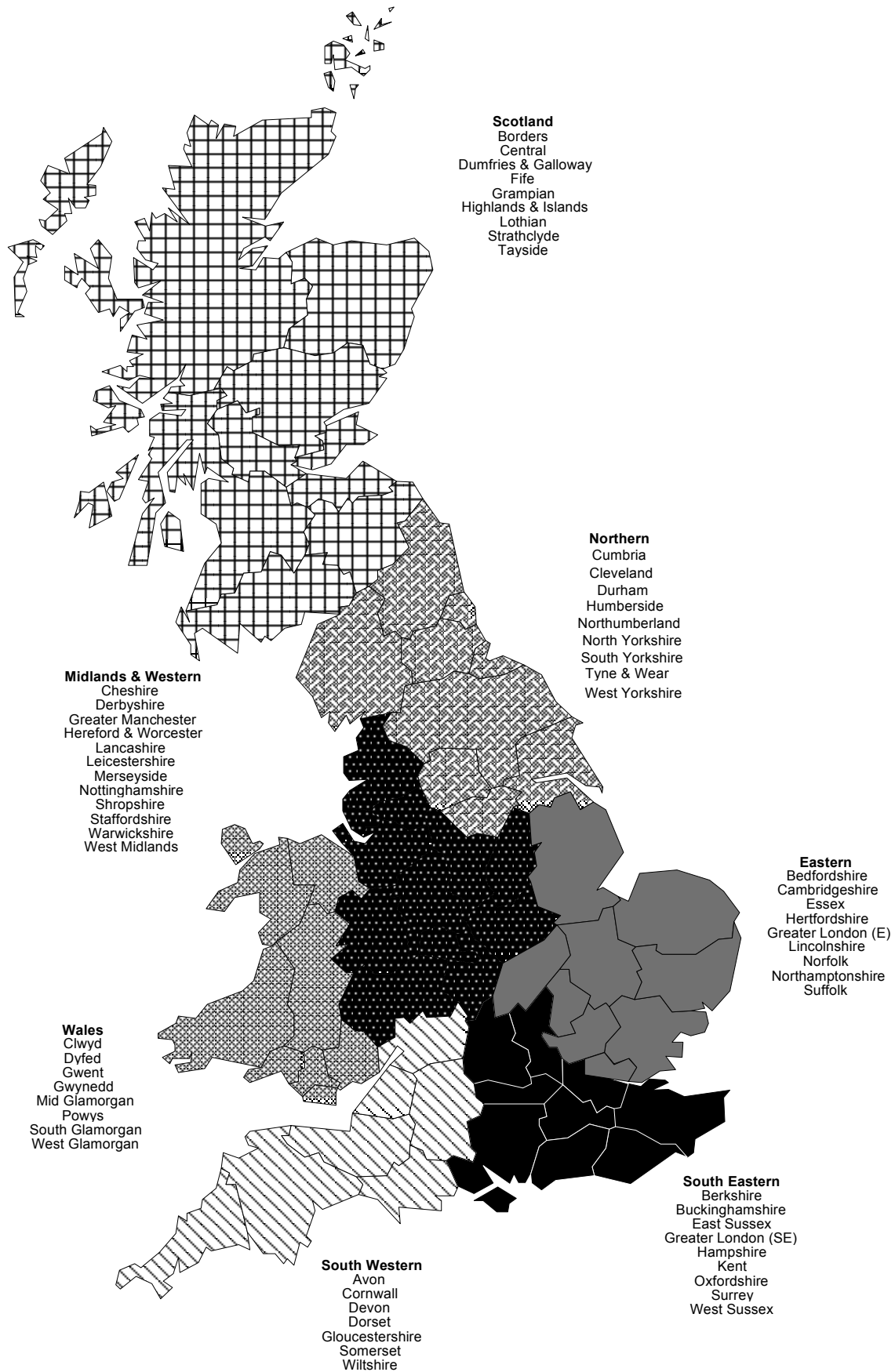
The independent Advisory Committee on Pesticides advises the British Government on all aspects of pesticide use. In order to discharge this function the Committee must regularly monitor the usage of all pesticides in Great Britain. It needs accurate data on the usage of individual pesticides.

As part of the ongoing process for obtaining data, the Pesticide Usage Survey Teams of the Central Science Laboratory, an executive agency of The Department for Environment, Food & Rural Affairs (DEFRA) and the Scottish Agricultural Science Agency, an agency of the Scottish Executive Environment Rural Affairs Department (SEERAD), conducted a survey of pesticide usage in potato stores on farms in Great Britain growing potatoes harvested in 2002. Information was also collected from potato merchants, who stored potatoes over the same period of time, using a postal questionnaire.

This is the sixth fully co-ordinated survey of pesticide usage in potato stores throughout Great Britain. The previous reports covered all pesticide usage on potatoes harvested and stored in 1992 (Olney & Garthwaite, 1994), 1994 (Goodwin & Garthwaite, 1996), 1996 (De'ath *et al.*, 1996), 1998 (Fox *et al.*, 1998) and in 2000 (Dennison *et al.*, 2002). One previous report has covered pesticide usage in England and Wales for potatoes harvested and stored in 1988 and 1990 (Olney *et al.*, 1992). Two previous reports have covered pesticide usage in potato stores in Scotland for potatoes harvested and stored in 1975 and 1986 (Tucker, 1978, Snowden *et al.*, 1989). In 1974 and 1977 information was collected on pesticide usage at farm stores in Great Britain but was reported in an unraised format covering usage only on those farms surveyed (Chapman *et al.*, 1977, Steed *et al.*, 1979).

A list of the most recently published reports can be found in the Appendix.

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



## METHODS

### The sample

The samples of holdings to be surveyed were selected using data from the Agricultural Census Returns, June 2001 for England and Wales (Anon., 2002a) and for Scotland (Anon., 2002b).

The samples were drawn to represent the area of all arable crops grown throughout England, Wales and Scotland. For England and Wales, the sample was selected within each of the six Defra regions (Fig. 1), while Scotland was divided into 11 land-use regions (Wood, 1931). The samples were stratified according to the total area of all arable crops grown in each region and by holding size group based on the total area of arable crops grown on each holding. The area of arable crops sampled in each size group and each region was proportional to the total area of arable crops grown on holdings of each size group in each region.

An introductory letter was sent to the occupiers of the selected holdings explaining the purpose of the survey. A total of 1,123 arable holdings was visited and information relating to potato storage was obtained from those growing potatoes. Of the 187 holdings growing potatoes, 93 (50%) stored them after harvest (Table 1). Holdings selling potatoes on to merchants were asked for details of these stores. Further information on these stores, and on additional storage premises, was provided by the British Potato Council (BPC). Data relating to pesticide usage on these premises were obtained by postal questionnaire at a later date.

Data were raised to estimate national pesticide usage (Thomas, 2001). The raising factors used for ware potatoes were based on a combination of census data (Anon 2003a, Anon 2003b) and potato stock movement information provided by the BPC. Separate raising factors were used for seed potatoes, which were also based on BPC estimates for stored seed potatoes in Great Britain.

**Table 1** Number and distribution of stores sampled in Great Britain – 2002

<i>Region</i>	<b>Farm Stores</b>	<b>Merchant Stores</b>
Eastern	42	13
Midlands & Western	15	6
Northern	9	5
Scotland	17	38
South Eastern	5	2
South Western	5	.
<b>Total – all regions</b>	<b>93</b>	<b>64</b>

## **METHODS (*continued*)**

### ***The Questionnaire***

The questionnaire consisted of two forms, which were completed by an experienced surveyor during an interview with the farmer, or by a store representative following issue of a comprehensive set of instructions, for commercial stores.

Form 1 summarised the area of potatoes grown on each holding during the 2002 growing season.

Form 2 detailed all aspects of pesticide usage in each store. A separate form was completed for each method of storage and treatment programme. Seed and ware potatoes were recorded separately and identical forms were sent to merchants as part of a postal survey.

### **TONNAGE OF POTATOES STORED**

It is estimated that 138,004 hectares of ware potatoes and 16,290 hectares of seed potatoes were grown in 2002 in Great Britain. An estimated 2,767,722 tonnes of ware potatoes were stored in farm stores and 1,917,971 tonnes were stored by merchants (Table 2). An estimated 456,000 tonnes of seed potatoes were stored in Great Britain.

## RESULTS AND DISCUSSION

### WARE POTATOES

#### *Storage type*

The three main types of stores on farm were ventilated (52%), refrigerated (44%) and unventilated (4%). A small quantity, less than one percent, was kept in clamps. The majority (72%) of potatoes surveyed were stored in boxes.

Potatoes held by merchants were mainly stored in refrigerated stores (86%) or ventilated stores (13%), with unventilated stores (1%) being the only other type encountered. Boxed storage accounted for 73% of the total weight of merchant-stored potatoes, with the majority of box-stored potatoes, (84%), being in refrigerated stores, whilst 91% of bulk-stored potatoes were held in refrigerated stores.

#### *Treatment of potatoes at farm stores*

Overall, 46% of ware potatoes were treated with pesticides and these received on average 2.4 applications (Tables 2 & 3). Pesticides were applied to 45% of bulk-stored potatoes, treated potatoes receiving on average 1.9 applications. Forty seven percent of box-stored potatoes were treated with pesticides, treated potatoes receiving 2.6 treatments on average.

Treatment of bulk-stored potatoes (Table 3) comprised almost entirely of chlorpropham (99%), though a very limited amount of non-approved use of tecnazene was encountered on one percent of the total tonnage treated. All approvals for use of tecnazene expired on 31 January 2002.

Two formulations were used on box-stored potatoes. Chlorpropham was the main formulation used, with non-approved use of imazalil accounting for less than one percent of the tonnage treated. Approvals for the use of imazalil are restricted to seed treatments prior to planting and treatment of seed in storage.

#### *Treatment of potatoes at merchant stores*

Overall, 58% of potatoes were treated with pesticides and received on average 1.5 treatments (Tables 2 & 4). Ninety seven percent of bulk-stored potatoes were treated and received on average 1.6 pesticide treatments. Forty four percent of box-stored potatoes were treated, receiving an average of 1.5 pesticide treatments.

Three formulations were used on bulk-stored potatoes, including chlorpropham, used on 72% of the total tonnage treated in bulk stores, dichlorophen on 14% and thiabendazole on 14% (Table 4).

Four formulations were used on box-stored potatoes (Table 4). Again, chlorpropham was the most important formulation used, accounting for 95% of the total tonnage of treated potatoes. Thiabendazole was used on 3% of boxed ware potatoes, non-approved use of imazalil on 2% and dichlorophen on less than one percent.

### ***Extent and quantity of individual active substances used***

Overall, chlorpropham was used on 94% of the tonnage treated (Table 5), while there was limited usage of thiabendazole 3% and dichlorophen 2%. Use of imazalil and tecnazene was on less than one percent of the tonnage treated. Approximately 79 tonnes of pesticide active substances (a.s.) were used on stored ware potatoes, mainly comprising of 71.8 tonnes of chlorpropham (91%), 4.5 tonnes of thiabendazole (6%), 1.1 tonnes of tecnazene (1%) and 1.1 tonnes of dichlorophen (1%).

In farm stores, chlorpropham (99.6% of the total tonnage) was the main storage treatment used, with less than one percent treated with tecnazene and imazalil. Forty-six tonnes of active substances were used, with chlorpropham accounting for 98% and tecnazene 2% of the total. Imazalil accounted for the remainder of the weight of active substances used.

At merchant stores chlorpropham was used on 85% of the total tonnage treated, with thiabendazole used on 8%, dichlorophen on 7% and imazalil on one percent. Merchant stored potatoes were treated with approximately 33 tonnes of active substances. Chlorpropham accounted for the majority of active substances applied, at 83%, with thiabendazole at 14%, dichlorophen 3% and imazalil less than one percent.

### ***Stated reasons for treatment***

The main reason given for pesticide usage at farm stores, with 99.8% of the total tonnage treated (where a reason was given), was to suppress sprouting (Table 6). Chlorpropham accounted for almost all sprout suppressant usage. Imazalil was applied for disease control.

The most important reason given for pesticide applications at merchants' stores was also sprout suppression (85% where a reason was given), with 15% specifying disease control (Table 7). Chlorpropham was the only sprout suppressant used. Thiabendazole accounted for 53% of pesticides used for disease control, dichlorophen being the only other active substance applied for this reason.

### ***Methods of application***

The methods of application used on farms included fumigants (99.6%), granules and sprays both of which accounted for less than one percent (Table 8). The only granules applied were tecnazene formulations, the only spray applications imazalil. No usage of dusts was recorded on ware potatoes at farm stores.

Table 9 shows that fumigation accounted for 91% of all application methods used at merchant stores, with chlorpropham accounting for 93% of the total tonnage treated in this manner. Only nine percent of applications were sprays and most of these (90%) comprised thiabendazole. No granular or dust applications were made to merchant stored potatoes.

**Table 2** Storage methods used for **ware** potatoes at farm and merchant stores in Great Britain, 2002 (tonnes stored)

	Outdoor	Unventilated		Ventilated		Refrigerated		Total		Total -all storage methods
	Clamp <sup>1</sup>	Bulk	Box	Bulk	Box	Bulk	Box	Bulk	Box	
Farm stores	9,659	18,299	83,728	729,572	700,841	24,728	1,200,894	782,259	1,985,463	2,767,722
Merchant stores	.	.	22,599	46,783	201,403	478,867	1,168,319	525,649	1,392,322	1,917,971
<b>All stores</b>	<b>9,659</b>	<b>18,299</b>	<b>106,327</b>	<b>776,355</b>	<b>902,244</b>	<b>503,595</b>	<b>2,369,213</b>	<b>1,307,908</b>	<b>3,377,785</b>	<b>4,685,693</b>

<sup>1</sup> By definition outdoor clamps are bulk storage

**Table 3 Farm Potato Stores: Storage pesticide use on ware potatoes in Great Britain, 2002 (tonnes treated)**

	Outdoor Clamp <sup>1</sup>	Unventilated		Ventilated		Refrigerated		Total		Total -all storage methods
		Bulk	Box	Bulk	Box	Bulk	Box	Bulk	Box	
<i>Pesticide</i>										
Chlorpropham	14,167	.	.	639,628	518,378	6,526	1,859,299	660,321	2,377,677	3,037,998
Imazalil	.	.	.	.	2,845	.	.	.	2,845	2,845
Tecnazene	.	.	.	8,624	.	.	.	8,624	.	8,624
Total – all pesticides	14,167	.	.	648,253	521,223	6,526	1,859,299	668,945	2,380,522	3,049,468
<b>Not treated</b>	859	18,299	83,728	390,932	436,724	21,466	533,146	431,555	1,053,598	1,485,153

**Table 4 Merchants' Potato Stores: Storage pesticide use on ware potatoes in Great Britain, 2002 (tonnes treated)**

	Outdoor Clamp <sup>1</sup>	Unventilated		Ventilated		Refrigerated		Total		Total -all storage methods
		Bulk	Box	Bulk	Box	Bulk	Box	Bulk	Box	
<i>Pesticide</i>										
Chlorpropham	.	.	8,592	75,167	141,815	496,951	746,413	572,119	896,821	1,468,939
Dichlorophen	.	.	.	.	.	113,693	3,558	113,693	3,558	117,252
Imazalil	.	.	97	.	2,022	.	13,408	.	15,527	15,527
Thiabendazole	.	.	.	.	.	109,209	24,261	109,209	24,261	133,470
Total – all pesticides	.	.	8,689	75,167	143,837	719,853	787,640	795,021	940,166	1,735,187
<b>Not treated</b>	.	.	17,953	7,683	126,345	9,451	635,983	17,133	780,281	797,414

<sup>1</sup> By definition outdoor clamps are bulk storage

**Table 5** Usage of individual active substances on stored ware potatoes in Great Britain, 2002

	Farm stores		Merchant stores		Total	
	Tonnes treated	Tonnes (a.s)	Tonnes treated	Tonnes (a.s)	Tonnes treated	Tonnes (a.s)
<b>Pesticide</b>						
Chlorpropham	3,037,998	44.62	1,468,939	27.14	4,506,938	71.76
Dichlorophen	.	.	117,252	1.06	117,252	1.06
Imazalil	2,845	0.02	15,527	0.16	18,372	0.18
Tecnazene	8,624	1.09	.	.	8,624	1.09
Thiabendazole	.	.	133,470	4.48	133,470	4.48
Total <sup>1</sup> - all pesticides	3,049,468	45.73	1,735,187	32.82	4,784,655	78.56

**Table 6** Farm Potato Stores: Storage pesticides and their reason for use on ware potatoes in Great Britain, 2002

<b>Pesticide</b>	Sprout suppressant	Disease control	Unspecified reason	Total	
				Tonnes treated	Tonnes (a.s)
Chlorpropham	1,152,896	.	1,885,102	3,037,998	44.62
Imazalil	.	2,845	.	2,845	0.02
Tecnazene	119	.	8,505	8,624	1.09
Total - all pesticides	1,153,016	2,845	1,893,607	3,049,468	45.73

**Table 7** Merchants' Potato Stores: Storage pesticides and their reason for use on ware potatoes in Great Britain, 2002

<b>Pesticides</b>	Sprout suppressant	Disease control	Unspecified reason	Total	
				Tonnes treated	Tonnes (a.s)
Chlorpropham	1,373,110	.	95,829	1,468,939	27.14
Dichlorophen	.	117,252	.	117,252	1.06
Imazalil	.	.	15,527	15,527	0.16
Thiabendazole	.	133,470	.	133,470	4.48
Total - all pesticides	1,373,110	250,721	111,356	1,735,187	32.82

<sup>1</sup>Denotes the total tonnage treated, not the column sum as entries are not always mutually exclusive.

**Table 8** *Farm Potato Stores: Formulations of storage pesticides used on ware potatoes in Great Britain, 2002 (tonnes treated)*

	<b>Fumigant</b>	<b>Granule</b>	<b>Spray</b>	<b>Total</b>
<b>Pesticide</b>				
Chlorpropham	3,037,998	.	.	3,037,998
Imazalil	.	.	2,845	2,845
Tecnazene	.	8,624	.	8,624
Total - all pesticides	3,037,998	8,624	2,845	3,049,468

**Table 9** *Merchants' Potato Stores: Formulations of storage pesticides used on ware potatoes in Great Britain, 2002 (tonnes treated)*

	<b>Fumigant</b>	<b>Granule</b>	<b>Spray</b>	<b>Total</b>
<b>Pesticide</b>				
Chlorpropham	1,468,939	.	.	1,468,939
Dichlorophen	117,252	.	.	117,252
Imazalil	.	.	15,527	15,527
Tecnazene/thiabendazole	.	.	133,470	133,470
Total - all pesticides	1,586,191	.	148,997	1,735,187

## SEED POTATOES

### RESULTS AND DISCUSSION

#### *Storage type*

An estimated 456,000 tonnes of seed potatoes were stored in Great Britain (Table 10). The majority of potatoes were stored in refrigerated stores (71%). Ventilated environments accounted for a further 19%, while unventilated storage was the least common, comprising 10%. Most seed potatoes (99.4%) were stored in boxes, the rest were bulk stored.

#### *Treatment of potatoes*

Overall, 39% of potatoes were treated, receiving on average just over one pesticide application during storage (Table 10 & 11). The only products recorded were imazalil, which accounted for 97% of the total tonnage treated, and 2-aminobutane (3%). Boxed potatoes in refrigerated stores accounted for 72% of the total tonnage treated with all formulations in all storage types.

#### *Extent and quantity of individual active substances used*

Use of only two active substances was encountered on seed potatoes (Table 12). Imazalil was used to treat the majority (97%) of the tonnage treated. Just over two and a half tonnes of active substances were applied, imazalil accounting for 64%, with 2-aminobutane comprising the remainder.

#### *Stated reasons for treatment*

Table 13 shows that the only reason specified for pesticide usage was disease control. Imazalil alone was used on 93% of the treated tonnage where a reason was specified, with 2-aminobutane accounting for the remaining 7%.

#### *Methods of application*

In line with the formulations recorded, sprays containing imazalil accounted for 97% of the formulations used to treat seed potatoes held in store, with 2-aminobutane being applied as a fumigant (Table 14).

*N.B.* All treatments to seed potatoes refer to storage treatments and do not include pre-planting seed treatments or treatments in chitting houses. Information on such pre-planting potato seed treatments can be found in the arable crops report for 2002 (Garthwaite, Thomas, Dawson & Stoddart, 2003).

**Table 10** Storage methods used for *seed* potatoes in Great Britain, 2002 (tonnes stored)

	Unventilated		Ventilated		Refrigerated		Total		Total -all storage methods
	Bulk	Box	Bulk	Box	Bulk	Box	Bulk	Box	
All regions	303	46,299	2,473	83,857	.	323,068	2,776	453,224	456,000

**Table 11** Storage pesticide use on *seed* potatoes in Great Britain, 2002 (tonnes treated)

	Unventilated		Ventilated		Refrigerated		Total		Total -all storage methods
	Bulk	Box	Bulk	Box	Bulk	Box	Bulk	Box	
<b>Pesticide</b>									
2-aminobutane	.	.	2,473	.	.	2,349	2,473	2,349	4,822
Imazalil	.	7,270	.	40,741	.	125,402	.	173,413	173,413
<b>Total</b>	.	<b>7,270</b>	<b>2,473</b>	<b>40,741</b>	.	<b>127,751</b>	<b>2,473</b>	<b>175,763</b>	<b>178,236</b>
<b>Not treated</b>	303	39,029	.	43,115	.	196,863	303	279,007	279,310

**Table 12** Usage of individual active substances on stored *seed* potatoes in Great Britain, 2002

<i>Pesticide</i>	Total tonnes treated <sup>1</sup>	Active substance (tonnes)
2-aminobutane	4,822	0.97
Imazalil	173,413	1.69
<b>Total - all pesticides</b>	<b>178,236</b>	<b>2.66</b>

**Table 13** Storage pesticides and their reason for use on *seed* potatoes at stores in Great Britain, 2002

<i>Pesticide</i>	Disease control	Unspecified reason	Total tonnes treated	Active substance (tonnes)
2-aminobutane	804	4,018	4,822	0.97
Imazalil	11,437	161,976	173,413	1.69
<b>Total - all pesticides</b>	<b>12,241</b>	<b>165,995</b>	<b>178,236</b>	<b>2.66</b>

**Table 14** Formulations of storage pesticides used on *seed* potatoes in Great Britain, 2002 (tonnes treated)

<i>Pesticide</i>	Fumigant	Spray	Total
2-aminobutane	4,822	.	4,822
Imazalil	.	173,413	173,413
<b>Total - all pesticides</b>	<b>4,822</b>	<b>173,413</b>	<b>178,236</b>

<sup>1</sup>Denotes the total tonnage treated, not the column sum as entries are not always mutually exclusive.

## COMPARISON BETWEEN SURVEYS CARRIED OUT IN GREAT BRITAIN IN 1996, 1998, 2000 & 2002

In 2002, it was estimated that the amount of ware potatoes harvested was 6,683,042 tonnes with a yield averaging 39.2 tonnes/hectare (Anon., 2002c). The area of ware potatoes grown had decreased by nearly 5% since the last survey while the area of seed potatoes grown had decreased by 3%. There had been an increase of 15% in the tonnage of ware potatoes stored and an increase of 6% in the tonnage of seed potatoes stored (Table 15).

### WARE POTATOES

#### *Storage type*

There was a 10% reduction in the tonnage of ware potatoes being stored in farm facilities since 2000. In 2002, as in 2000, ventilated stores were used to store the largest tonnage, but this had decreased from 54% in 2000 to 52% in 2002. This decrease is in contrast to the increase observed in 2000 from 40% in 1998. Unventilated farm storage had continued to decrease from 24% in 1998 and 12% in 2000 to 4% in 2002, whilst in contrast the proportion of refrigerated stores had increased from 34% in 2000 to 44% in 2002. In the current survey, 72% of ware potatoes stored on farms were stored in boxes, whilst in 2000 the figure was 46%. In 1994, bulk storage was most common but the proportion of potatoes stored by this method had decreased from 62% in 1994, 43% in 1998 and 28% in 2002, with some upward fluctuation, 54% in 2000, in the years in between.

The tonnage of ware potatoes stored by merchants increased by 86% between 2000 and 2002. Refrigerated stores were the most common store type in 2002 (86%), increasing from 43% of the total in 2000 and 55% in 1998. Previously, ventilated stores had been the most important, accounting for 54% in 2000, but this had decreased to 13% in 2002. Unventilated stores decreased from 7% in 1998 and 3% in 2000 to 1% in the current survey. The majority (73%) of merchant stored potatoes were stored in boxes, though this had decreased from 80% in both 1998 and 2000.

#### *Treatment of potatoes at farm stores*

The percentage of potatoes treated with either sprout suppressants or against diseases in store had decreased since the last survey, with 46% of potatoes held in farm stores being treated in 2002, 47% in 2000, 55% in 1998 and 45% in 1996. This shows a significant reduction from the 1994 survey, where 70% of potatoes were treated and reflects the increased use of refrigeration and the approaching withdrawal of tecnazene formulations. There was a 13% increase in the total tonnage of active substances used in farm stores between 2000 and 2002, a contrast to the 52% decrease between 1998 and 2000, and 14% decrease between 1996 and 1998. The initial drop was mainly due to the phasing out of tecnazene, but the recent increase is due in part to a greater tonnage of potatoes being treated with the sprout suppressant chlorpropham and an increase in the number of applications at farm stores from an average of 1.7 in 2000 to 2.4 in 2002. The use of formulations containing chlorpropham alone had increased from 39% of all tonnage treated in 1996 to 80% in 1998, 82% in 2000, and 99.6% in 2002 (Table 3). Previously also available in formulation with propham, no use was recorded in 2002, all approvals having expired on 11 April 1999. The use of formulations containing tecnazene decreased from 37% of the treated tonnage at farm stores used in 1996, to 11% in 1998, 3% in 2000 and less than one percent in 2002. Such use was non-approved, having expired on 31 January 2002. The use of tecnazene/thiabendazole formulations was not recorded in 2000 or 2002.

There has been a reduction in the range of formulations used on bulk-stored potatoes from five in 1996 and 1998, four in 2000 to two in 2002, reflecting the loss of approved products available. The range of formulations used on boxed potatoes fell from six in 1996 to just two in the current survey. The non-approved use of 2-aminobutane has not been encountered on either boxed or bulk farm stored ware potatoes since the 1996 survey.

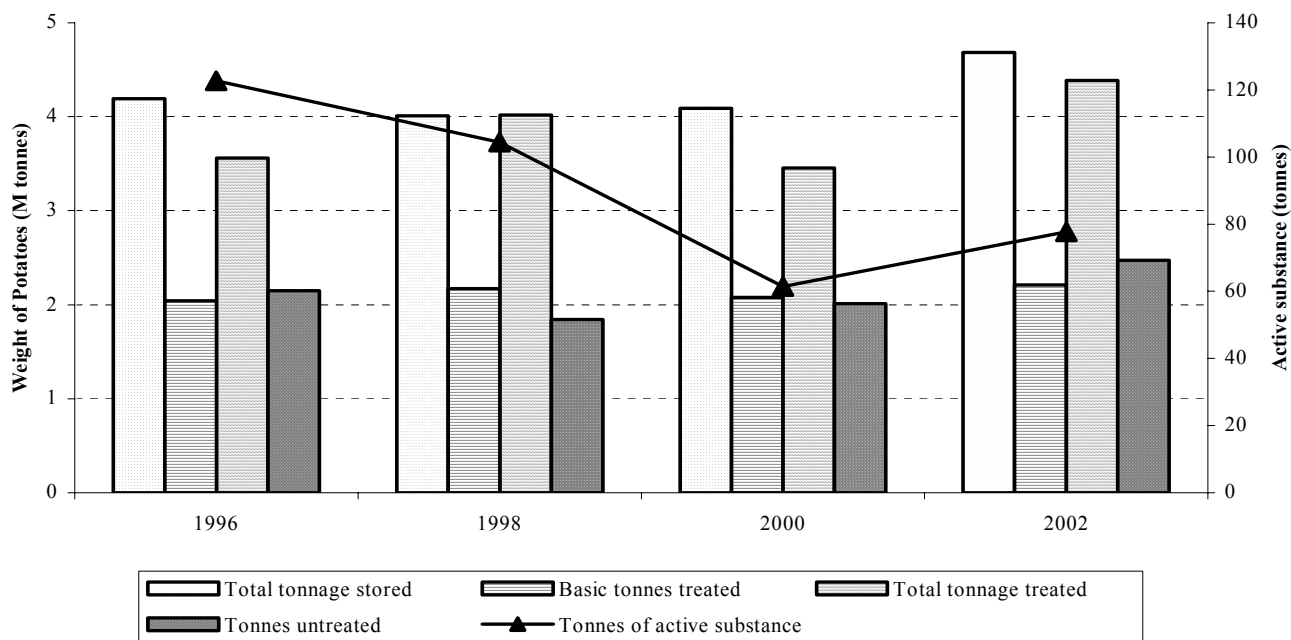
### Treatment of potatoes at merchant stores

The proportion of potatoes treated in merchants' stores was 58%. This was a decrease since the previous survey in 2000, in which an estimated 63% were treated. In 1998 and 1996, 50% and 68% of merchant stored potatoes were treated, respectively. The number of applications made to potatoes in store decreased from an average of 1.6 in 2000 to 1.5 in 2002, although there was a 58% increase in the tonnes of active substances used since the previous survey. The proportion of bulk-stored potatoes treated increased since the last survey from 86% in 2000 to 97% in 2002, but the average number of treatments declined from 1.7 to 1.6. The proportion of box-stored potatoes treated had decreased since the last survey, from 57% in 2000 to 44% in 2002. The average number of treatments on box-stored potatoes also decreased from 1.6 to 1.5.

Chlorpropham remained the most important active substance used on all merchant-stored potatoes, chlorpropham alone increasing from 79% of the total treated merchant-stored potatoes in 1996 to 82% in 1998, 90% in 2000 but declining to 85% in 2002. Sixty-one percent of these treatments were applied to box-stored potatoes, showing a 13% decrease since 2000.

The trends in treatments to ware potatoes in the UK since 1996 are shown in Figure 2 below and in Table 15.

**Fig. 2** Treatments made to *ware* potatoes in Great Britain, 1996 to 2002



### ***Extent and quantity of active substances used***

The 2000 survey recorded the use of tecnazene on only 3% of all treated potatoes in both merchants' stores and those stored on farms, reflecting its approaching revocation. In the current survey, despite all approvals having expired in early 2002, some use was encountered but accounted for less than one percent of potatoes treated on the farm. The only products encountered comprised tecnazene used alone and not part of a formulated mixture (e.g. tecnazene/thiabendazole).

There was an overall increase of 28% in the weight of active substances applied to ware potatoes between 2000 and 2002, in contrast to the downward trend previously recorded of 15% between 1996 and 1998 and 41% between 1998 and 2000. The weight of chlorpropham applied increased by 43% in 2002 compared to that in 2000, in line with an increase in the total tonnage treated of 46%. The use of thiabendazole more than doubled over the same period.

### ***Stated reasons for treatment***

In 1996, 1998 and in 2000 the main reason for treating stored ware potatoes was to suppress sprouting. This remains the main reason given and chlorpropham continues to be the major active substance used, as in all previous surveys.

### ***Methods of application***

Fumigants have remained the preferred method of application for farm and merchant stored potatoes. This has been the situation since 1996.

In this survey there were no recorded uses of dust formulations in farm or merchant stores. Tecnazene was the only substance applied as a granule on ware potatoes in 1996 and 1998, whilst in 2000 chlorpropham granules were also used in merchant stores. The current survey found tecnazene to be the only granular formulation used and then only in farm stores. No granular applications were made in merchant stores.

## SEED POTATOES

### *Storage type*

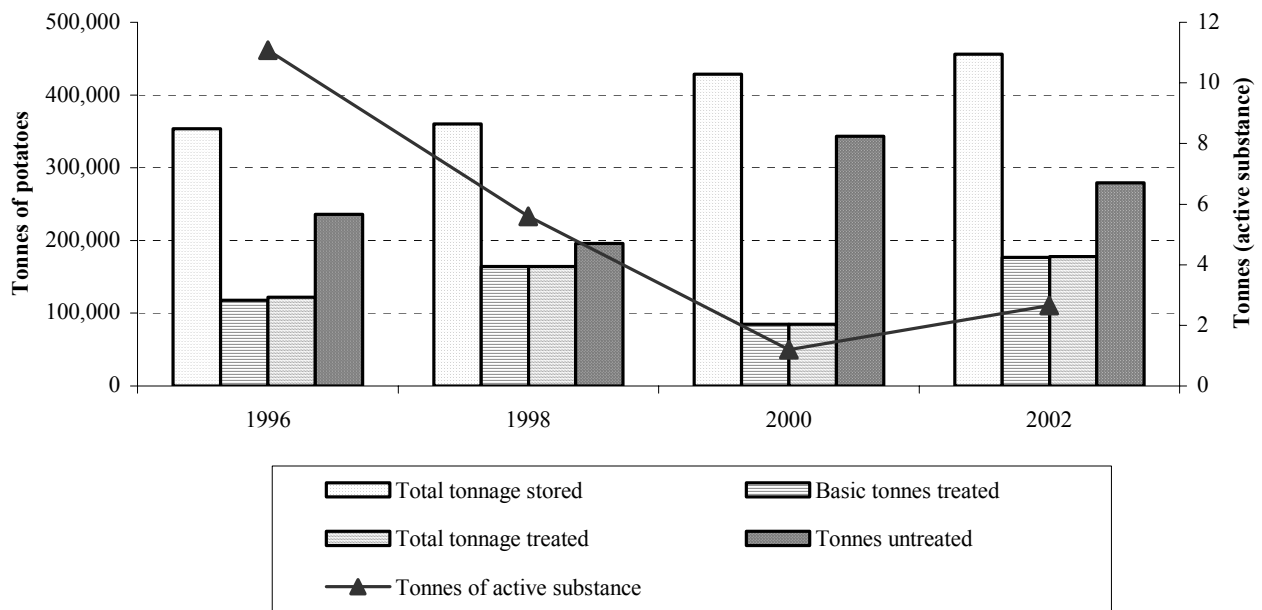
The total tonnage of stored seed potatoes increased by 6% over the period between the previous and current surveys. The proportion stored in ventilated stores decreased from 63% in 2000 to 19% in 2002. Refrigerated storage increased during the same period from 37% in 2000 to 71% in 2002. All seed potatoes encountered in 2000 were stored in boxes, but in 2002 most were stored in boxes with less than one percent being bulk stored.

### *Treatment of potatoes*

The proportion of the tonnage treated was found to have increased between 2000 and 2002 from 20% to 39%. The tonnage treated in previous surveys had been variable with 33% treated in 1996 and 46% in 1998 (Table 15). In 2000, imazalil accounted for 94% of the total tonnage treated, 2-aminobutane 3% and dichlorophen 2%. In 1998, imazalil accounted for 72%, imazalil/ thiabendazole, 15% and 2-aminobutane 12% of the tonnage treated, the remainder being tecnazene. In 2002, imazalil accounted for 97% of the total tonnage treated, the other 3% being 2-aminobutane. No use of other pesticides was recorded.

The trends in treatments to seed potatoes in the UK since 1996 are shown in Figure 3 below and in Table 15.

**Fig. 3** *Treatments made to seed potatoes in Great Britain, 1996 to 2002*



### *Stated reasons for treatment*

In 2002, the only reason for treatment that was given was to prevent unspecified diseases, as in 2000, 1998 and 1996.

### *Methods of application*

Following the trend observed in the previous two surveys, spray applications as a percentage of the treated tonnage have continued to increase from 59% in 1996 to 97% in 2002. Two fumigant formulations were found in the 2000 survey, 2-aminobutane and dichlorophen, each accounting for approximately half of the total tonnage treated by this method. However, the only fumigant applied in 1996, 1998 and 2002 was 2-aminobutane. Granules accounted for less than one percent of the total tonnage treated in 1996, 1998 and 2000 and were not recorded in 2002.

**Table 15** Comparison of production, storage and treatment of potatoes in Great Britain 1996-2002

		1996	1998	2000	2002
<b>Area grown (ha)</b>	Ware	152,776	142,119	144,702	138,004
	Seed	15,718	16,263	16,800	16,290
<b>Tonnes stored</b>	Ware	4,190,647	4,011,278	4,088,499	4,685,693
	Seed	353,615	360,611	428,700	456,000
<b>Basic tonnes treated<sup>1</sup></b>	Ware	2,042,725	2,169,300	2,075,983	2,403,126
	Seed	117,788	164,366	85,142	176,690
<b>Total tonnage treated<sup>2</sup></b>	Ware	3,562,785	4,019,982	3,453,836	4,784,655
	Seed	121,902	164,336	85,142	178,236
<b>Tonnes untreated<sup>3</sup></b>	Ware	2,147,922	1,841,978	2,012,517	2,282,567
	Seed	235,827	196,245	343,558	279,310
<b>Tonnes treated<sup>4</sup> with (ware + seed)</b>	Chlorpropham	2,149,132	3,232,223	3,078,338	4,506,938
	Tecnazene	806,400	371,104	102,157	8,624
	Thiabendazole	610,290	253,029	72,112	133,470
<b>Amount used (tonnes a.s.) (ware + seed)</b>	Chlorpropham	28.58	49.09	50.19	71.11
	Tecnazene	70.68	43.31	8.6	1.09
	Thiabendazole	23.04	10.21	2.2	4.48
	All pesticides	133.84	109.98	62.55	81.22

<sup>1</sup> Basic tonnes treated = tonnes stored – tonnes untreated

<sup>2</sup> Total tonnage treated = basic tonnes treated x number of treatments

<sup>3</sup> Tonnes untreated = potatoes stored which receive **NO** pesticide treatments during storage

<sup>4</sup> Tonnes treated = basic tonnes treated x number of treatments

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