

# **PESTICIDE USAGE SURVEY REPORT 265**

## **ORCHARDS**

### **IN THE**

### **UNITED KINGDOM**

**2014**



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## A NATIONAL STATISTICS SURVEY

National Statistics are produced to high professional standards set out in the Code of Practice for Official Statistics. They are free from any political interference. The United Kingdom Statistics Authority (UKSA) has a statutory duty to assess National Statistics for compliance with this Code of Practice. Further information is available from the Office for National Statistics website (<http://www.ons.gov.uk/ons/index.html>). The statistics undergo regular quality assurance reviews to ensure that they meet customers' needs.

The UKSA has designated these statistics as National Statistics, in accordance with the Statistics and Registration Service Act 2007 and signifying compliance with the Code of Practice for Official Statistics.

Designation can be broadly interpreted to mean that the statistics:

- meet identified user needs;
- are well explained and readily accessible;
- are produced according to sound methods; and
- are managed impartially and objectively in the public interest.

Once statistics have been designated as National Statistics it is a statutory requirement that the Code of Practice shall continue to be observed.

If you have any enquiries or feedback on the statistics included in this report they can be directed to the contact given below:

Pesticide Usage Survey Team – e-mail: [PUS@fera.co.uk](mailto:PUS@fera.co.uk)

Telephone: 01904 462694

Alternatively please contact: Fera at: [science@fera.co.uk](mailto:science@fera.co.uk)

## DATA USES

The data are used for a number of purposes including:

- Quantifying pesticide usage and changes in the use of active substances over time;
- Informing the pesticide risk assessment (authorisation) process;
- Policy, including assessing the economic and/or environmental implications of the introduction of new active substances and the withdrawal/non-authorisation of pesticide products (the data reported to organisations such as the OECD and EU enabling the UK to honour international agreements); evaluating changes in growing methods and Integrated Pest Management where this has an impact on pesticide usage;
- Informing the targeting of monitoring programmes for residues in food and the environment;
- Contributing to assessing the impact of pesticide use, principally as part of the Pesticides Forum's Annual Report;
- Responding to enquiries (for example, Parliamentary Questions, correspondence, queries under the Freedom of Information Act or Environmental Information Regulations, etc.);
- Providing information to assist research projects which can support all of the above activities;
- Training/teaching programmes which are designed to improve practice in the use of pesticides by the farming/training industries;
- Informing the Wildlife Incident Investigation Scheme (WIIS) programme to help identify potential misuse of pesticides.

## REVISIONS POLICY

This report presents a comprehensive summary of data for orchard crops grown and taken to harvest in 2014. We will provide information on any revisions we make to the report or the datasets if any inaccuracies or errors occur. Details of any revisions, including the date upon which they were changed, will appear on the following website:

<https://secure.fera.defra.gov.uk/pusstats/surveys/index.cfm>

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## EXECUTIVE SUMMARY

This report contains information on orchard crops including dessert apples (Cox and others), culinary apples (Bramley & others), cider apples & perry pears, pears, plums, cherries and other orchard crops including nuts. Data on pesticide usage on these were collected during the winter of 2014/2015 from 2,913 examples (orchards) grown on 283 holdings throughout the United Kingdom. Orchards grown on the sampled 283 accounted for 35% of the total area of orchard crops grown in the United Kingdom during the 2014 season (autumn 2013, spring & summer 2014). Organic holdings were included in the survey and accounted for 8% of the holdings surveyed. The area of crops surveyed in each region was proportional to the area of orchard crops grown in that region. The data on the area of pesticide treatments and the amount of active substances applied have been raised to give national usage estimates.

Fungicides, including copper products for bacterial canker control on some crops, accounted for 64% of the total pesticide-treated area of orchard crops in the United Kingdom in 2014, insecticides 12%, herbicides 7%, growth regulators 7%, sulphur 2% (used as a pesticide for powdery mildew control) and acaricides less than one percent. Other pesticides, including the commodity chemical urea (used for leaf destruction in the autumn to prevent the spread of disease), growth stimulants (harpin protein, mainly for frost protection), biological control agents (primarily *Anthocoris* spp. for pear sucker control), physical control agents (maltodextrin), disinfectants and repellents (kaolin) comprised a further 7%.

By weight applied fungicides accounted for 67% of pesticides used, other pesticides (urea, repellents, disinfectants, growth stimulants and physical controls) 15%, sulphur 7%, herbicides 6%, insecticides 5%, growth regulators and acaricides less than 1% each.

The most extensively used fungicide formulation was captan, being used on 80,973 hectares; chlorpyrifos was the most extensively used insecticide being applied to 24,249 hectares; the herbicide glyphosate was applied to 22,121 hectares and the gibberellins were the most extensively used growth regulators, being applied to 19,252 hectares of orchard crops.

The biopesticide *Adoxophyes orana* gv strain bv-0001 was recorded for the first time in 2014, being used in the control of the summer fruit tortrix moth. There were large increases in the use of the fungicide difenoconazole since 2012 and also in the use of commercially available biological control agents *Anthocoris* spp.

The organophosphates, primarily chlorpyrifos, accounted for 34% of the insecticide-treated area, diamides 13% (chlorantraniliprole), diacylhydrazines (methoxyfenozide) 13% and neonicotinoids (thiacloprid & acetamiprid) 12% each.

Since 2012 the area of orchard crops had increased by 4%, whilst the area treated increased by only 2% with the weight remaining the same in both years. The discrepancy is due mainly to the wet weather conditions in 2012 which resulted in an increased number of fungicide sprays (particularly captan, myclobutanil and dithianon) for scab and powdery mildew control in that year. In 2014 there were declines in areas treated of 11%, 14% and 7% of captan, myclobutanil and dithianon respectively which reflect this change in usage.

The only major increases in pesticide usage in the principal 10 active substances were of urea, increasing by 64% in terms of area treated, dodine 43%, penconazole 9%, chlorpyrifos 7% and copper oxychloride by 23%.

Since 2008, the area of orchards treated with pesticides in England & Wales (data were not available from Scotland & Northern Ireland in 2008) has increased by 33% and the weight applied by 33%, despite there being only a 4% increase in the area grown. Over this period, the use of insecticides has increased by 37%, fungicides by 21%, growth regulator usage by 21% and herbicide usage by 5%. Much of the increase is due to increased areas of dessert apples, which are relatively intensively treated, and a combination of increased areas and more intensive usage on crops such as cherries and cider apples.

## INTRODUCTION

The Expert Committee on Pesticides (ECP) advises government on all aspects of pesticide use. In order to discharge this function, the Committee must regularly monitor the usage of all pesticides. It needs accurate data on the usage of individual pesticides. Pesticide usage data are now also required under the EU Statistics Regulation (1185/2009/EC).

As part of the on-going process for obtaining data, the Pesticide Usage Survey Teams of Fera, a joint venture between Capita PLC and the Department for Environment, Food & Rural Affairs (Defra); Science & Advice for Scottish Agriculture (SASA), a division of the Scottish Government's Agriculture, Food and Rural Communities Directorate and the Agri-Food & Biosciences Institute (AFBI), a Non-Departmental Public Body of the Department of Agriculture and Rural Development, Northern Ireland (DARD) conducted surveys of pesticide usage in orchard crops in 2013/14 by visiting holdings throughout the United Kingdom during the winter of 2014/15.

Since 2010, all surveys of pesticide usage in agriculture and horticulture have been fully co-ordinated by the survey teams of England & Wales, Scotland and Northern Ireland. The methodology used for sample selection and the collection of data from sample holdings is identical in each region. Reports are produced of pesticide usage throughout the United Kingdom. All teams have undertaken recent United Kingdom Statistics Authority (UKSA) audits and the data are accredited as National Statistics.

This is the second survey of pesticide usage on orchard crops in the United Kingdom. The previous report for the United Kingdom was published in 2013 covering pesticide usage on orchard crops in 2012 (Garthwaite et al., 2013).

Additional data on crop agronomy and fruit storage is collected for all surveys but is not presented within the report. For additional data relating to the surveys please refer to the contacts below.

Information on all aspects of pesticide usage in the United Kingdom as a whole, or for Wales or the Defra regions of England, may be obtained from the Pesticide Usage Survey Team at Fera, Sand Hutton, York, UK YO41 1LZ.

For further information please contact:

The survey team – e-mail: [PUS@fera.co.uk](mailto:PUS@fera.co.uk) Telephone: 01904 462 694  
Or visit the website: <https://secure.fera.defra.gov.uk/pusstats/surveys/index.cfm>

Alternatively please contact: Fera at: [science@fera.co.uk](mailto:science@fera.co.uk)

Further data relating specifically to Scotland may be obtained from the Pesticide Usage Survey Team at Science and Advice for Scottish Agriculture, Edinburgh. Also available at:  
<http://www.sasa.gov.uk/pesticides/pesticide-usage/pesticide-usage-survey-reports>

Copies of reports on pesticide usage in Northern Ireland may be obtained from Her Majesty's Stationery Offices. Also available at:  
<http://www.afbini.gov.uk/index/services/services-specialist-advice/pesticide-usage-overview/pesticide-reports-table.htm>

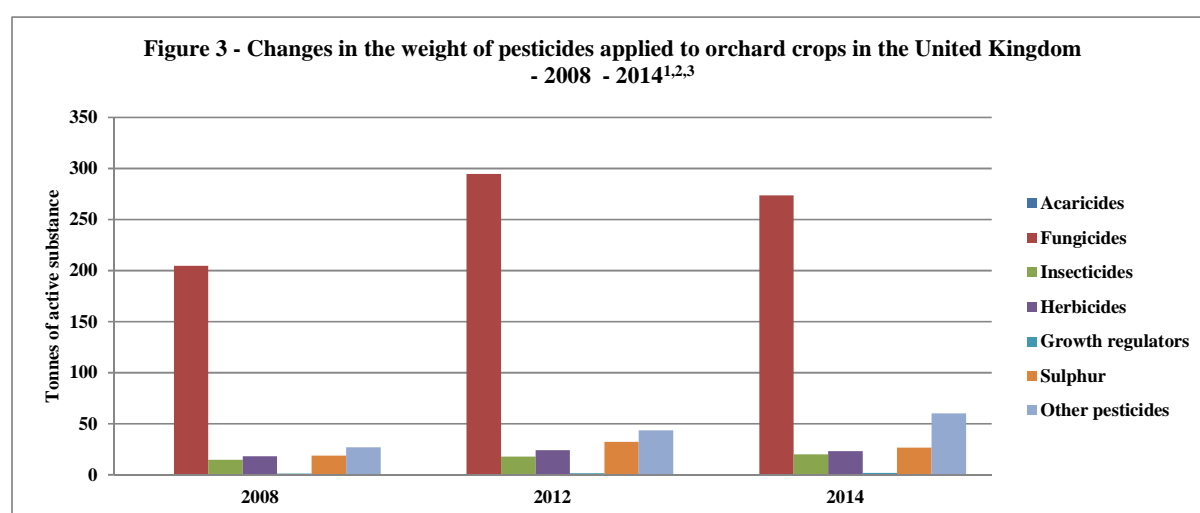
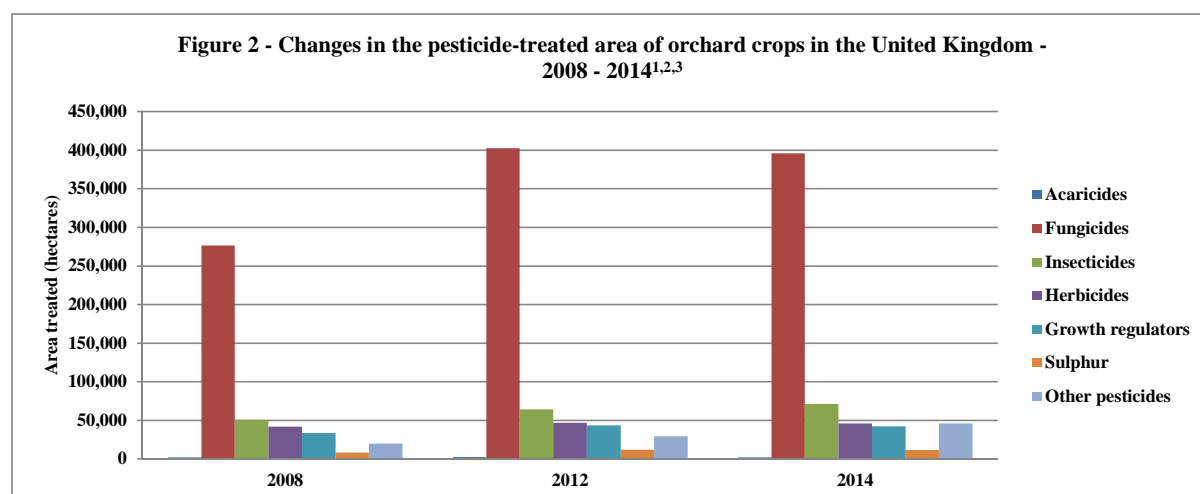
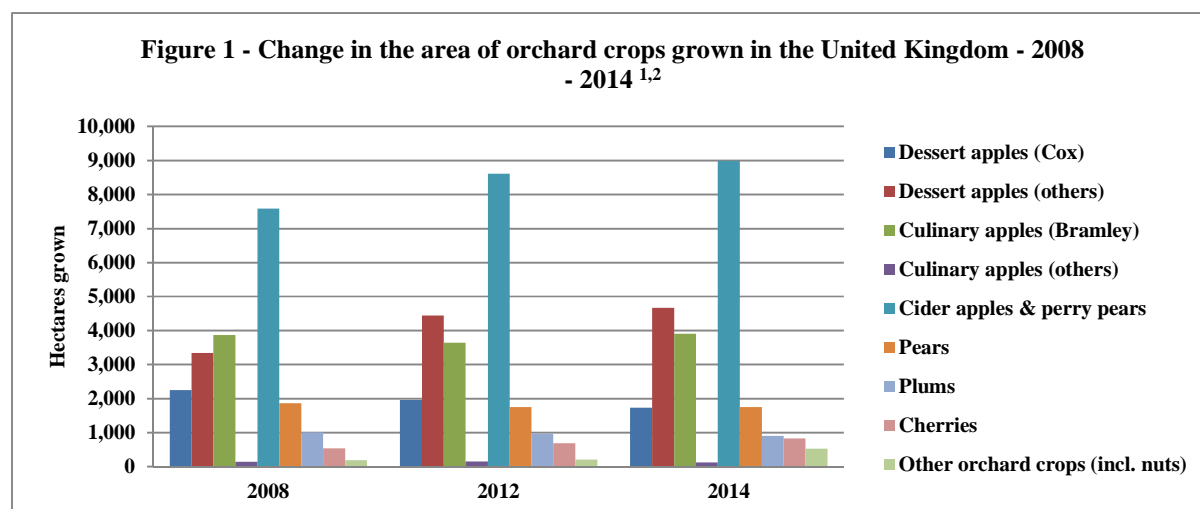
Recently-published reports for the United Kingdom, Great Britain, England & Wales and Northern Ireland can also be viewed and downloaded on the Internet at:

<https://secure.fera.defra.gov.uk/pusstats/surveys/index.cfm>

Alternatively, pesticide data for the UK can be extracted using the search tool – PUSSTATS:

<https://secure.fera.defra.gov.uk/pusstats/>

## TRENDS



<sup>1</sup> Data for 2008 excludes information from Scotland and Northern Ireland

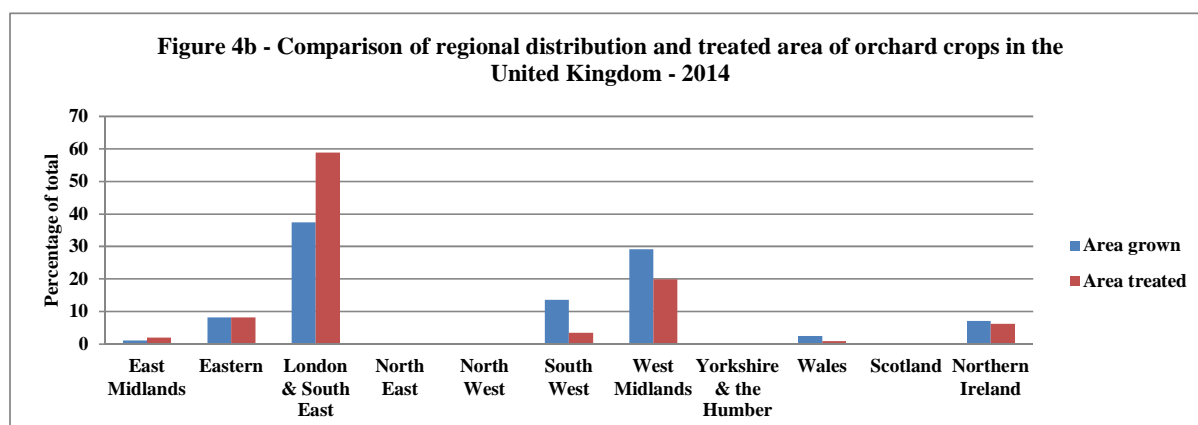
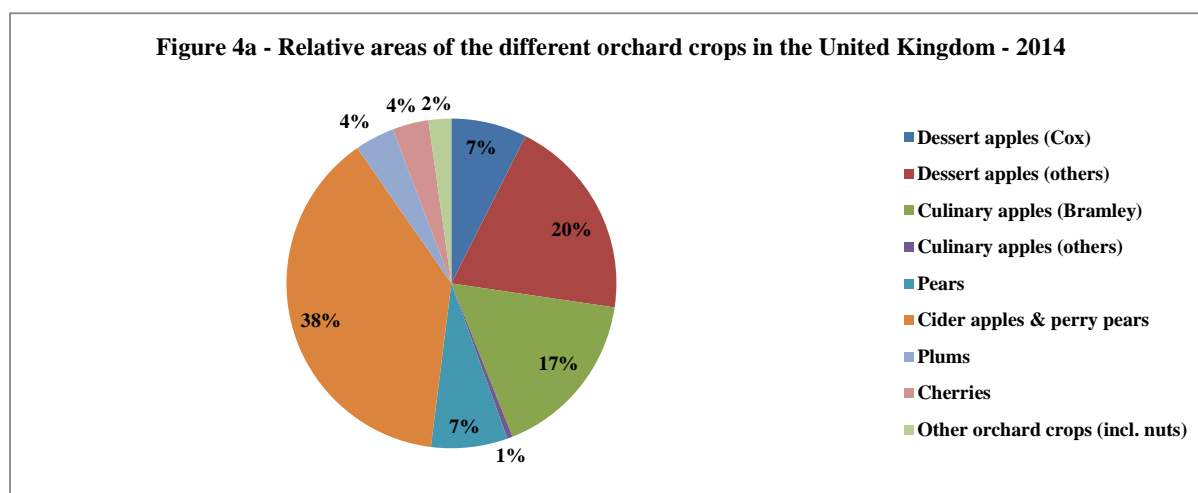
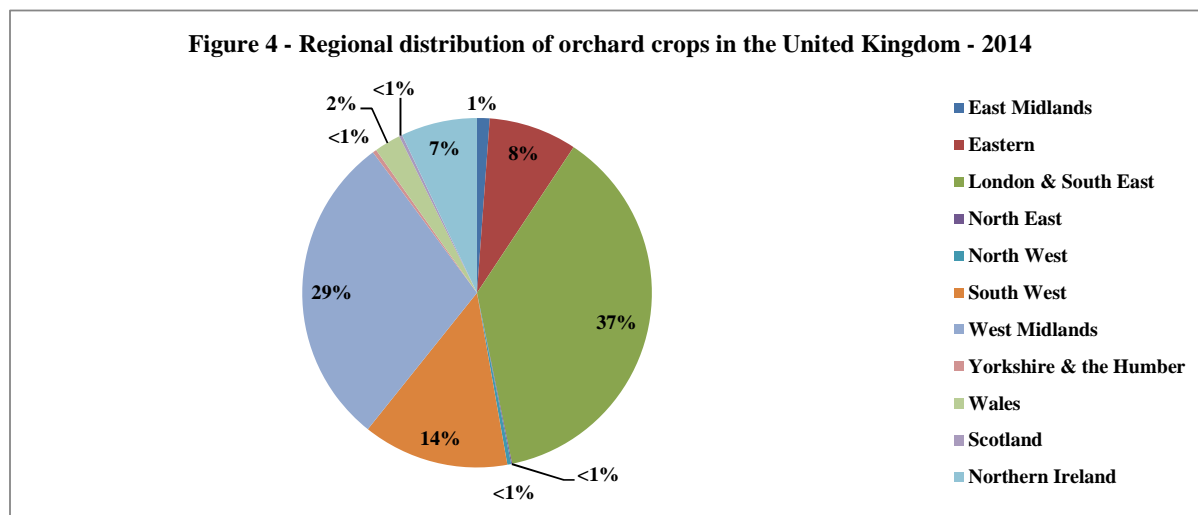
<sup>2</sup> Data for 2012 excludes information from Scotland

<sup>3</sup> Within Figures 2 & 3, other pesticides include biological control agents, repellents, urea, disinfectants, growth stimulants and physical control agents.

**Please note - All Pie-Charts within this report should be read clockwise from the top, as both the pie segments and the contents of the key appear in the same order.**

## CROPS

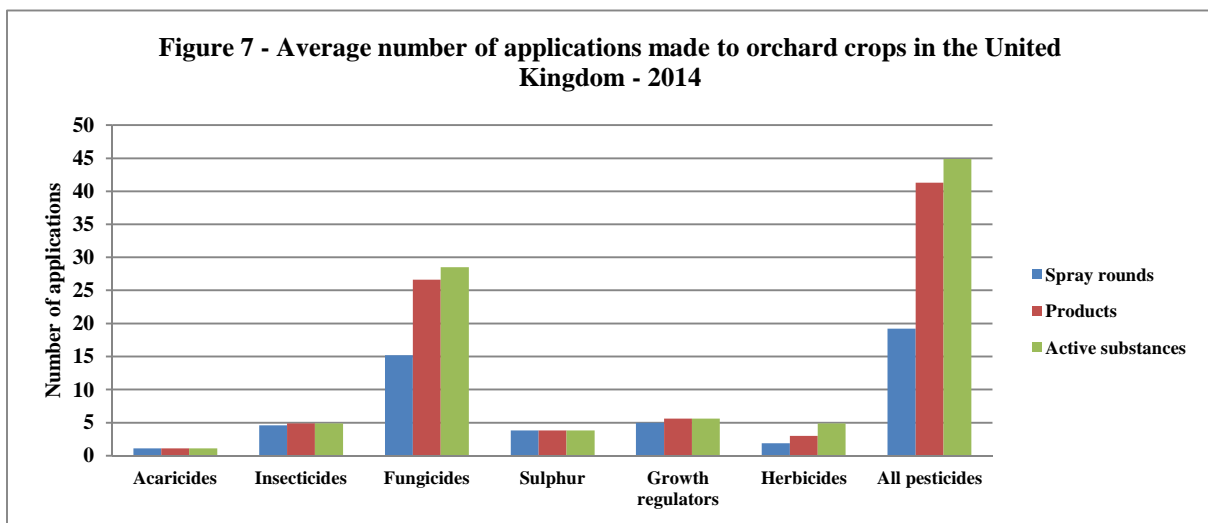
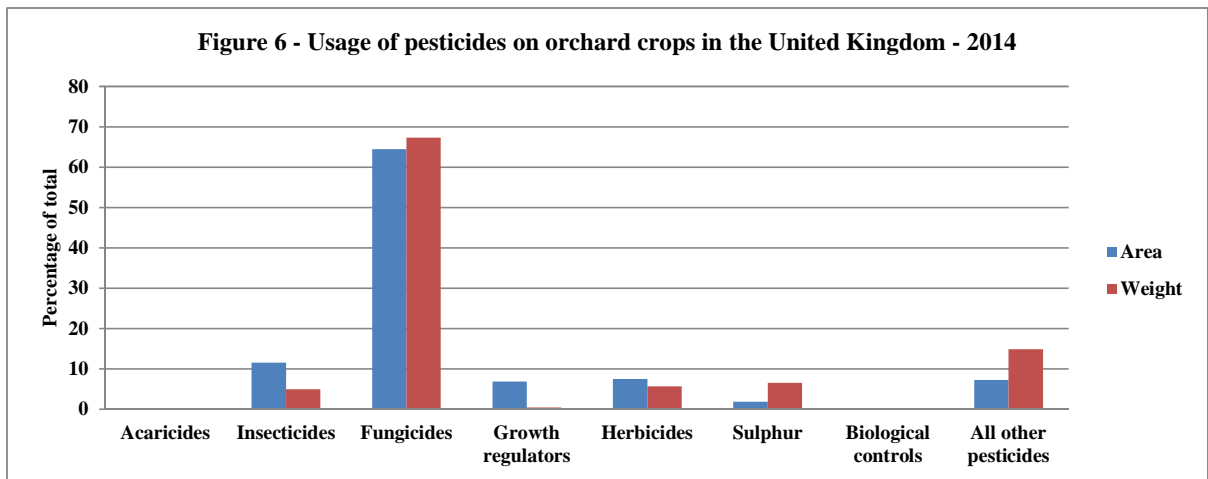
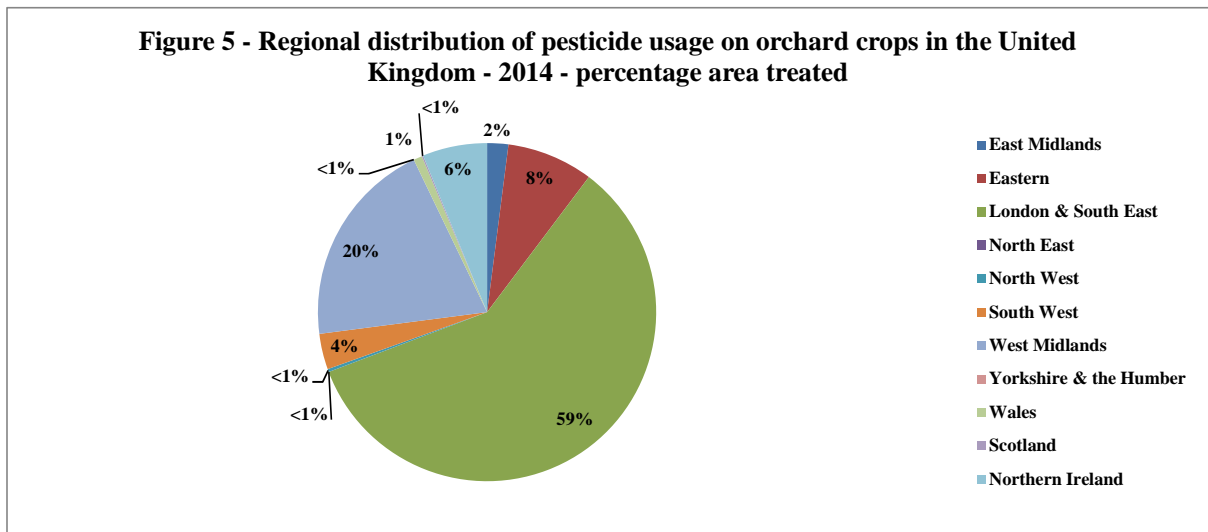
Information is given concerning nine types of orchard crops; dessert apples (Cox and others), culinary apples (Bramley & others), cider apples & perry pears, pears, plums, cherries and other orchard crops including nuts. Data on pesticide usage were collected from 2,913 examples (orchards) grown on 283 holdings throughout the United Kingdom. The sample accounted for 35% of the total area of orchard crops grown in the United Kingdom during the 2014 season. Fruit crops grown under permanent polythene and glasshouse structures are excluded from this report but are included within the team's survey of protected crops. Cherry crops grown for part of the time under Spanish tunnels or nets are included in the survey.



For maps of the United Kingdom showing individual Government Office regions, please visit the following website:

<http://www.ons.gov.uk/ons/guide-method/geography/beginner-s-guide/maps/index.html>

**PESTICIDE USAGE**



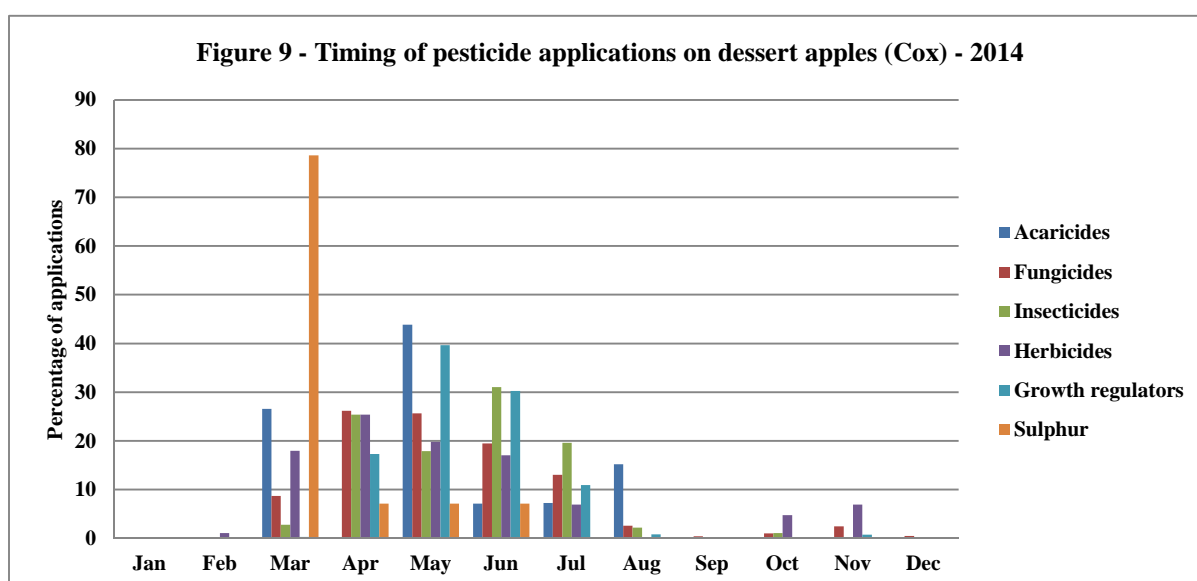
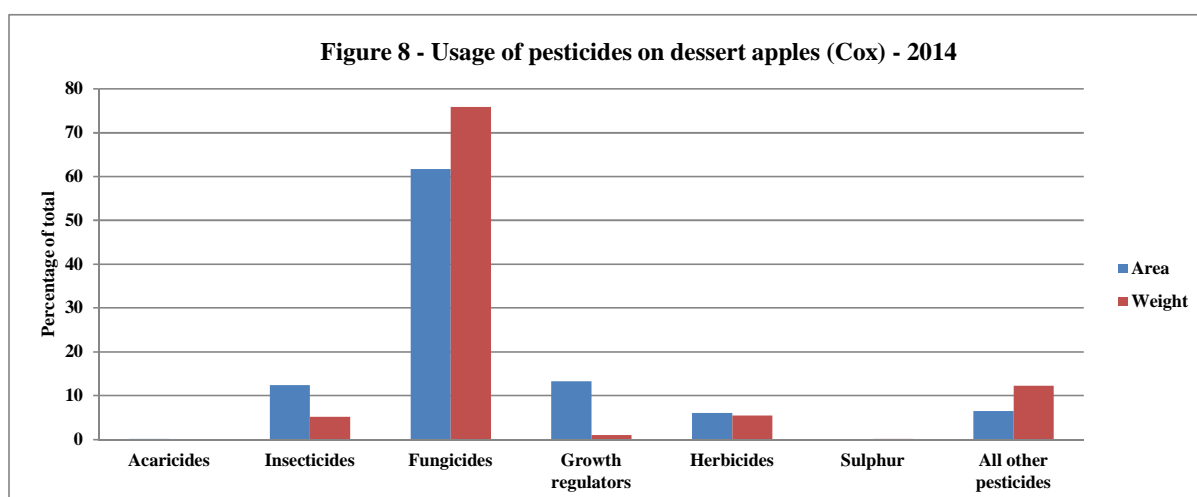


## PESTICIDE USAGE ON POME FRUITS

### Dessert apples (Cox)

- 1,738 hectares of dessert apples (Cox) grown in the United Kingdom
- 77,397 treated hectares
- 49.1 tonnes applied
- 1.2% of dessert apples (Cox) remained untreated
- Dessert apples (Cox) received on average 17 fungicides, 6 growth regulators, 6 insecticides and 2 herbicides

In line with many of the other fruit crops included in this report, Cox apples are treated with a range of fungicides throughout the season to control a range of fungal pathogens, particularly scab and powdery mildew. The grower's aim is to give continuous protection to the crop throughout the season by using regular applications of a range of active substances. A variety of active substances with different modes of action minimise disease resistance and control an increased range of pathogens.

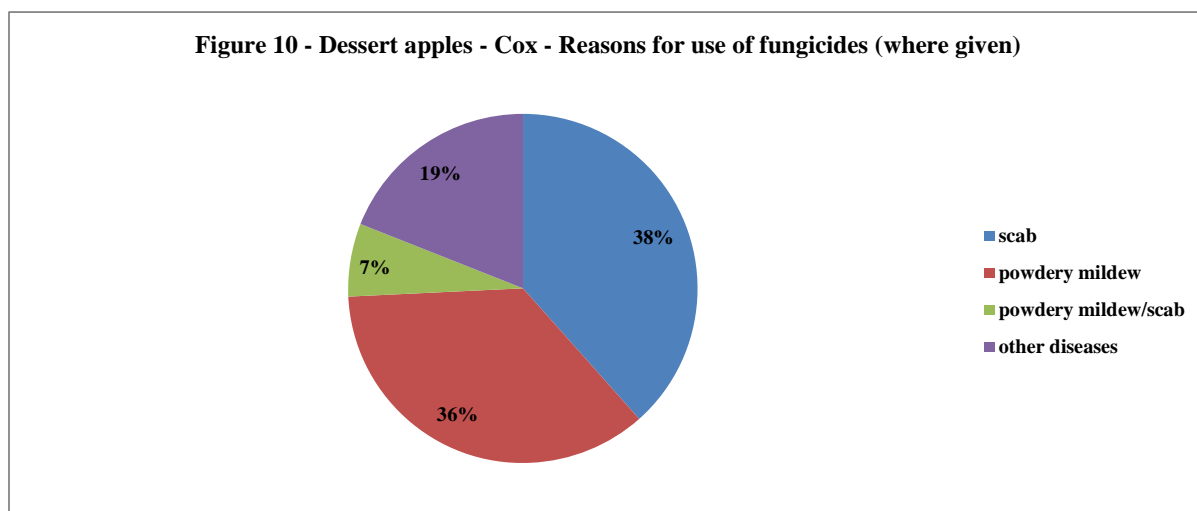


*Dessert apples (Cox) – Fungicides*

- **Formulation area treated: 47,744 hectares**
- **Weight of active substances applied: 37.3 tonnes**
- **The five most common formulations were:**

	Formulation area treated (ha)	Weight of a.s. applied (kg)	Proportion of fungicide-treated area	Proportion of area grown	Average number of applications (where applied)	Average proportion of maximum product label rate
Captan	10,887	15,764	0.21	0.96	6.51	0.62
Penconazole	6,333	246	0.12	0.83	4.40	0.78
Myclobutanil	5,331	334	0.10	0.83	3.70	0.70
Dithianon	3,994	2,447	0.08	0.80	2.87	0.88
Dodine	2,396	2,042	0.05	0.74	1.87	0.86

**Figure 10 - Dessert apples - Cox - Reasons for use of fungicides (where given)**



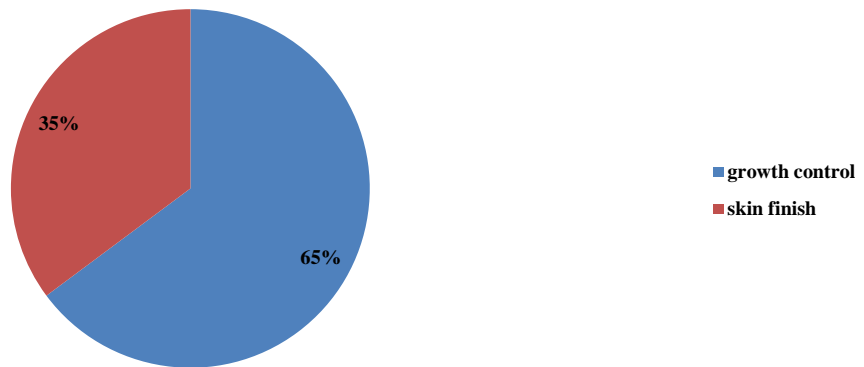
Use of sulphur, for powdery mildew control, accounted for less than 1% of the treated area and 1% of the weight applied.

*Dessert apples (Cox) – Growth regulators*

- **Formulation area treated: 10,257 hectares**
- **Weight of active substances applied: 0.5 tonnes**
- **The four formulations encountered were:**

	Formulation area treated (ha)	Weight of a.s. applied (kg)	Proportion of growth regulator – treated area	Proportion of area grown	Average number of applications (where applied)	Average proportion of maximum product label rate
Paclobutrazol	4,347	324	0.42	0.50	4.99	0.30
Gibberellins	4,305	13	0.42	0.66	3.76	0.55
Prohexadione-calcium	1,506	150	0.15	0.60	1.44	0.80
6-benzyladenine	99	9	0.01	0.06	1.00	0.64

**Figure 11- Dessert apples - Cox- Reasons for use of growth regulators (where given)**

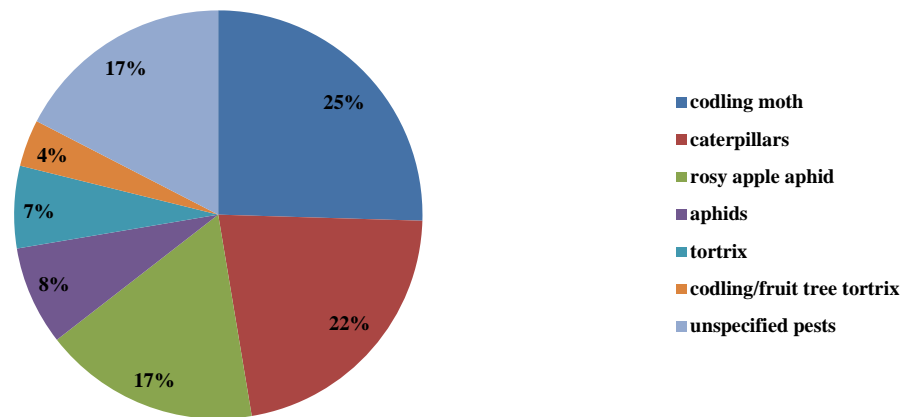


*Dessert apples (Cox) – Insecticides*

- **Formulation area treated: 9,589 hectares**
- **Weight of active substances applied: 2.5 tonnes**
- **The five most common formulations were:**

	Formulation area treated (ha)	Weight of a.s. applied (kg)	Proportion of insecticide – treated area	Proportion of area grown	Average number of applications (where applied)	Average proportion of maximum product label rate
Chlorpyrifos	2,893	1,983	0.30	0.77	2.15	0.72
Chlorantraniliprole	1,792	62	0.19	0.64	1.61	0.99
Flonicamid	1,526	107	0.16	0.64	1.36	1.00
Methoxyfenozide	1,070	131	0.11	0.44	1.40	0.85
Thiacloprid	1,051	160	0.11	0.52	1.17	0.85

**Figure 12 - Dessert apples - Cox - Reasons for use of insecticides (where given)**

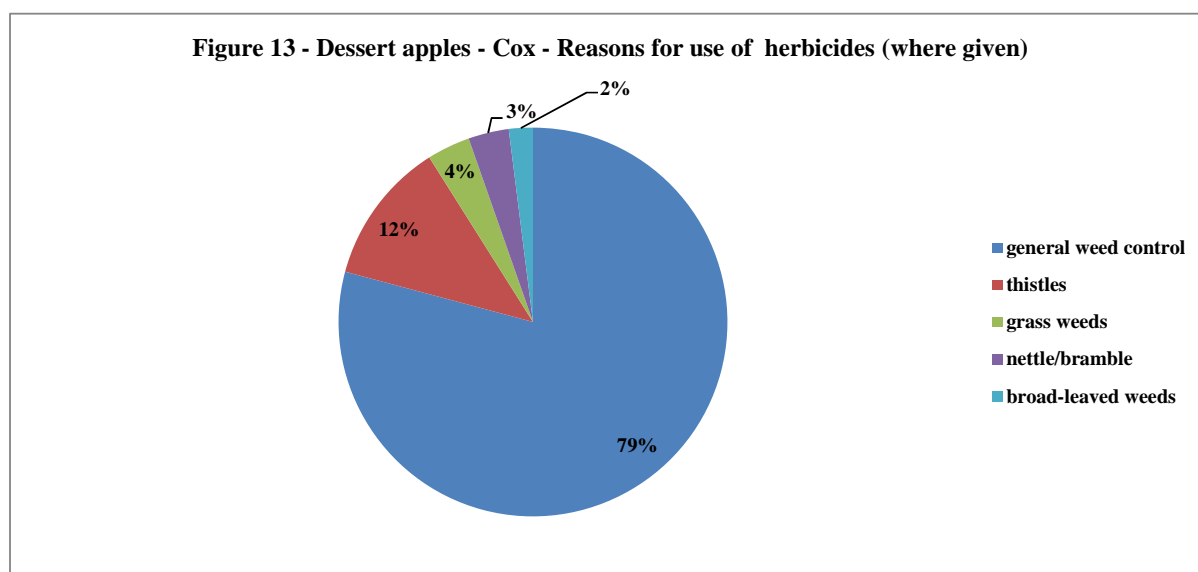


### *Dessert apples (Cox) – Herbicides*

In line with all other crops presented in this report, herbicides are generally applied to a strip at the base of the trees in order to keep the area clear of weeds. The areas reported for herbicide usage are the full orchard area. However, the reported weight of herbicides applied takes into account the proportion of treated strip within each orchard and reflects the actual weight of herbicides used.

- **Formulation area treated: 4,653 hectares**
- **Weight of active substances applied: 2.7 tonnes**
- **The five most common formulations were:**

	Formulation area treated (ha)	Weight of a.s. applied (kg)	Proportion of herbicide – treated area	Proportion of area grown	Average number of applications (where applied)	Average proportion of maximum product label rate
Glyphosate	2,201	1,424	0.47	0.88	1.41	0.72
Dicamba/MCPA/mecoprop-P	1,503	908	0.32	0.66	1.31	0.77
Glufosinate-ammonium	393	114	0.08	0.23	1.00	0.80
Amitrole	281	131	0.06	0.16	1.00	0.25
Propyzamide	141	75	0.03	0.08	1.00	0.67



### *Dessert apples (Cox) – Other pesticides*

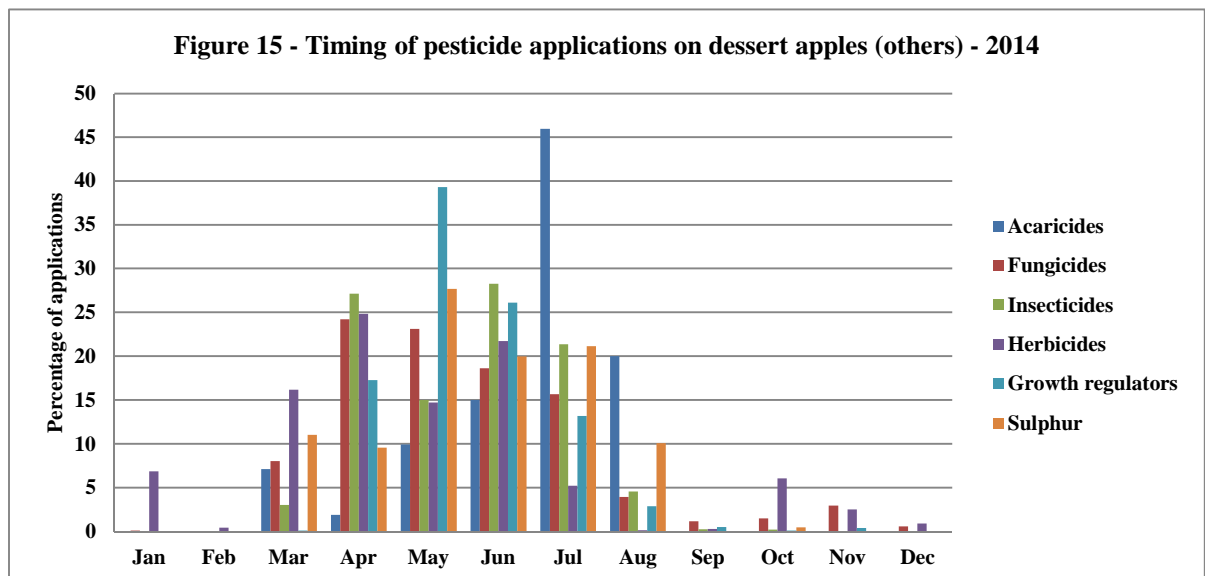
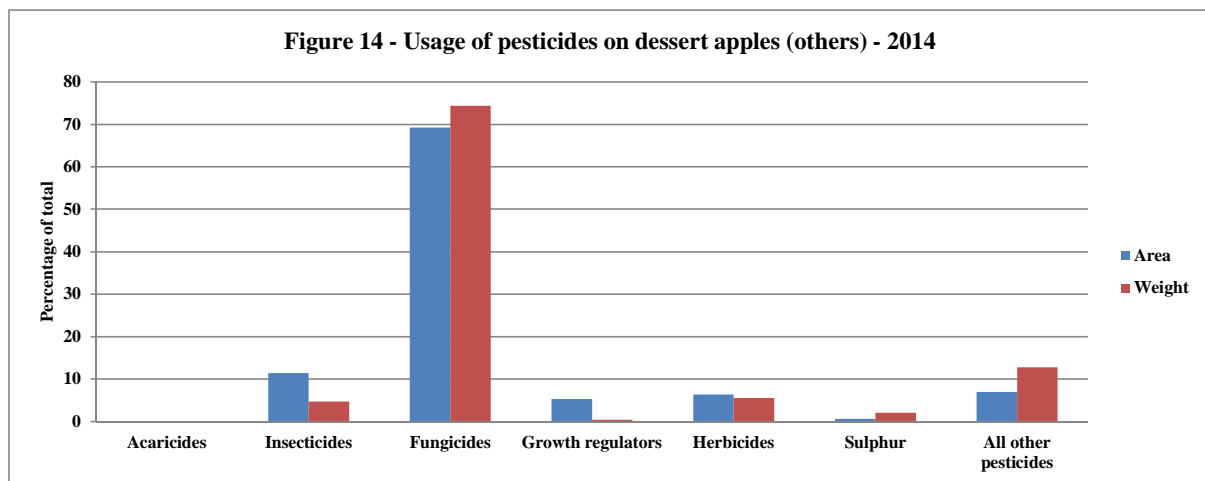
All other pesticide groups applied to Cox apples together accounted for 7% or less of the total treated area and 12% of the weight applied. Much of the discrepancy between the area treated and the weight applied is due to the use of urea, applied at relatively high rates per hectare.

Other pesticide groups included acaricides, disinfectants, urea and physical control agents.

However, in terms of weight applied, urea accounted for almost all of the weight of other pesticides applied.

**Dessert apples (others)**

- 4,665 hectares of dessert apples (other) grown in the United Kingdom
- 208,126 treated hectares
- 132.7 tonnes applied
- 6.6 % of dessert apples (other) remained untreated
- Dessert apples (other) received on average 18 fungicides, 5 insecticides, 4 growth regulators and 2 herbicides
- Gala (and clones) and Braeburn were the two main varieties grown, accounting for 43% and 19% of the total respectively

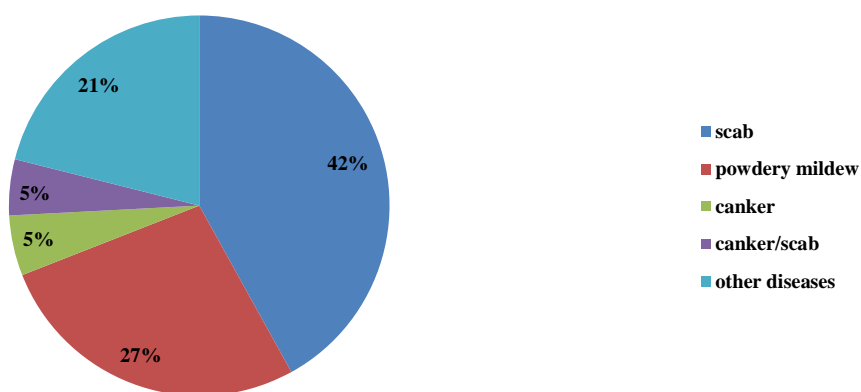


*Dessert apples (others) – Fungicides*

- **Formulation area treated: 144,117 hectares**
- **Weight of active substances applied: 98.8 tonnes**
- **The five most common formulations were:**

	Formulation area treated (ha)	Weight of a.s. applied (kg)	Proportion of fungicide-treated area	Proportion of area grown	Average number of applications (where applied)	Average proportion of maximum product label rate
Captan	33,356	50,115	0.21	0.86	8.31	0.64
Penconazole	16,802	648	0.11	0.75	4.78	0.77
Myclobutanil	14,918	911	0.09	0.81	3.96	0.68
Dithianon	13,383	7,674	0.08	0.78	3.65	0.87
Copper oxychloride	12,233	9,369	0.08	0.76	3.45	0.40

**Figure 16 - Dessert apples - (others) - Reasons for use of fungicides (where given)**



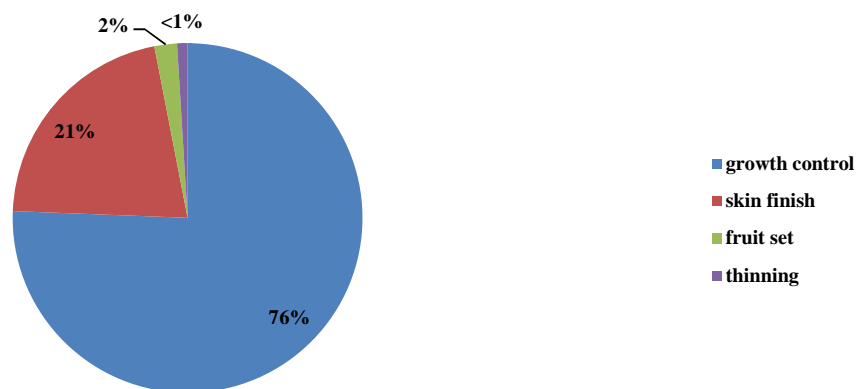
Sulphur accounted for less than 1% of the overall area of dessert apples (others) but 2% of the weight applied.

*Dessert apples (others) – Growth regulators*

- **Formulation area treated: 11,147 hectares**
- **Weight of active substances applied: 0.6 tonnes**
- **The five most common formulations were:**

	Formulation area treated (ha)	Weight of a.s. applied (kg)	Proportion of growth regulator – treated area	Proportion of area grown	Average number of applications (where applied)	Average proportion of maximum product label rate
Paclobutrazol	4,728	323	0.42	0.25	4.03	0.27
Gibberellins	4,110	9	0.37	0.27	3.26	0.30
Prohexadione-calcium	1,877	160	0.17	0.26	1.56	0.68
6-benzyladenine	303	37	0.03	0.06	1.00	0.82
1-naphthylacetic acid	72	<1	0.01	0.02	1.00	volumetric

**Figure 17 - Dessert apples - (others) - Reasons for use of growth regulators (where given)**



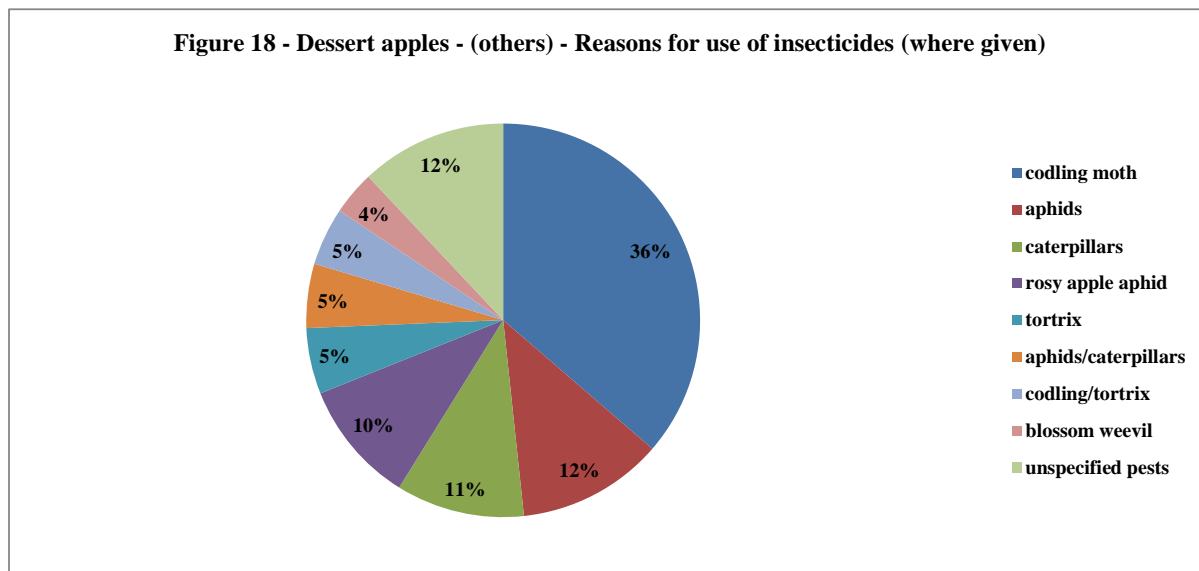


*Dessert apples (others) – Insecticides*

- **Formulation area treated: 23,688 hectares**
- **Weight of active substances applied: 6.3 tonnes**
- **The five most common formulations were:**

	Formulation area treated (ha)	Weight of a.s. applied (kg)	Proportion of insecticide – treated area	Proportion of area grown	Average number of applications (where applied)	Average proportion of maximum product label rate
Chlorpyrifos	7,180	4,906	0.30	0.72	2.12	0.71
Flonicamid	4,359	304	0.18	0.69	1.35	1.00
Chlorantraniliprole	4,325	150	0.18	0.53	1.75	0.99
Methoxyfenozide	2,761	360	0.12	0.42	1.40	0.90
Thiacloprid	2,161	347	0.09	0.39	1.18	0.89

**Figure 18 - Dessert apples - (others) - Reasons for use of insecticides (where given)**

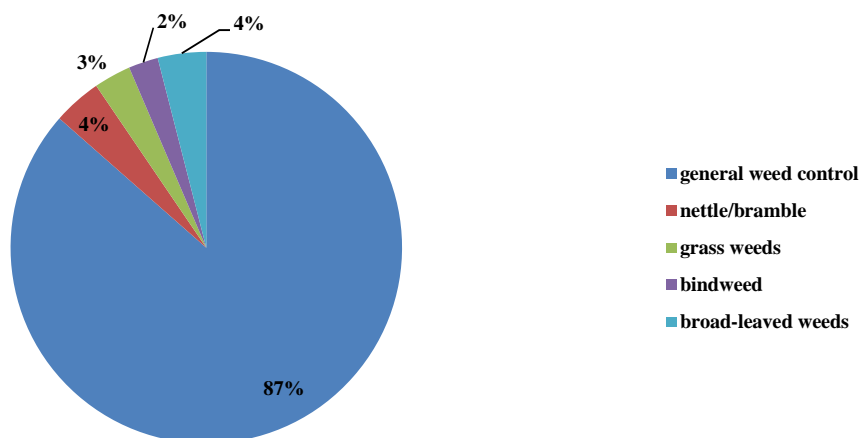


*Dessert apples (others) – Herbicides*

- **Formulation area treated: 13,192 hectares**
- **Weight of active substances applied: 7.3 tonnes**
- **The five most common formulations were:**

	Formulation area treated (ha)	Weight of a.s. applied (kg)	Proportion of herbicide – treated area	Proportion of area grown	Average number of applications (where applied)	Average proportion of maximum product label rate
Glyphosate	5,768	3,735	0.44	0.80	1.53	0.70
Dicamba/MCPA/mecoprop-P	4,380	2,539	0.33	0.64	1.45	0.74
Glufosinate-ammonium	876	202	0.07	0.18	1.06	0.70
Amitrole	656	286	0.05	0.14	1.01	0.26
2,4-D	628	269	0.05	0.13	1.05	0.78

**Figure 19 - Dessert apples - (others) - Reasons for use of herbicides (where given)**

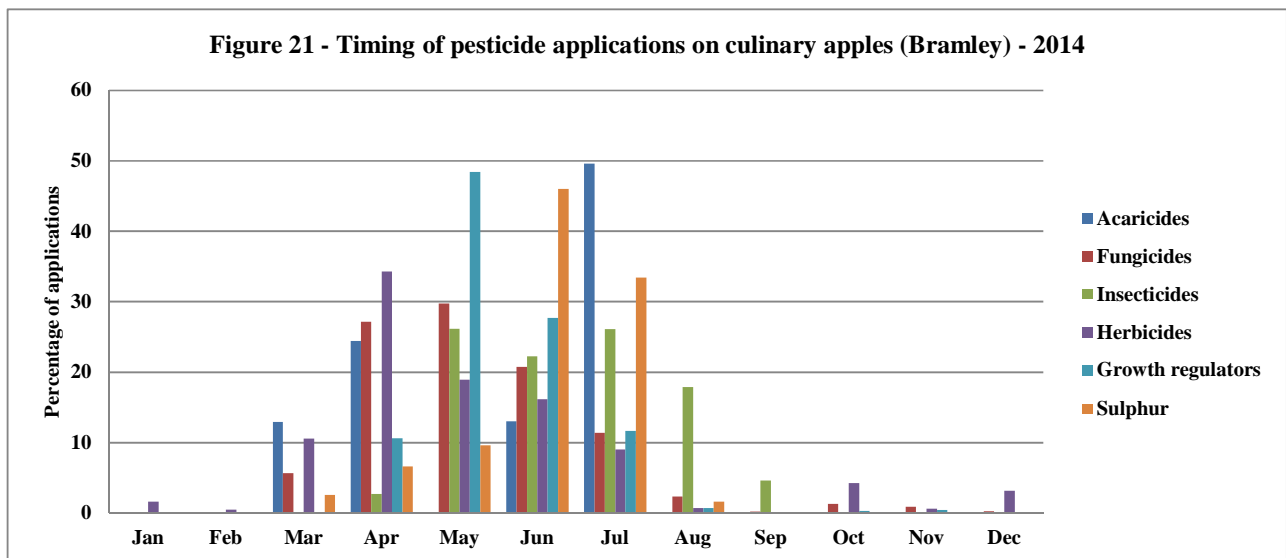
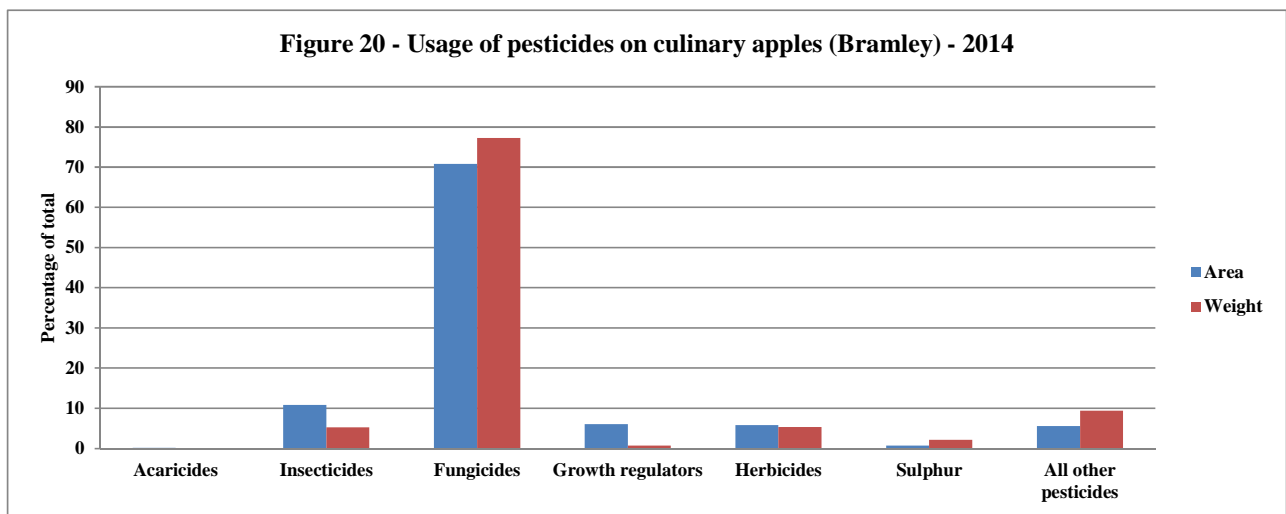


*Dessert apples (others) – Other pesticides*

All other pesticide groups applied to dessert apples (others) accounted for 7% of the total treated area and included urea, acaricides, disinfectants, growth stimulants, physical control agents and repellents. However, in terms of weight applied, urea accounted for 13% of the total.

### Culinary apples (Bramley)

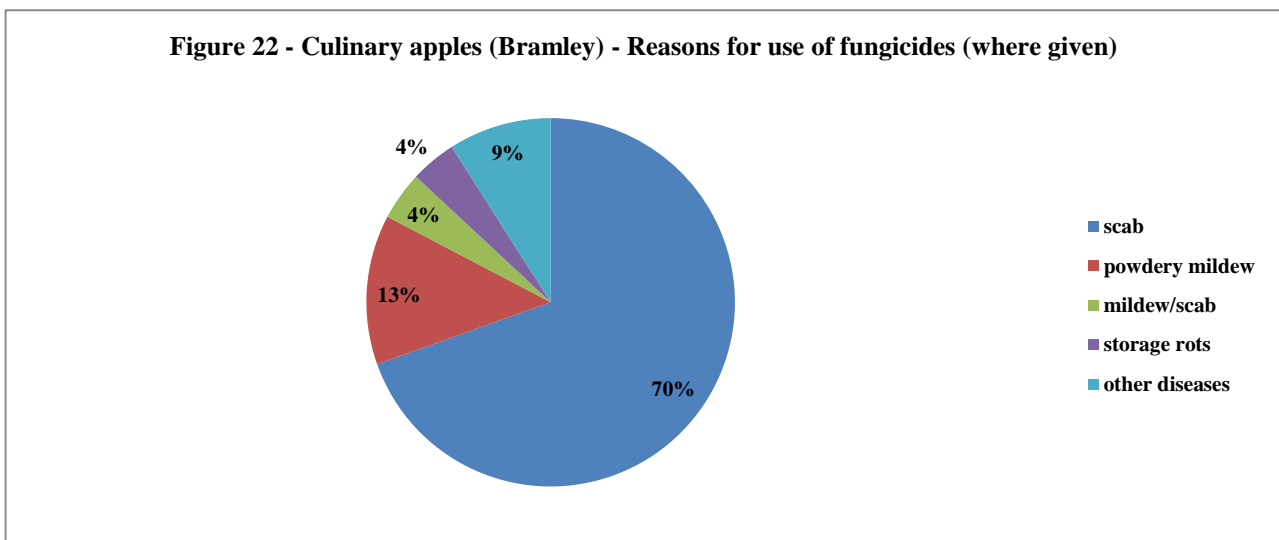
- 3,901 hectares of culinary apples (Bramley) grown in the United Kingdom
- 123,417 treated hectares
- 73.9 tonnes applied
- 4% of culinary apples (Bramley) remained untreated
- Culinary apples (Bramley) received on average 14 fungicides, 4 insecticides, 3 growth regulators and 2 herbicides
- 42% of the area of culinary apples (Bramley) was grown in Northern Ireland



**Culinary apples (Bramley) – Fungicides**

- **Formulation area treated: 87,352 hectares**
- **Weight of active substances applied: 57.1 tonnes**
- **The five most common formulations were:**

	Formulation area treated (ha)	Weight of a.s. applied (kg)	Proportion of fungicide-treated area	Proportion of area grown	Average number of applications (where applied)	Average proportion of maximum product label rate
Captan	15,845	21,924	0.17	0.83	4.86	0.57
Dithianon	11,502	6,595	0.12	0.70	4.23	0.86
Myclobutanil	8,840	580	0.09	0.64	3.53	0.73
Penconazole	7,448	290	0.08	0.48	3.99	0.78
Pyrimethanil	7,098	2,297	0.08	0.74	2.47	0.73



The use of sulphur accounted for 1% of the area of Bramley apples treated, but for 2% of the total weight of pesticides applied, reflecting the relatively high rate of application of this product.

**Culinary apples (Bramley) – Growth regulators**

- **Formulation area treated: 7,462 hectares**
- **Weight of active substances applied: 0.6 tonnes**
- **The five formulations encountered were:**

	Formulation area treated (ha)	Weight of a.s. applied (kg)	Proportion of growth regulator – treated area	Proportion of area grown	Average number of applications (where applied)	Average proportion of maximum product label rate
Paclobutrazol	3,431	318	0.46	0.25	3.53	0.37
Prohexadione-calcium	2,422	243	0.32	0.41	1.53	0.80
Gibberellins	1,576	5	0.21	0.18	2.28	0.68
1-naphthylacetic acid	24	<1	0.00	0.01	1.00	volumetric
6-benzyladenine	9	1	0.00	0.00	1.00	0.93

**Figure 23 - Culinary apples - (Bramley) - Reasons for use of growth regulators (where given)**

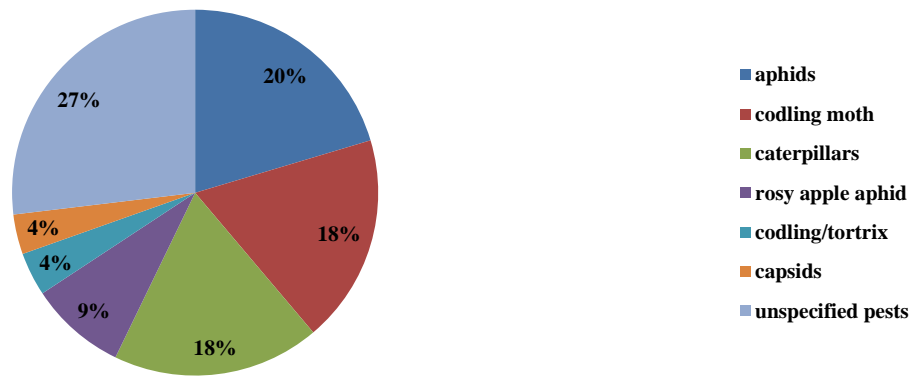


**Culinary apples (Bramley) – Insecticides**

- **Formulation area treated: 13,411 hectares**
- **Weight of active substances applied: 3.9 tonnes**
- **The five most common formulations were:**

	Formulation area treated (ha)	Weight of a.s. applied (kg)	Proportion of insecticide – treated area	Proportion of area grown	Average number of applications (where applied)	Average proportion of maximum product label rate
Chlorpyrifos	4,357	3,081	0.32	0.57	1.97	0.74
Flonicamid	2,149	149	0.16	0.42	1.30	0.99
Chlorantraniliprole	2,005	70	0.15	0.32	1.60	0.99
Methoxyfenozide	1,749	235	0.13	0.25	1.79	0.93
Thiacloprid	1,011	154	0.08	0.22	1.18	0.85

**Figure 24 - Culinary apples - (Bramley) - Reasons for use of insecticides (where given)**

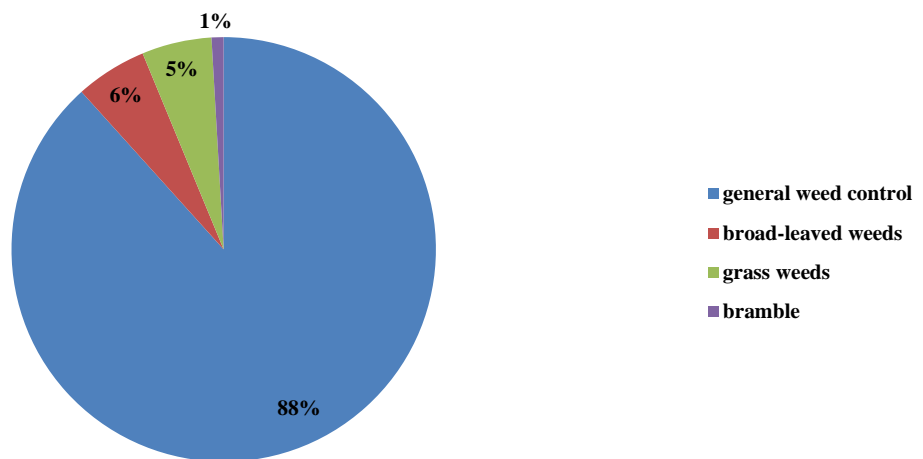


**Culinary apples (Bramley) – Herbicides**

- **Formulation area treated: 7,200 hectares**
- **Weight of active substances applied: 3.9 tonnes**
- **The five most common formulations were:**

	Formulation area treated (ha)	Weight of a.s. applied (kg)	Proportion of herbicide – treated area	Proportion of area grown	Average number of applications (where applied)	Average proportion of maximum product label rate
Glyphosate	3,524	2,036	0.49	0.68	1.32	0.63
Dicamba/MCPA/mecoprop-P	2,429	1,344	0.34	0.49	1.28	0.69
Glufosinate-ammonium	327	101	0.05	0.08	1.06	0.81
2,4-D	295	146	0.04	0.08	1.00	0.80
Amitrole	242	107	0.03	0.06	1.00	0.26

**Figure 25 - Culinary apples - (Bramley) - Reasons for use of herbicides (where given)**

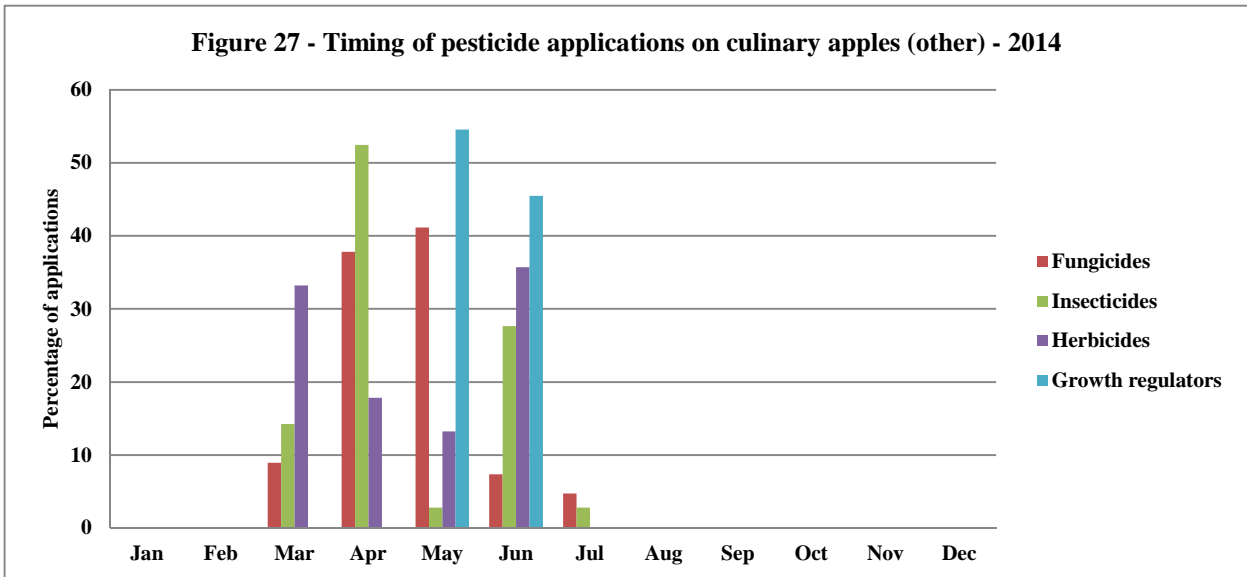
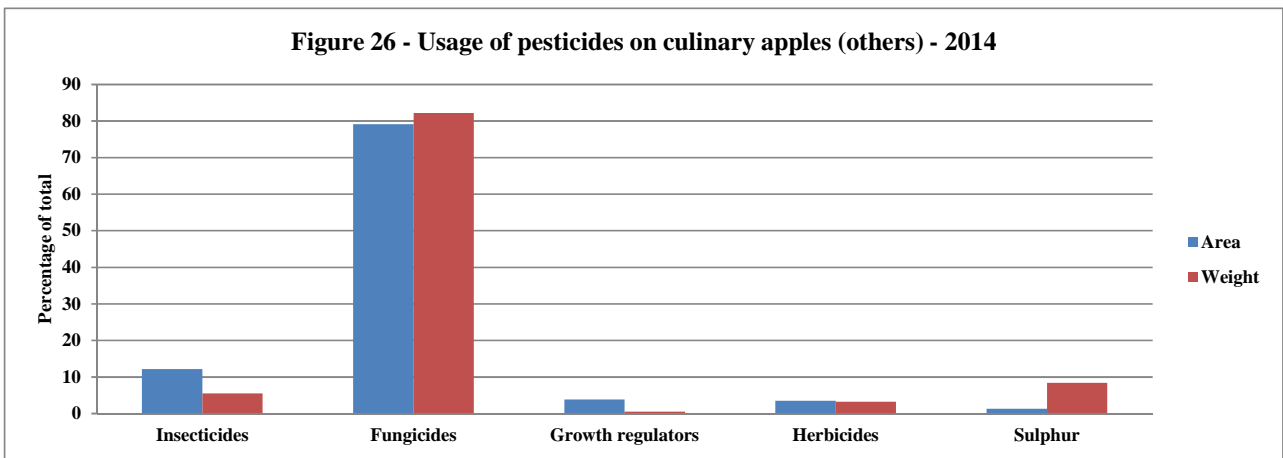


**Culinary apples (Bramley) – Other pesticides**

All other pesticide groups applied to culinary apples (Bramley) accounted for 6% of the total treated area and included urea, acaricides and disinfectants. However, in terms of weight applied, urea accounted for 9% of the total.

**Culinary apples (others)**

- 126 hectares of culinary apples (others) grown in the United Kingdom
- 531 treated hectares
- 0.3 tonnes applied
- 75.9% of culinary apples (others) remained untreated, reflecting both the age and intended use of the orchards, with most likely to be sold either through local shops or for juicing. Both outlets would have lower quality requirements than those going into the supermarket trade and therefore receive less pesticide inputs.
- Culinary apples (others) received on average 10 fungicides, 2 insecticides, 2 herbicides and 2 growth regulators



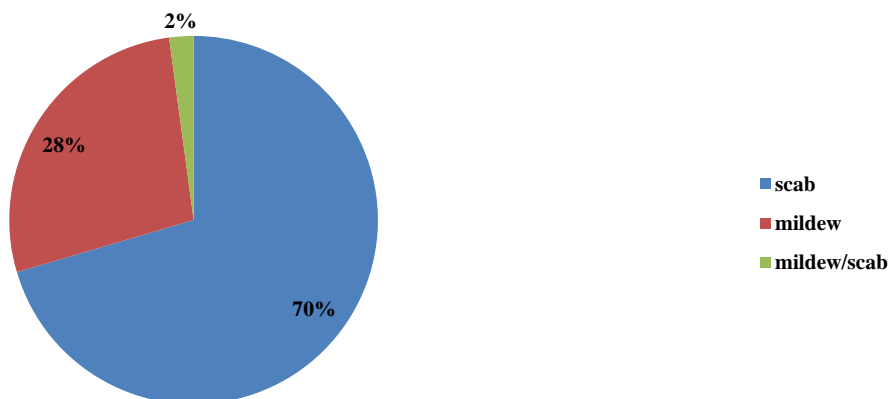


**Culinary apples (others) – Fungicides**

- **Formulation area treated: 420 hectares**
- **Weight of active substances applied: 0.2 tonnes**
- **The five most common formulations were:**

	Formulation area treated (ha)	Weight of a.s. applied (kg)	Proportion of fungicide-treated area	Proportion of area grown	Average number of applications (where applied)	Average proportion of maximum product label rate
Dithianon	126	101	0.30	0.21	4.64	0.97
Myclobutanil	91	6	0.22	0.17	4.26	0.75
Copper oxychloride	52	9	0.12	0.03	15.00	0.23
Pyrimethanil	37	14	0.09	0.11	2.51	0.87
Dodine	33	29	0.08	0.11	2.24	0.89

**Figure 28 - Culinary apples - (others) - Reasons for use of fungicides (where given)**



**Culinary apples (others) – Growth regulators**

- **Formulation area treated: 20 hectares**
- **Weight of active substances applied: <0.1 tonnes**
- **The one formulation encountered was:**

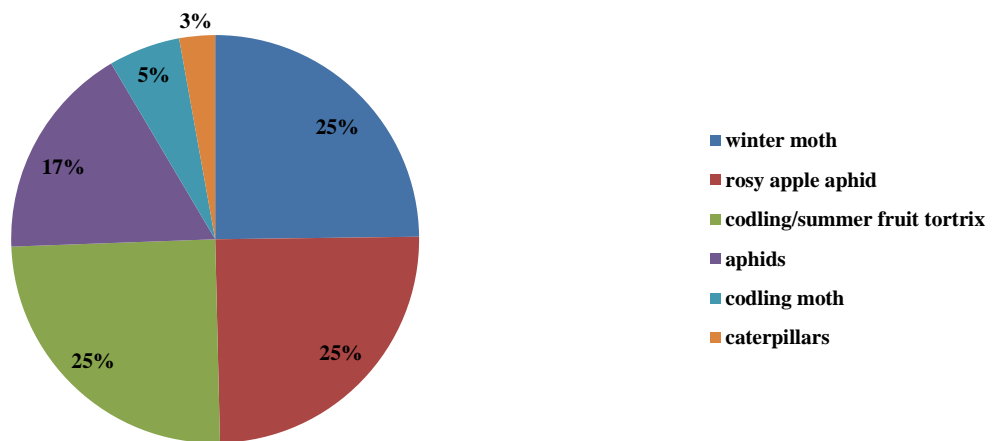
	Formulation area treated (ha)	Weight of a.s. applied (kg)	Proportion of growth regulator – treated area	Proportion of area grown	Average number of applications (where applied)	Average proportion of maximum product label rate
Prohexadione-calcium	20	2	1.00	0.09	1.83	0.62

**Culinary apples (others) – Insecticides**

- **Formulation area treated: 65 hectares**
- **Weight of active substances applied: <0.1 tonnes**
- **The four formulations encountered were:**

	Formulation area treated (ha)	Weight of a.s. applied (kg)	Proportion of insecticide – treated area	Proportion of area grown	Average number of applications (where applied)	Average proportion of maximum product label rate
Chlorpyrifos	22	11	0.33	0.14	1.21	0.54
Thiacloprid	18	3	0.28	0.14	1.00	0.97
Indoxacarb	16	1	0.25	0.13	1.00	1.00
Cypermethrin	9	<1	0.14	0.07	1.00	1.00

**Figure 29- Culinary apples - (others) - Reasons for use of insecticides (where given)**



*Culinary apples (others) – Herbicides*

- **Formulation area treated: 19 hectares**
- **Weight of active substances applied: <0.1 tonnes**
- **The two formulations encountered were:**

	<b>Formulation area treated (ha)</b>	<b>Weight of a.s. applied (kg)</b>	<b>Proportion of herbicide – treated area</b>	<b>Proportion of area grown</b>	<b>Average number of applications (where applied)</b>	<b>Average proportion of maximum product label rate</b>
Glyphosate	16	8	0.87	0.07	1.79	0.66
Dicamba/MCPA/mecoprop-P	2	1	0.13	0.02	1.00	1.00

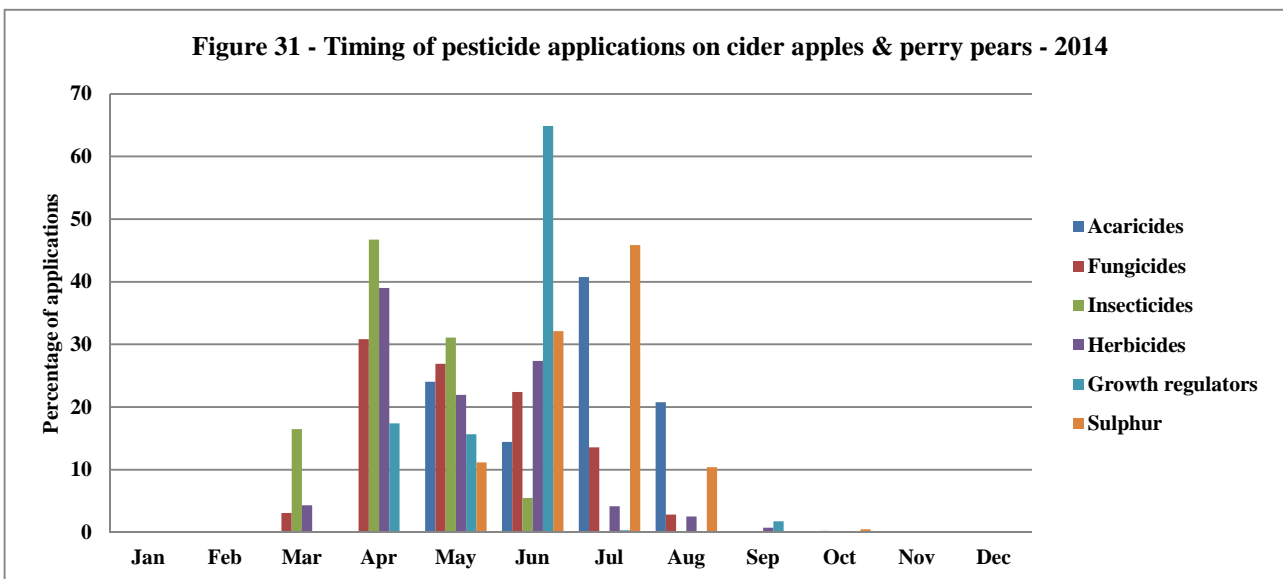
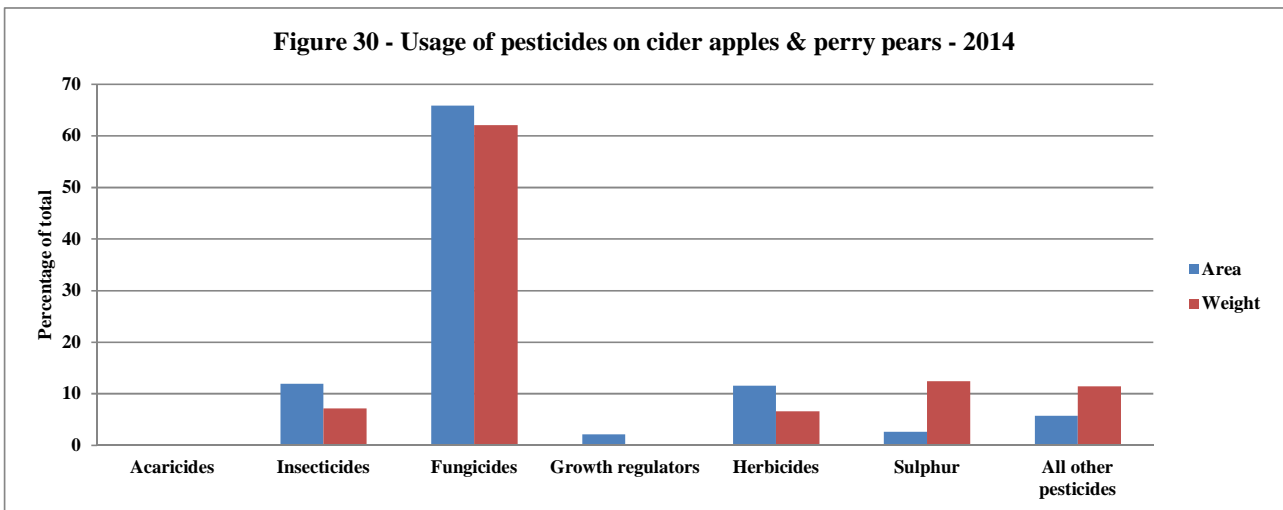
General weed control accounted for all of the reasons specified for herbicide usage.

*Culinary apples (others) – Other pesticides*

No other pesticides were recorded on culinary apples (others).

### Cider apples & perry pears

- 8,985 hectares of cider apples & perry pears grown in the United Kingdom
- 116,485 treated hectares
- 71.6 tonnes applied
- 44.2% of cider apples & perry pears remained untreated
- Many of the untreated crops included older, traditional type orchards, that were both grazed (e.g. by sheep) and grassed to the tree base
- Cider apples & perry pears received on average 8 fungicides, 2 insecticides, 2 herbicides and 2 sulphur applications

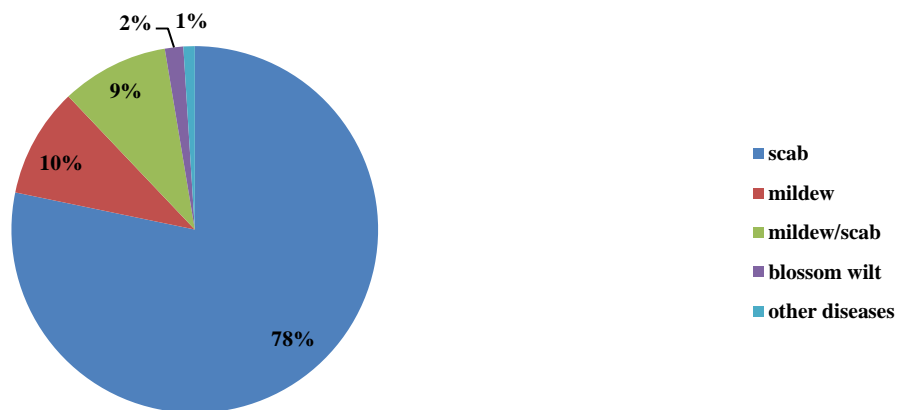


*Cider apples & perry pears – Fungicides*

- **Formulation area treated: 76,786 hectares**
- **Weight of active substances applied: 44.5 tonnes**
- **The five most common formulations were:**

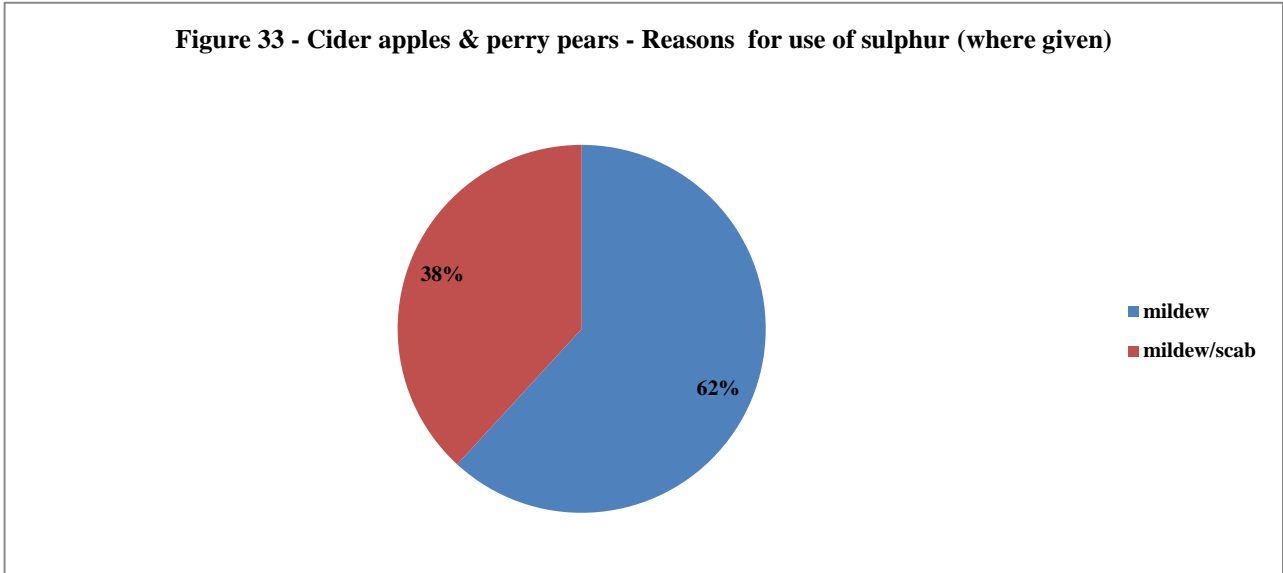
	Formulation area treated (ha)	Weight of a.s. applied (kg)	Proportion of fungicide-treated area	Proportion of area grown	Average number of applications (where applied)	Average proportion of maximum product label rate
Dodine	22,843	21,268	0.27	0.64	3.98	0.94
Myclobutanil	12,013	1,046	0.14	0.32	4.18	0.97
Dithianon	8,579	5,180	0.10	0.35	2.72	0.76
Penconazole	8,167	390	0.10	0.33	2.74	0.95
Captan	7,402	12,303	0.09	0.36	2.26	0.73

**Figure 32 - Cider apples & perry pears - Reasons for use of fungicides (where given)**



**Cider apples & perry pears – Sulphur**

- **Formulation area treated: 3,074 hectares**
- **Weight of active substances applied: 8.9 tonnes**



**Cider apples & perry pears – Growth regulators**

- **Formulation area treated: 2,499 hectares**
- **Weight of active substances applied: <0.1 tonnes**
- **The four formulations encountered were:**

	Formulation area treated (ha)	Weight of a.s. applied (kg)	Proportion of growth regulator – treated area	Proportion of area grown	Average number of applications (where applied)	Average proportion of maximum product label rate
Gibberellins	2,030	10	0.81	0.17	1.29	1.00
6-benzyladenine	317	45	0.13	0.04	1.00	0.95
Prohexadione-calcium	109	11	0.04	0.01	1.16	0.83
2-chloroethylphosphonic acid	43	19	0.02	0.00	1.00	1.23

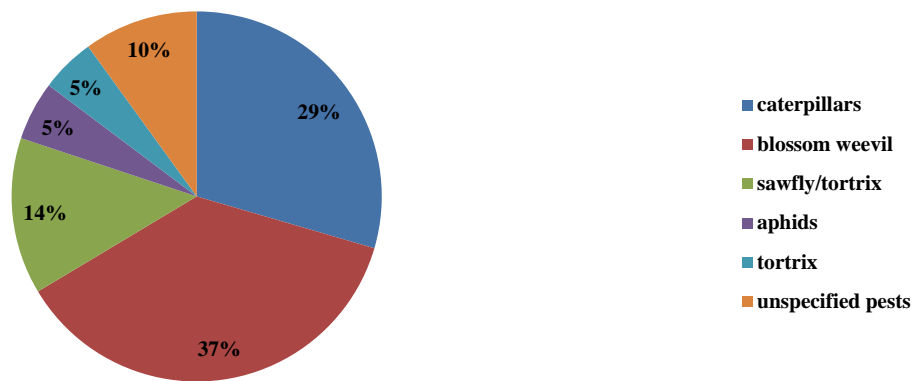
Growth control was the main reason specified for 72% of applications, fruit thinning for 25% and skin finish the remaining 3%.

*Cider apples & perry pears – Insecticides*

- **Formulation area treated: 13,925 hectares**
- **Weight of active substances applied: 5.1 tonnes**
- **The five most common formulations were:**

	Formulation area treated (ha)	Weight of a.s. applied (kg)	Proportion of insecticide – treated area	Proportion of area grown	Average number of applications (where applied)	Average proportion of maximum product label rate
Chlorpyrifos	8,320	4,403	0.60	0.58	1.60	0.56
Thiacloprid	3,069	386	0.22	0.30	1.14	0.70
Methoxyfenozide	2,478	352	0.18	0.15	1.84	0.99
Flonicamid	25	2	0.00	0.00	1.00	1.00
Chlorantraniliprole	23	<1	0.00	0.00	1.00	0.40

**Figure 34 - Cider apples & perry pears - Reasons for use of insecticides (where given)**



### *Cider apples & perry pears – Herbicides*

- **Formulation area treated: 13,436 hectares**
- **Weight of active substances applied: 4.8 tonnes**
- **The five most common formulations were:**

	Formulation area treated (ha)	Weight of a.s. applied (kg)	Proportion of herbicide – treated area	Proportion of area grown	Average number of applications (where applied)	Average proportion of maximum product label rate
Glyphosate	7,200	2,901	0.54	0.60	1.35	0.76
Glufosinate-ammonium	2,136	489	0.16	0.24	1.00	0.97
Dicamba/MCPA/mecoprop-P	1,946	555	0.14	0.18	1.19	0.66
2,4-D	1,506	670	0.11	0.16	1.07	0.99
Clopyralid/fluroxypyr/triclopyr	198	59	0.01	0.02	1.00	1.00

Almost all (97%) herbicide usage was for general weed control with the remaining 3% being for broad-leaved weed control.

### *Cider apples & perry pears – Other pesticides*

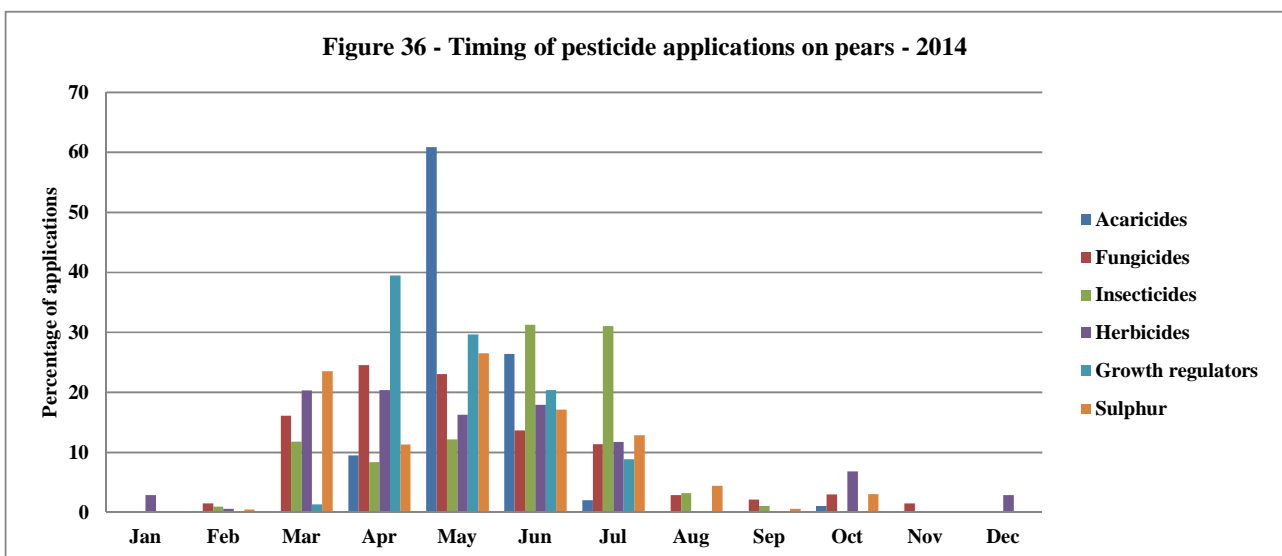
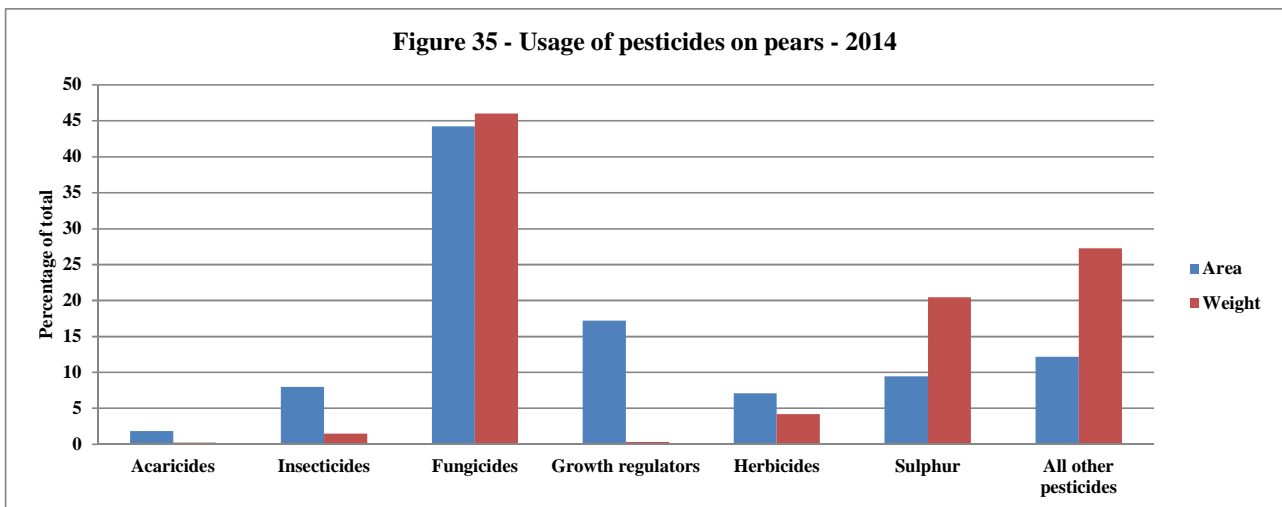
Usage of acaricides was minimal.

Urea accounted for 6% of the overall treated area and 11% of the weight applied.



## Pears

- 1,751 hectares of pears grown in the United Kingdom
- 62,964 treated hectares
- 64.35 tonnes applied
- 3.8% of pears remained untreated
- Pears received on average 15 fungicides, 8 growth regulators, 5 sulphur applications, 3 insecticides, 2 herbicides and 1 acaricide

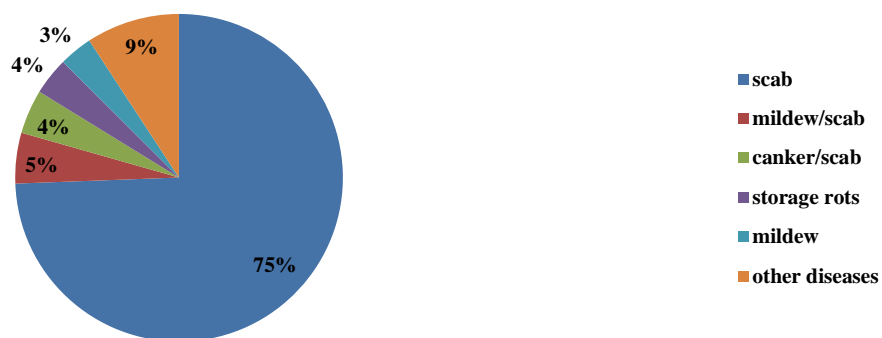


*Pears – Fungicides*

- **Formulation area treated: 27,846 hectares**
- **Weight of active substances applied: 29.6 tonnes**
- **The five most common formulations were:**

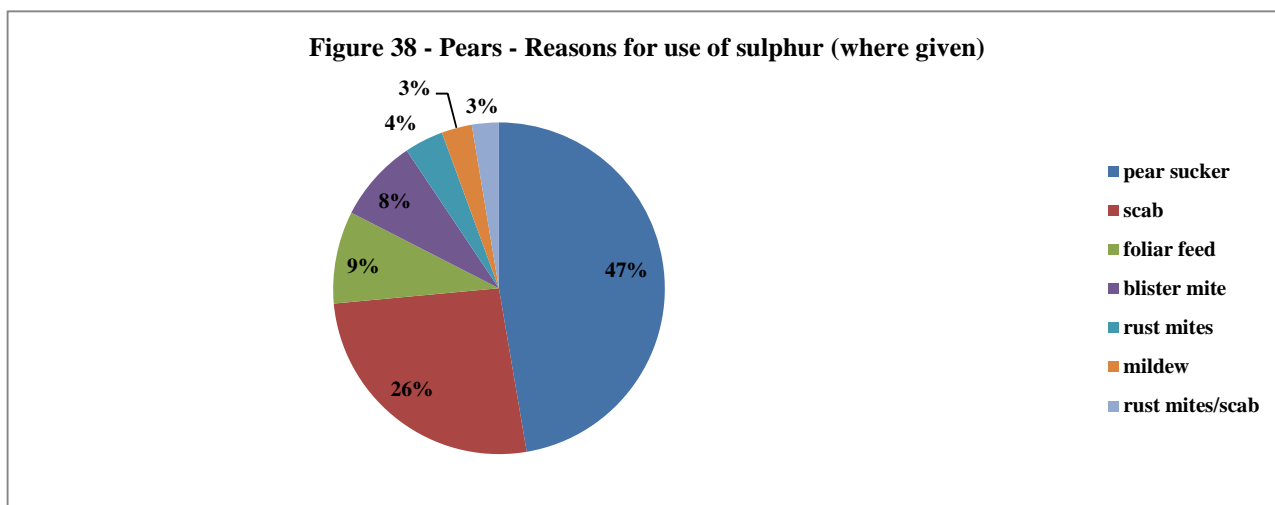
	Formulation area treated (ha)	Weight of a.s. applied (kg)	Proportion of fungicide-treated area	Proportion of area grown	Average number of applications (where applied)	Average proportion of maximum product label rate
Captan	13,446	21,801	0.40	0.87	8.81	0.67
Dithianon	2,835	1,882	0.09	0.66	2.45	0.92
Dodine	1,981	1,694	0.06	0.68	1.65	0.86
Pyrimethanil	1,947	559	0.06	0.51	2.19	0.67
Myclobutanil	1,756	93	0.05	0.16	6.11	0.59

**Figure 37 - Pears - Reasons for use of fungicides (where given)**



**Pears – Sulphur**

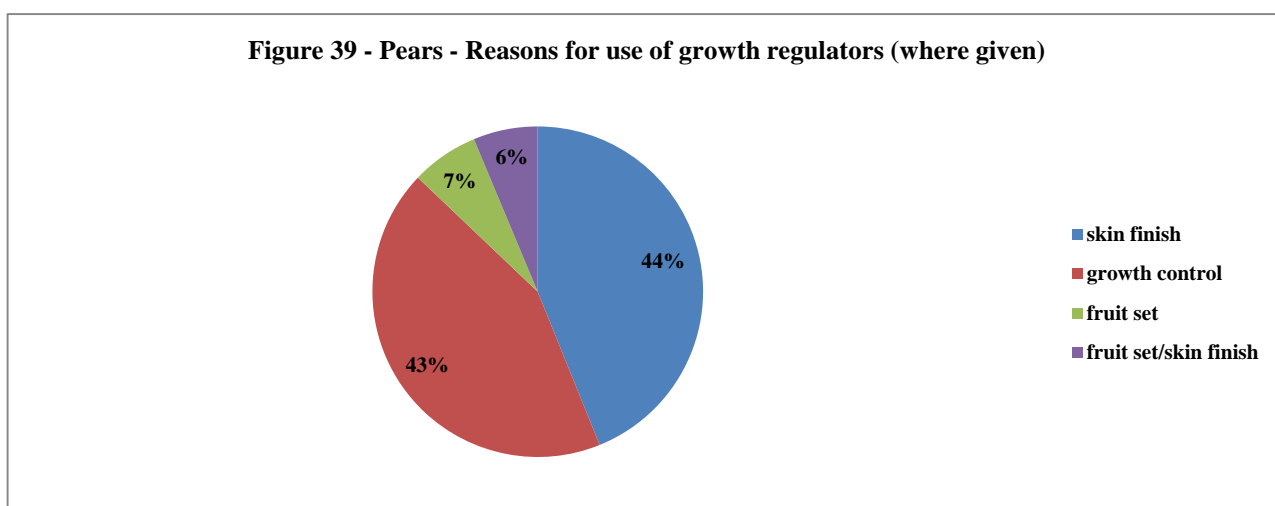
- **Formulation area treated: 5,958 hectares**
- **Weight of active substances applied: 13.1 tonnes**



**Pears – Growth regulators**

- **Formulation area treated: 10,843 hectares**
- **Weight of active substances applied: 0.2 tonnes**
- **The five formulations encountered were:**

	Formulation area treated (ha)	Weight of a.s. applied (kg)	Proportion of growth regulator – treated area	Proportion of area grown	Average number of applications (where applied)	Average proportion of maximum product label rate
Gibberellins	7,211	24	0.67	0.75	5.26	0.63
Paclobutrazol	3,454	190	0.32	0.41	4.75	0.22
Prohexadione-calcium	154	12	0.01	0.07	1.22	0.61
6-benzyladenine	13	2	0.00	0.01	1.00	1.00
Gibberellic acid	11	<1	0.00	0.01	1.00	0.15

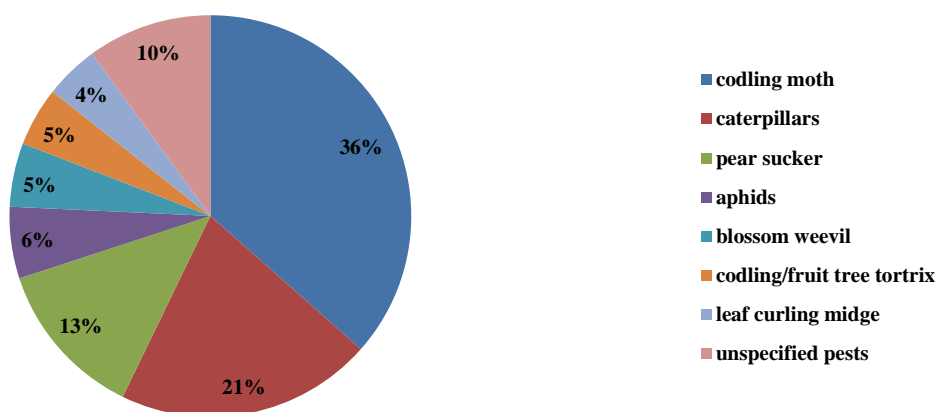


**Pears – Insecticides**

- **Formulation area treated: 5,033 hectares**
- **Weight of active substances applied: 1.0 tonnes**
- **The five most common formulations were:**

	Formulation area treated (ha)	Weight of a.s. applied (kg)	Proportion of insecticide – treated area	Proportion of area grown	Average number of applications (where applied)	Average proportion of maximum product label rate
Chlorantraniliprole	1,447	50	0.29	0.52	1.58	0.99
Methoxyfenozide	942	128	0.19	0.48	1.13	0.94
Cydia pomonella granulovirus	594	2	0.12	0.15	2.34	0.93
Fenoxycarb	530	61	0.11	0.17	1.73	0.76
Thiacloprid	305	52	0.06	0.16	1.09	0.94

**Figure 40 - Pears - Reasons for use of insecticides (where given)**

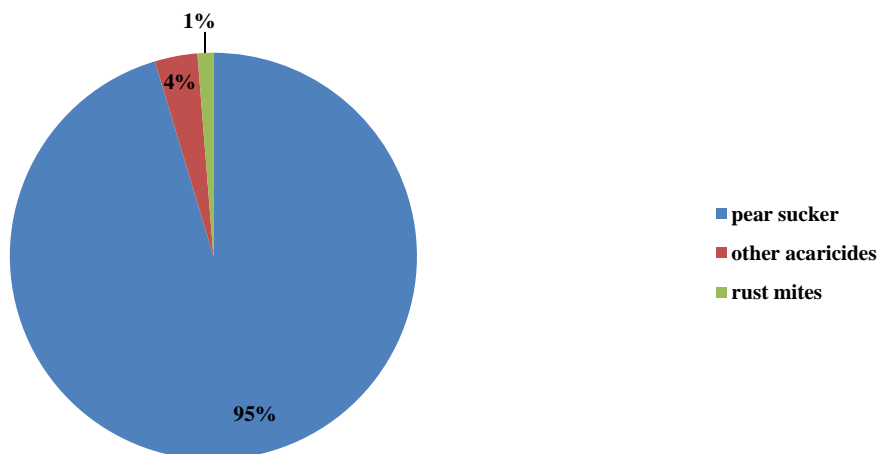


**Pears – Acaricides**

- **Formulation area treated: 1,166 hectares**
- **Weight of active substances applied: 0.2 tonnes**
- **The two formulations encountered were:**

	Formulation area treated (ha)	Weight of a.s. applied (kg)	Proportion of acaricide – treated area	Proportion of area grown	Average number of applications (where applied)	Average proportion of maximum product label rate
Spirodiclofen	1,101	158	0.94	0.61	1.03	1.00
Abamectin	64	1	0.06	0.04	1.00	1.00

**Figure 41 - Pears - Reasons for use of acaricides (where given)**



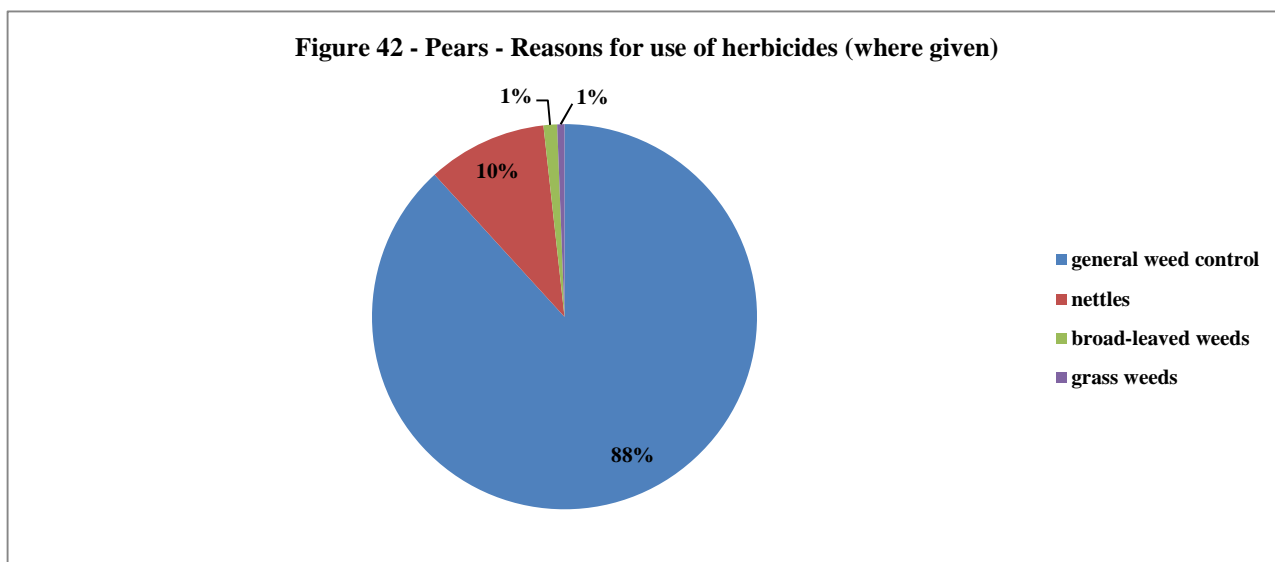
The reasons for use show that active substances, such as abamectin and spiroadiclofen, whilst registered primarily for acaricide usage and classified within this report as acaricides, can have both acaricidal and insecticidal uses.

**Pears – Herbicides**

- **Formulation area treated: 4,457 hectares**
- **Weight of active substances applied: 2.7 tonnes**
- **The five most common formulations were:**

	Formulation area treated (ha)	Weight of a.s. applied (kg)	Proportion of herbicide – treated area	Proportion of area grown	Average number of applications (where applied)	Average proportion of maximum product label rate
Glyphosate	1,949	1,379	0.44	0.80	1.39	0.76
Dicamba/MCPA/mecoprop-P	1,518	927	0.34	0.60	1.36	0.76
Glufosinate-ammonium	327	79	0.07	0.18	1.02	0.66
2,4-D	198	128	0.04	0.11	1.00	0.93
Amitrole	187	103	0.04	0.11	1.00	0.31

**Figure 42 - Pears - Reasons for use of herbicides (where given)**



**Pears – Other pesticides**

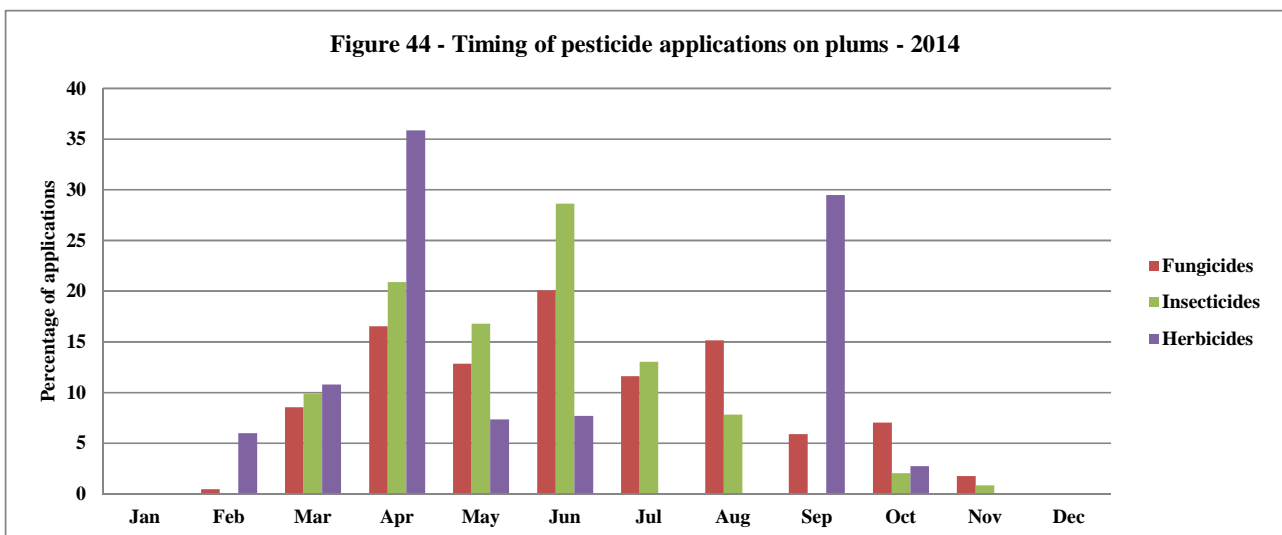
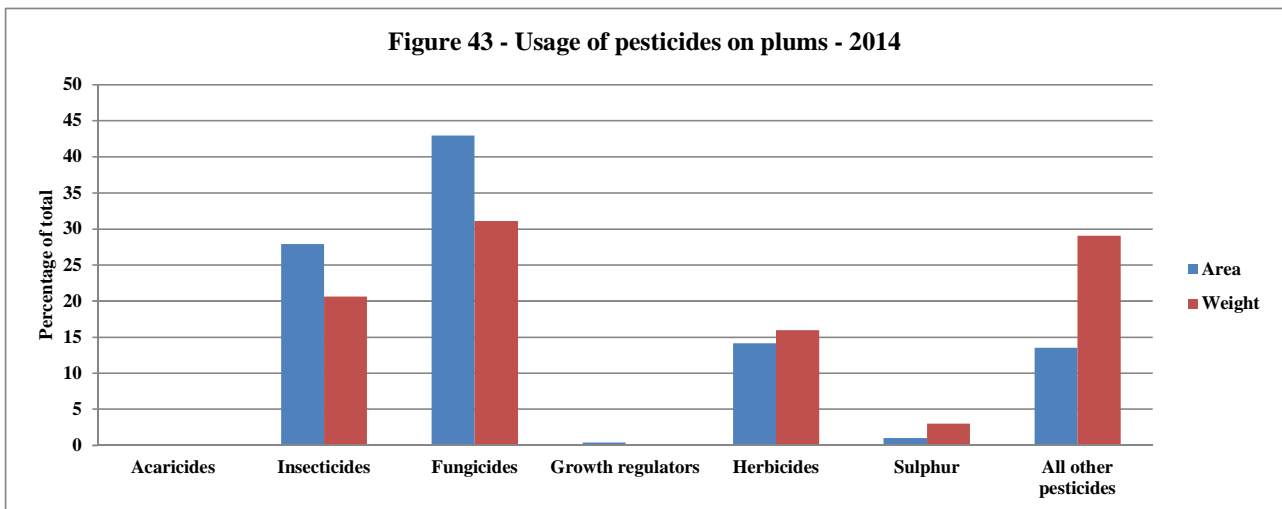
Urea accounted for 9% of the area of pesticides used on pears, biological control agents 2%, repellents 1% and growth stimulants less than one percent. By weight applied the repellent kaolin (used for pear sucker control) and urea comprised 16% and 11% of the total respectively.

The only biological control agents recorded on pears were the predatory bugs *Anthocoris* spp, used for the control of pear sucker.

## PESTICIDE USAGE ON STONE FRUITS AND NUTS

### Plums

- 909 hectares of plums grown in the United Kingdom
- 8,045 treated hectares
- 4.4 tonnes applied
- 45.4% of plums remained untreated
- Plums received on average 10 fungicides, 5 insecticides and 2 herbicides

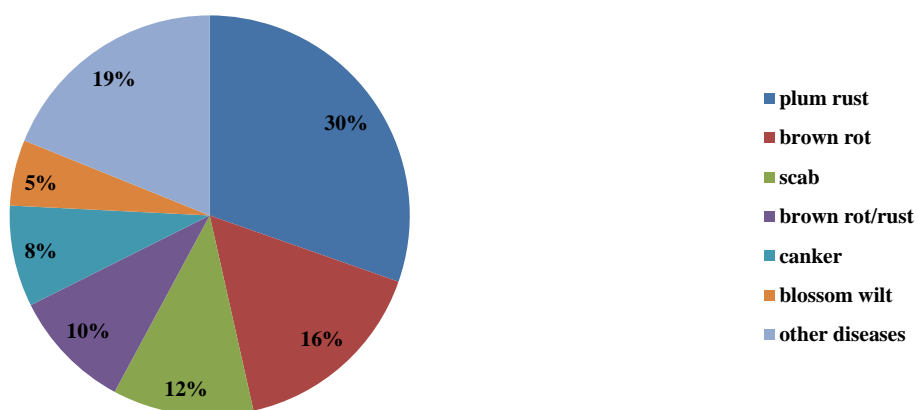


**Plums – Fungicides**

- **Formulation area treated: 3,455 hectares**
- **Weight of active substances applied: 1.4 tonnes**
- **The five most common formulations were:**

	Formulation area treated (ha)	Weight of a.s. applied (kg)	Proportion of fungicide-treated area	Proportion of area grown	Average number of applications (where applied)	Average proportion of maximum product label rate
Myclobutanil	1,072	94	0.26	0.40	2.94	0.77
Fenbuconazole	780	50	0.19	0.29	2.93	0.86
Fenhexamid	608	432	0.15	0.32	2.07	0.95
Copper oxychloride	488	686	0.12	0.26	2.07	0.46
Cyprodinil/fludioxonil	353	82	0.09	0.31	1.25	0.62

**Figure 45 - Plums - Reasons for use of fungicides (where given)**



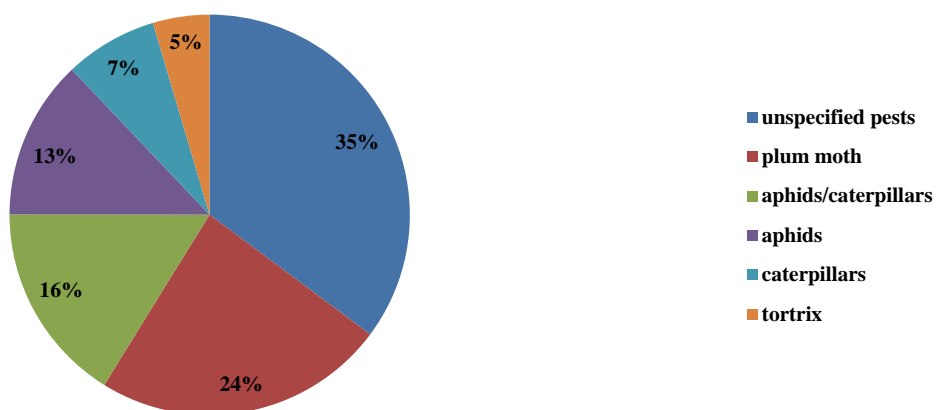


**Plums – Insecticides**

- **Formulation area treated: 2,246 hectares**
- **Weight of active substances applied: 0.9 tonnes**
- **The five most common formulations were:**

	Formulation area treated (ha)	Weight of a.s. applied (kg)	Proportion of insecticide – treated area	Proportion of area grown	Average number of applications (where applied)	Average proportion of maximum product label rate
Chlorpyrifos	1,237	791	0.55	0.52	2.63	0.67
Pirimicarb	245	61	0.11	0.21	1.31	0.95
Thiacloprid	205	28	0.09	0.21	1.09	0.96
Deltamethrin	181	3	0.08	0.17	1.17	volumetric
Diflubenzuron	175	25	0.08	0.11	1.79	1.01

**Figure 46 - Plums - Reasons for use of insecticides (where given)**



### *Plums – Herbicides*

- **Formulation area treated: 1,140 hectares**
- **Weight of active substances applied: 0.7 tonnes**
- **The five most common formulations were:**

	<b>Formulation area treated (ha)</b>	<b>Weight of a.s. applied (kg)</b>	<b>Proportion of herbicide – treated area</b>	<b>Proportion of area grown</b>	<b>Average number of applications (where applied)</b>	<b>Average proportion of maximum product label rate</b>
Glyphosate	579	411	0.51	0.44	1.46	0.77
Dicamba/MCPA/mecoprop-P	337	205	0.30	0.28	1.31	0.85
Amitrole	80	44	0.07	0.09	1.00	0.28
Glufosinate-ammonium	40	12	0.04	0.04	1.00	0.82
Pendimethalin	36	20	0.03	0.04	1.00	0.85

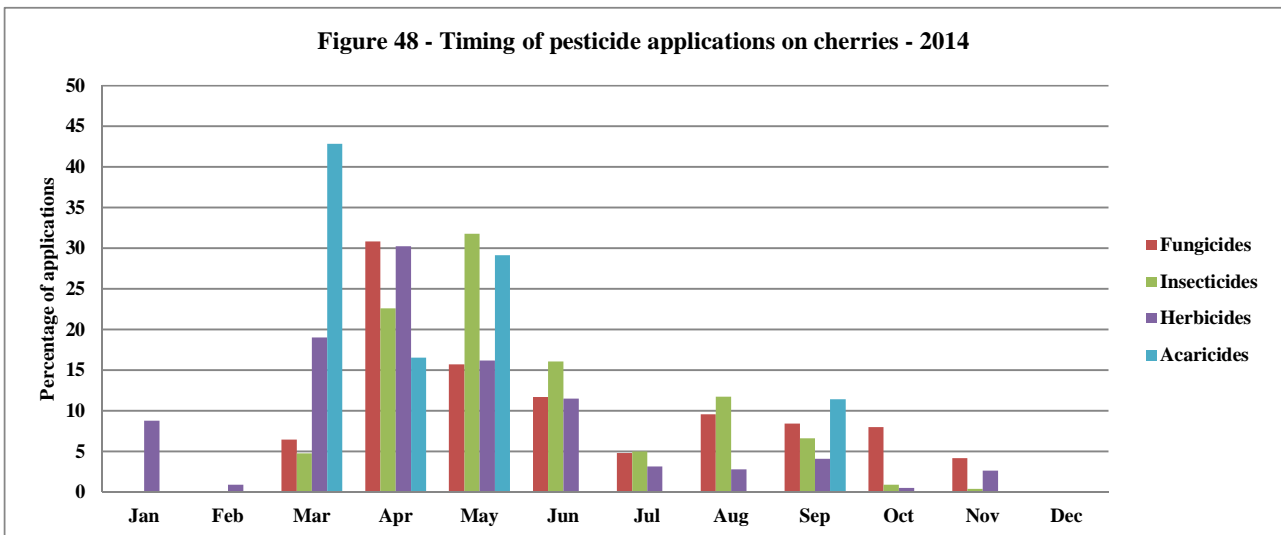
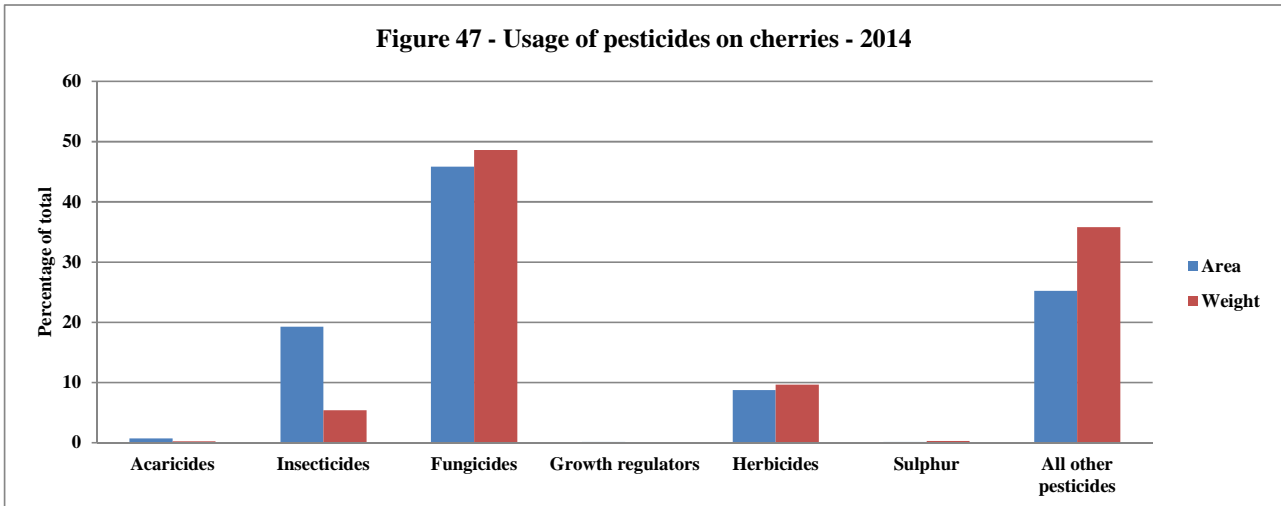
General weed control, 91%, and grass weed control were the only reasons specified for herbicide usage.

### *Plums – Other pesticides*

All other pesticide groups applied to plums accounted for 14% of the total treated area and included acaricides, urea and growth stimulants. Urea accounted for 7% of the area treated and the growth stimulant, harpin protein for 6%. In terms of weight applied urea accounted for 6% of the weight of all pesticides applied to plums.

## Cherries

- 832 hectares of cherries grown in the United Kingdom
- 15,562 treated hectares
- 9.6 tonnes applied
- 8.2% of cherries remained untreated
- Cherries received on average 11 fungicides, 5 insecticides, 2 herbicides and 2 growth stimulants

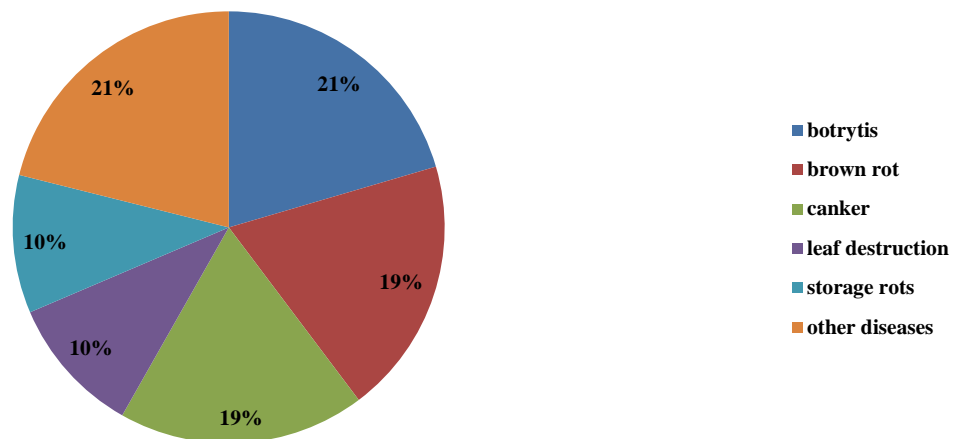


*Cherries – Fungicides*

- **Formulation area treated: 7,131 hectares**
- **Weight of active substances applied: 4.7 tonnes**
- **The five most common formulations were:**

	Formulation area treated (ha)	Weight of a.s. applied (kg)	Proportion of fungicide-treated area	Proportion of area grown	Average number of applications (where applied)	Average proportion of maximum product label rate
Copper oxychloride	2,273	3,235	0.24	0.77	3.53	0.69
Fenhexamid	1,390	859	0.15	0.66	2.52	0.82
Fenbuconazole	1,317	66	0.14	0.75	2.11	1.00
Boscalid/pyraclostrobin	1,031	255	0.11	0.66	1.89	0.99
Cyprodinil/fludioxonil	755	235	0.08	0.52	1.73	0.83

**Figure 49 - Cherries - Reasons for use of fungicides (where given)**

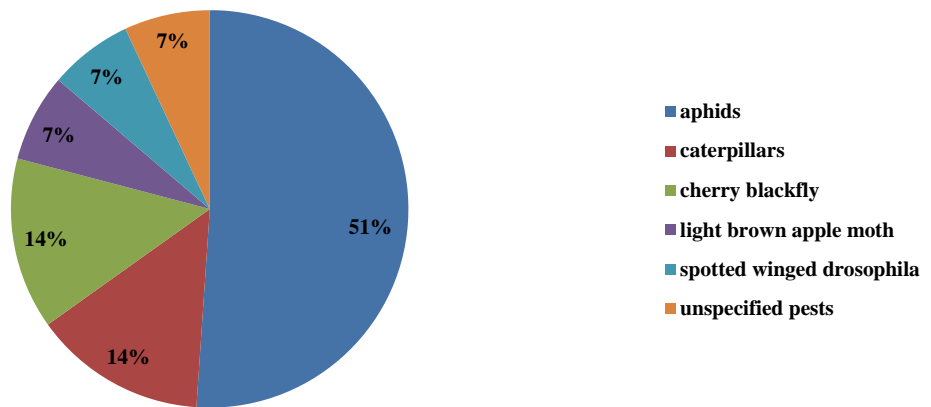


**Cherries – Insecticides**

- **Formulation area treated: 2,996 hectares**
- **Weight of active substances applied: 0.5 tonnes**
- **The five most common formulations were:**

	Formulation area treated (ha)	Weight of a.s. applied (kg)	Proportion of insecticide – treated area	Proportion of area grown	Average number of applications (where applied)	Average proportion of maximum product label rate
Pirimicarb	1,387	378	0.46	0.73	2.30	0.97
Indoxacarb	532	33	0.18	0.48	1.33	0.98
Thiacloprid	433	62	0.14	0.42	1.23	0.96
Spinosad	241	29	0.08	0.29	1.00	1.00
<i>Bacillus thuringiensis var. kurstaki</i>	112	3	0.04	0.11	1.28	1.00

**Figure 50 - Cherries - Reasons for use of insecticides (where given)**



### *Cherries – Herbicides*

- **Formulation area treated: 1,359 hectares**
- **Weight of active substances applied: 0.9 tonnes**
- **The five most common formulations were:**

	<b>Formulation area treated (ha)</b>	<b>Weight of a.s. applied (kg)</b>	<b>Proportion of herbicide – treated area</b>	<b>Proportion of area grown</b>	<b>Average number of applications (where applied)</b>	<b>Average proportion of maximum product label rate</b>
Glyphosate	605	460	0.45	0.50	1.45	0.78
Glufosinate-ammonium	283	92	0.21	0.26	1.30	0.77
Dicamba/MCPA/mecoprop-P	152	90	0.11	0.16	1.13	0.75
Amitrole	126	156	0.09	0.15	1.00	0.45
Pendimethalin	80	68	0.06	0.10	1.00	0.95

General weed control accounted for all herbicide applications.

### *Cherries – Other pesticides*

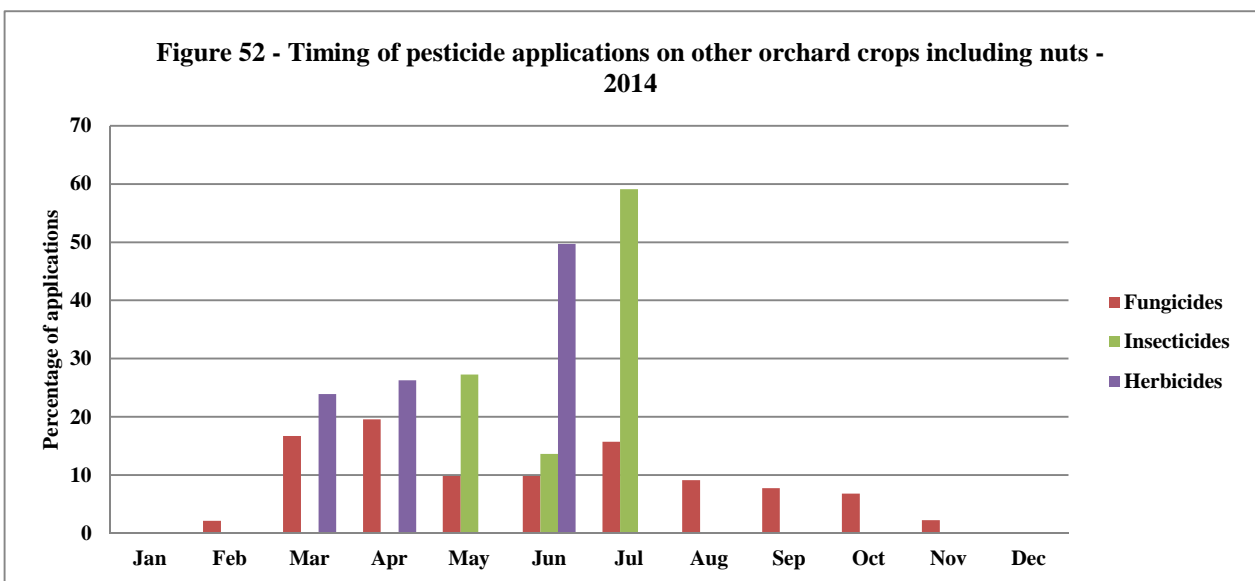
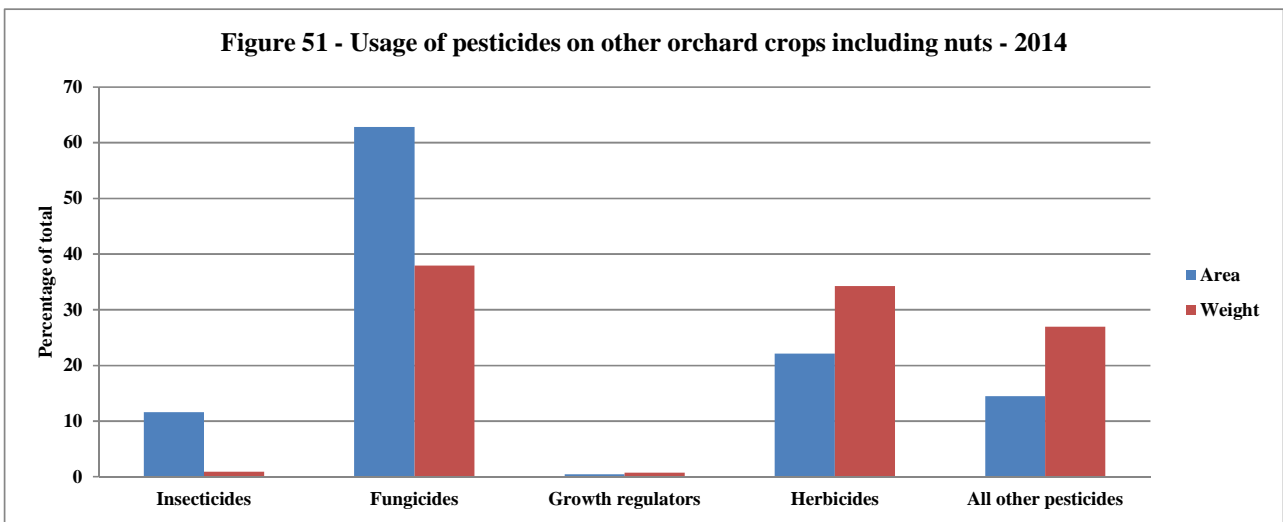
The growth stimulant harpin protein, used to prevent fruit split, accounted for 8% of the total area of cherries treated, but less than 1% of the weight applied.

The only other groups recorded were urea (15% of the area treated, 34% of the weight of all pesticides applied), biological controls and acaricides accounting for 1% of the total treated area.

*Neoseiulus cucumeris* and *Phytoseiulus persimilis* were the only biological control agents recorded on cherries.

**Other orchard crops including nuts**

- 526 hectares of other orchard crops including nuts grown in the United Kingdom
- 1,916 treated hectares
- 0.6 tonnes applied
- 49.2% of other orchard crops including nuts remained untreated
- Other orchard crops including nuts received on average 6 fungicides, 2 insecticides and 2 herbicides
- Other orchard crops included apricots, hazelnuts, medlar, mulberry, peaches, quinces and walnuts
- Inputs on other orchard crops including nuts varied widely, reflecting the diversity of fruit types included in this category



*Other orchard crops including nuts – Fungicides*

- **Formulation area treated: 1,080 hectares**
- **Weight of active substances applied: 0.2 tonnes**
- **The five most common formulations were:**

	Formulation area treated (ha)	Weight of a.s. applied (kg)	Proportion of fungicide - treated area	Proportion of area grown	Average number of applications (where applied)	Average proportion of maximum product label rate
Cyprodinil/fludioxonil	242	50	0.20	0.18	2.58	0.55
Myclobutanil	230	19	0.19	0.14	3.03	3.68
Copper oxychloride	196	43	0.16	0.05	6.95	1.00
Boscalid/pyraclostrobin	156	39	0.13	0.16	1.91	1.00
Tebuconazole	116	17	0.09	0.22	1.00	1.00

Most fungicide applications, 52%, were used to control scab, with 46% for mildew control.

*Other orchard crops including nuts – Herbicides*

- **Formulation area treated: 381 hectares**
- **Weight of active substances applied: 0.2 tonnes**
- **The four formulations encountered were:**

	Formulation area treated (ha)	Weight of a.s. applied (kg)	Proportion of herbicide-treated area	Proportion of area grown	Average number of applications (where applied)	Average proportion of maximum product label rate
Glyphosate	279	151	0.73	0.46	1.17	0.83
Dicamba/MCPA/mecoprop-P	68	52	0.18	0.13	1.00	0.81
Glufosinate-ammonium	28	10	0.07	0.05	1.00	0.80
Amitrole	6	5	0.02	0.01	1.00	0.50

*Other orchard crops including nuts – Insecticides*

- **Formulation area treated: 199 hectares**
- **Weight of active substances applied: <0.1 tonnes**
- **The four formulations encountered were:**

	Formulation area treated (ha)	Weight of a.s. applied (kg)	Proportion of insecticide - treated area	Proportion of area grown	Average number of applications (where applied)	Average proportion of maximum product label rate
Lambda-cyhalothrin	116	1	0.58	0.22	1.00	1.00
Pyrethrins	80	4	0.40	0.05	3.00	0.74
Chlorantraniliprole	2	<1	0.01	<0.01	1.00	1.00
Diflubenzuron	2	<1	0.01	<0.01	1.00	1.00

*Other orchard crops including nuts – Other pesticides*

The only other pesticides recorded on other orchard crops including nuts were urea and the growth stimulant harpin protein. Together they accounted for 14% of the area treated and 27% of the weight applied.



## APPENDIX 1 – FOLIAR APPLICATION TABLES

*Table 1 Area of orchard crops grown in the United Kingdom, 2014 (hectares)*

	East Midlands	Eastern	London & South East	North East	North West	South West	West Midlands	Yorkshire & the Humber	Wales	Scotland	Northern Ireland	United Kingdom
Dessert apples (Cox)	87	333	1,064	.	.	68	169	.	17	.	.	1,738
Dessert apples (others)	10	478	3,501	9	75	163	375	24	25	1	4	4,665
Culinary apples (Bramley)	173	447	1,388	.	9	5	230	.	9	1	1,639	3,901
Culinary apples (others)	.	46	.	.	.	18	.	.	53	.	9	126
Pears	1	265	1,370	3	.	24	64	6	16	.	2	1,751
Cider apples & perry pears	2	189	1	.	.	2,800	5,563	7	423	.	.	8,985
Plums	2	90	504	5	.	37	238	7	7	19	.	909
Cherries	1	12	553	.	.	27	185	2	3	49	.	832
Other orchard crops (incl. nuts)	.	53	388	4	.	25	.	35	21	.	.	526
All orchard crops	276	1,913	8,769	21	84	3,167	6,824	81	574	70	1,654	23,433

**Table 2 Treated area of orchard crops in the United Kingdom, 2014, by crop group (spray hectares)**

Chemical group	Dessert apples		Culinary apples		Pears	Cider apples & perry pears	Plums	Cherries	Other orchard crops (incl. nuts)	Total all orchard crops
	Cox	others	Bramley	Others						
Acaricides	71	261	247	.	1,166	81	5	113	.	1,943
Insecticides	9,589	23,688	13,411	65	5,033	13,925	2,246	2,996	199	71,151
Fungicides	47,744	144,117	87,352	420	27,846	76,786	3,455	7,131	1,080	395,932
Growth regulators	10,257	11,147	7,462	20	10,843	2,499	30	20	8	42,286
Herbicides	4,653	13,192	7,200	19	4,457	13,436	1,140	1,359	381	45,834
Sulphur	23	1,257	859	7	5,958	3,074	80	17	.	11,275
Biological controls	.	.	.	.	1,300	.	.	97	.	1,397
All other pesticides	5,060	14,464	6,886	.	6,361	6,685	1,090	3,829	248	44,624
All pesticides	77,397	208,126	123,417	531	62,964	116,485	8,045	15,562	1,916	614,442
Area grown	1,738	4,665	3,901	126	1,751	8,985	909	832	526	23,433

**Table 2a Treated weight of orchard crops in the United Kingdom, 2014, by crop group (kg a.s. applied)**

Chemical group	Dessert apples		Culinary apples		Pears	Cider apples & perry pears	Plums	Cherries	Other orchard crops (incl. nuts)	Total all orchard crops
	Cox	others	Bramley	Others						
Acaricides	10	32	34	.	159	10	<1	23	.	268
Insecticides	2,530	6,290	3,857	16	961	5,144	915	521	6	20,241
Fungicides	37,283	98,750	57,063	235	29,629	44,459	1,380	4,687	241	273,728
Growth regulators	497	550	567	2	228	86	6	2	5	1,941
Herbicides	2,698	7,339	3,900	9	2,696	4,755	709	933	218	23,256
Sulphur	78	2,781	1,567	24	13,140	8,937	135	25	.	26,687
Biological controls	.	.	.	.	.	.	.	.	.	.
All other pesticides	6,026	16,969	6,902	.	17,535	8,188	1,291	3,452	172	60,534
All pesticides	49,122	132,713	73,889	286	64,349	71,578	4,436	9,642	642	406,656

**Table 3 Usage of pesticides on orchard crops in the United Kingdom, 2014 - percentage area of crops treated with pesticides**

	<b>Insecticides</b>	<b>Acaricides</b>	<b>Biological control agents</b>	<b>Fungicides</b>	<b>Sulphur</b>	<b>Herbicides</b>	<b>Growth regulators</b>	<b>Urea</b>	<b>Not treated</b>
Dessert apples (Cox)	97.8	98.8	.	98.8	1.1	97.6	82.6	73.9	1.2
Dessert apples (others)	90.8	92.9	.	92.9	3.5	86.9	56.9	69.4	6.6
Culinary apples (Bramley)	83.5	95.8	.	95.8	8.0	71.7	54.7	37.5	4.0
Culinary apples (others)	21.4	24.1	.	24.1	2.8	7.0	8.7	.	75.9
Pears	83.2	89.2	25.4	89.2	64.2	89.6	76.1	53.1	3.8
Cider apples & perry pears	50.6	55.2	.	55.2	27	48.5	2.6	11	44.2
Plums	52.8	43.3	.	43.3	<0.1	40.7	2.9	9.4	45.4
Cherries	84.2	88.5	0.8	88.5	1.4	76.2	0.3	58.6	8.2
Other orchard crops (incl. nuts)	29.6	46.3	.	46.3	.	49.1	1.7	13.9	49.2
All crops	72.8	77.8	2.1	77.8	16.4	69.1	36.7	39.1	20.6

**Table 4a Usage of pesticides on orchard crops in the United Kingdom, 2014 – mean number of spray rounds applied to treated crops**

	<b>Insecticides</b>	<b>Acaricides</b>	<b>Biological control agents</b>	<b>Fungicides</b>	<b>Sulphur</b>	<b>Herbicides</b>	<b>Growth regulators</b>	<b>Urea</b>	<b>All pesticides</b>
Dessert apples (Cox)	5.5	1.1	.	17.4	2.5	2.2	6.3	4.8	21.4
Dessert apples (others)	5.2	1.1	.	17.9	5.1	2.0	4.2	5.3	21.2
Culinary apples (Bramley)	3.8	1.0	.	14.4	2.9	1.7	3.4	6.4	17.6
Culinary apples (others)	2.3	<0.1	.	10.2	2.0	1.7	1.5	.	12.8
Pears	3.3	1.1	2.9	14.8	4.6	1.9	8.3	6.3	21.0
Cider apples & perry pears	1.7	1.0	.	7.7	1.5	1.6	1.6	2	9.5
Plums	4.8	1.0	.	9.8	<0.1	1.7	1.2	5.7	14.2
Cherries	4.9	1.0	2.0	10.5	1.5	1.8	1.0	7.7	18.0
Other orchard crops (incl. nuts)	2.0	<0.1	.	6.4	.	1.6	1.0	2.5	8.0
All crops	4.6	1.1	2.9	15.2	3.8	1.9	5.0	5.7	19.2

**Table 4b Usage of pesticides on orchard crops in the United Kingdom, 2014 – mean number of products applied to treated crops**

	<b>Insecticides</b>	<b>Acaricides</b>	<b>Biological control agents</b>	<b>Fungicides</b>	<b>Sulphur</b>	<b>Herbicides</b>	<b>Growth regulators</b>	<b>Urea</b>	<b>All pesticides</b>
Dessert apples (Cox)	6.0	1.1	.	33.1	2.5	3.3	7.9	4.8	52.6
Dessert apples (others)	5.7	1.1	.	35.0	5.1	3.3	4.4	5.3	50.3
Culinary apples (Bramley)	4.1	1	.	25.0	2.9	2.7	3.7	6.4	35.7
Culinary apples (others)	2.7	.	.	17.0	2.0	2.0	1.5	.	21.8
Pears	3.4	1.1	2.9	19.4	4.6	3.1	9.2	6.3	43.4
Cider apples & perry pears	1.7	1	.	11.7	1.5	2.4	1.7	2	16.2
Plums	4.8	1	.	10.5	<0.1	2.4	1.2	5.7	19.4
Cherries	5.0	1	2.0	11.2	1.5	2.5	1.0	7.7	25.9
Other orchard crops (incl. nuts)	2.0	.	.	6.4	.	2.0	1.0	2.5	10.1
All crops	4.9	1.1	2.9	26.6	3.8	3.0	5.6	5.7	41.3

**Table 4c Usage of pesticides on orchard crops in the United Kingdom, 2014 – mean number of active substances applied to treated crops**

	<b>Insecticides</b>	<b>Acaricides</b>	<b>Biological control agents</b>	<b>Fungicides</b>	<b>Sulphur</b>	<b>Herbicides</b>	<b>Growth regulators</b>	<b>Urea</b>	<b>All pesticides</b>
Dessert apples (Cox)	6.0	1.1	.	34.9	2.5	5.5	7.9	4.8	56.6
Dessert apples (others)	5.7	1.1	.	37.2	5.1	5.4	4.4	5.3	54.6
Culinary apples (Bramley)	4.1	1.0	.	26.9	2.9	4.4	3.7	6.4	39.3
Culinary apples (others)	2.7	.	.	17.8	2.0	2.7	1.5	.	23.0
Pears	3.4	1.1	2.9	19.8	4.6	5.3	9.2	6.3	45.9
Cider apples & perry pears	1.7	1.0	.	12.8	1.5	4.0	1.7	2	18.5
Plums	4.8	1.0	.	12.2	<0.1	3.7	1.2	5.7	22.0
Cherries	5.0	1.0	2.0	13.8	1.5	3.5	1.0	7.7	29.4
Other orchard crops (incl. nuts)	2.0	.	.	8.6	.	2.9	1.0	2.5	12.8
All crops	4.9	1.1	2.9	28.5	3.8	4.9	5.6	5.7	44.9

**Table 5** *Estimated usage of pesticides on orchard crops grown in the United Kingdom, 2014 (spray hectares)*

	Dessert apples		Culinary apples		Pears	Cider apples & perry pears	Plums	Cherries	Other orchard crops (incl. nuts)	Total all orchard crops
	Cox	Others	Bramley	Others						
<i>Fungicides</i>										
Boscalid/pyraclostrobin	1,882	6,115	3,863	18	690	440	155	1,031	156	14,351
Bupirimate	1,492	3,063	844	4	83	2,141	.	.	.	7,626
Captan	10,887	33,356	15,845	26	13,446	7,402	.	.	12	80,973
Copper oxychloride <sup>1</sup>	1,712	12,233	1,920	52	1,661	779	488	2,273	196	21,313
Cyflufenamid	2,275	4,267	1,408	.	53	237	.	.	.	8,240
Cyprodinil/fludioxonil	34	319	683	.	234	.	353	755	242	2,621
Difenoconazole	2,235	7,310	3,914	6	1,604	5,629	.	.	.	20,698
Dithianon	3,994	13,383	11,502	126	2,835	8,579	.	.	24	40,443
Dithianon/pyraclostrobin	1,385	3,187	2,569	2	43	4,555	.	.	.	11,741
Dodine	2,396	5,700	7,003	33	1,981	22,843	.	.	6	39,962
Fenbuconazole	146	1,924	3,527	.	128	863	780	1,317	33	8,717
Fenhexamid	.	.	.	.	.	.	608	1,390	64	2,062
Kresoxim-methyl	1,735	3,966	1,969	4	15	1,319	.	.	.	9,007
Mancozeb	153	1,600	6,629	18	973	30	.	.	.	9,404
Meptyldinocap	1,474	2,514	1,100	2	7	307	.	.	.	5,405
Myclobutanil	5,331	14,918	8,840	91	1,756	12,013	1,072	329	230	44,580
Penconazole	6,333	16,802	7,448	2	59	8,167	.	.	.	38,811
Potassium hydrogen carbonate	1,652	2,730	438	.	.	.	.	.	.	4,819
Pyrimethanil	2,206	7,858	7,098	37	1,947	1,481	.	.	.	20,627
Tebuconazole	421	2,840	575	.	323	.	.	.	116	4,275
Other fungicides <sup>2</sup>	.	31	177	.	10	.	.	37	.	255
<b>All fungicides</b>	<b>47,744</b>	<b>144,117</b>	<b>87,352</b>	<b>420</b>	<b>27,846</b>	<b>76,786</b>	<b>3,455</b>	<b>7,131</b>	<b>1,080</b>	<b>395,932</b>
<i>Sulphur</i>	<b>23</b>	<b>1,257</b>	<b>859</b>	<b>7</b>	<b>5,958</b>	<b>3,074</b>	<b>80</b>	<b>17</b>	<b>.</b>	<b>11,275</b>
<i>Urea</i>	<b>5,008</b>	<b>14,304</b>	<b>6,858</b>	<b>.</b>	<b>5,372</b>	<b>6,685</b>	<b>589</b>	<b>2,275</b>	<b>152</b>	<b>41,244</b>

<sup>1</sup> Copper fungicides are also used for their bactericidal activity against bacterial canker in cherries and plums.

<sup>2</sup> Other fungicides include azoxystrobin, *Bacillus subtilis*, Bordeaux mixture, chlorine, copper sulphate, fludioxonil, flutriafol, iprodione and thiram.

Table 5 (cont.) Estimated usage of pesticides on orchard crops grown in the United Kingdom, 2014 (spray hectares)

	Dessert apples		Culinary apples		Pears	Cider apples & perry pears	Plums	Cherries	Other orchard crops (incl. nuts)	Total all orchard crops
	Cox	Others	Bramley	Others						
<i>Acaricides</i>										
Spirodiclofen	52	159	107	.	1,101	62	.	.	.	1,481
Other acaricides <sup>1</sup>	19	102	140	.	64	20	5	113	.	462
<b>All acaricides</b>	<b>71</b>	<b>261</b>	<b>247</b>	<b>.</b>	<b>1,166</b>	<b>81</b>	<b>5</b>	<b>113</b>	<b>.</b>	<b>1,943</b>
<i>Insecticides</i>										
Chlorantraniliprole	1,792	4,325	2,005	.	1,447	23	.	.	2	9,593
Chlorpyrifos	2,893	7,180	4,357	22	240	8,320	1,237	.	.	24,249
<i>Cydia pomonella</i> granulovirus	38	693	4	.	594	.	.	.	.	1,330
Cypermethrin	512	795	663	9	2	.	.	44	.	2,026
Flonicamid	1,526	4,359	2,149	.	74	25	68	5	.	8,206
Indoxacarb	436	808	850	16	88	1	.	532	.	2,731
Methoxyfenozide	1,070	2,761	1,749	.	942	2,478	.	.	.	9,000
Pirimicarb	86	279	433	.	276	9	245	1,387	.	2,716
Thiacloprid	1,051	2,161	1,011	18	305	3,069	205	433	.	8,252
Other insecticides <sup>2</sup>	184	327	190	.	1,065	.	490	596	197	3,049
<b>All insecticides</b>	<b>9,589</b>	<b>23,688</b>	<b>13,411</b>	<b>65</b>	<b>5,033</b>	<b>13,925</b>	<b>2,246</b>	<b>2,996</b>	<b>199</b>	<b>71,151</b>

<sup>1</sup> Other acaricides include abamectin, clofentezine, fenpyroximate and tebufenpyrad

<sup>2</sup> Other insecticides include acetamiprid, *Adoxophyes orana* gv strain bv-0001, *Bacillus thuringiensis* var. *kurstaki*, deltamethrin, diflubenzuron, dimethoate, fatty acids, fenoxycarb, lambda-cyhalothrin, polysaccharides, pyrethrins and spinosad.

**Table 5 (cont.)** *Estimated usage of pesticides on orchard crops grown in the United Kingdom, 2014 (spray hectares)*

	Dessert apples		Culinary apples		Pears	Cider apples & perry pears	Plums	Cherries	Other orchard crops (incl. nuts)	Total all orchard crops
	Cox	Others	Bramley	Others						
<i>Herbicides</i>										
2,4-D	119	628	295	.	198	1,506	6	.	.	2,752
Amitrole	281	656	242	.	187	77	80	126	6	1,655
Dicamba/MCPA/mecoprop-P	1,503	4,380	2,429	2	1,518	1,946	337	152	68	12,335
Glufosinate-ammonium	393	876	327	.	327	2,136	40	283	28	4,411
Glyphosate	2,201	5,768	3,524	16	1,949	7,200	579	605	279	22,121
Propyzamide	141	430	123	.	81	.	.	71	.	846
Other herbicides <sup>1</sup>	15	454	259	.	197	571	98	122	.	1,716
<b>All herbicides</b>	<b>4,653</b>	<b>13,192</b>	<b>7,200</b>	<b>19</b>	<b>4,457</b>	<b>13,436</b>	<b>1,140</b>	<b>1,359</b>	<b>381</b>	<b>45,834</b>

<sup>1</sup> Other herbicides include carfentrazone-ethyl, clopyralid, clopyralid/fluroxypyr/triclopyr, clopyralid/triclopyr, diquat, fluzifop-P-butyl, flufenacet/metribuzin, fluroxypyr, isoxaben, MCPA, mecoprop-P, oxadiazon, pendimethalin and unspecified herbicides.

Table 5 (cont.) Estimated usage of pesticides on orchard crops grown in the United Kingdom, 2014 (spray hectares)

	Dessert apples		Culinary apples		Pears	Cider apples & perry pears	Plums	Cherries	Other orchard crops (incl. nuts)	Total all orchard crops
	Cox	Others	Bramley	Others						
<b>Biological control agents</b>										
<i>Anthocoris</i> spp.	.	.	.	.	1,300	.	.	.	.	1,300
Other biological control agents <sup>1</sup>	.	.	.	.	.	.	.	97	.	97
<b>All biological control agents</b>	<b>.</b>	<b>.</b>	<b>.</b>	<b>.</b>	<b>1,300</b>	<b>.</b>	<b>.</b>	<b>97</b>	<b>.</b>	<b>1,397</b>
<b>Disinfectants</b>										
Other disinfectants <sup>2</sup>	50	135	28	.	.	.	.	316	.	530
<b>Growth regulators</b>										
6-benzyladenine	99	303	9	.	13	317	.	.	.	742
Gibberellins	4,305	4,110	1,576	.	7,211	2,030	3	17	.	19,252
Paclobutrazol	4,347	4,728	3,431	.	3,454	.	20	2	8	15,990
Prohexadione-calcium	1,506	1,877	2,422	20	154	109	.	.	.	6,089
Other growth regulators <sup>3</sup>	.	128	24	.	11	43	7	.	.	213
<b>All growth regulators</b>	<b>10,257</b>	<b>11,147</b>	<b>7,462</b>	<b>20</b>	<b>10,843</b>	<b>2,499</b>	<b>30</b>	<b>20</b>	<b>8</b>	<b>42,286</b>
<b>Growth stimulants</b>										
Harpin protein	.	19	.	.	111	.	502	1,238	96	1,965
<b>Physical controls</b>										
Other physical controls <sup>4</sup>	2	5	.	.	.	.	.	.	.	6
<b>Repellents</b>										
Kaolin	.	1	.	.	877	.	.	.	.	879

<sup>1</sup> Other biological control agents were *Neoseiulus cucumeris* and *Phytoseiulus persimilis*

<sup>2</sup> Other disinfectants were hydrogen peroxide, peroxyacetic acid and sodium hypochlorite.

<sup>3</sup> Other growth regulators were 1-naphthylacetic acid, 2-chloroethylphosphonic acid and gibberellic acid.

<sup>4</sup> Other physical control agents were maltodextrin.



**Table 6** *Estimated usage of pesticides on orchard crops grown in the United Kingdom, 2014 (kg of active substance)*

	Dessert apples		Culinary apples		Pears	Cider apples & perry pears	Plums	Cherries	Other orchard crops (incl. nuts)	Total all orchard crops
	Cox	Others	Bramley	Others						
<b>Fungicides</b>										
Boscalid/pyraclostrobin	555	1,842	1,135	6	206	127	37	255	39	4,201
Bupirimate	138	358	79	<1	12	152	.	.	.	740
Captan	15,764	50,115	21,924	40	21,801	12,303	.	.	10	121,957
Copper oxychloride <sup>1</sup>	2,001	9,369	2,442	9	1,820	1,272	686	3,235	43	20,877
Cyflufenamid	55	105	35	.	1	5	.	.	.	202
Cyprodinil/fludioxonil	17	152	298	.	117	.	82	235	50	952
Difenoconazole	109	358	194	<1	79	248	.	.	.	990
Dithianon	2,447	7,674	6,595	101	1,882	5,180	.	.	12	23,892
Dithianon/pyraclostrobin	517	1,254	973	1	17	1,772	.	.	.	4,534
Dodine	2,042	4,706	6,009	29	1,694	21,268	.	.	3	35,749
Fenbuconazole	8	98	179	.	7	46	50	66	1	455
Fenhexamid	.	.	.	.	.	.	432	859	46	1,337
Kresoxim-methyl	173	395	194	<1	1	132	.	.	.	896
Mancozeb	222	2,488	10,512	28	1,264	62	.	.	.	14,576
Meptyldinocap	300	523	230	<1	1	64	.	.	.	1,119
Myclobutanil	334	911	580	6	93	1,046	94	29	19	3,113
Penconazole	246	648	290	<1	3	390	.	.	.	1,578
Potassium hydrogen carbonate	11,641	14,959	2,918	.	.	.	.	.	.	29,519
Pyrimethanil	648	2,356	2,297	14	559	391	.	.	.	6,266
Tebuconazole	65	433	86	.	46	.	.	.	17	646
Other fungicides <sup>2</sup>	.	6	93	.	23	.	.	9	.	131
<b>All fungicides</b>	<b>37,283</b>	<b>98,750</b>	<b>57,063</b>	<b>235</b>	<b>29,629</b>	<b>44,459</b>	<b>1,380</b>	<b>4,687</b>	<b>241</b>	<b>273,728</b>
<b>Sulphur</b>	<b>78</b>	<b>2,781</b>	<b>1,567</b>	<b>24</b>	<b>13,140</b>	<b>8,937</b>	<b>135</b>	<b>25</b>	<b>.</b>	<b>26,687</b>
<b>Urea</b>	<b>5,998</b>	<b>16,892</b>	<b>6,887</b>	<b>.</b>	<b>7,116</b>	<b>8,188</b>	<b>1,289</b>	<b>3,243</b>	<b>168</b>	<b>49,782</b>

<sup>1</sup> Copper fungicides are also used for their bactericidal activity against bacterial canker in cherries and plums.

<sup>2</sup> Other fungicides include azoxystrobin, *Bacillus subtilis*, Bordeaux mixture, chlorine, copper sulphate, fludioxonil, flutriafol, iprodione and thiram.

**Table 6 (cont.)** *Estimated usage of pesticides on orchard crops grown in the United Kingdom, 2014 (kg of active substance)*

	Dessert apples		Culinary apples		Pears	Cider apples & perry pears	Plums	Cherries	Other orchard crops (incl. nuts)	Total all orchard crops
	Cox	Others	Bramley	Others						
<i>Acaricides</i>										
Spirodiclofen	7	21	14	.	158	8	.	.	.	207
Other acaricides <sup>1</sup>	4	11	20	.	1	2	<1	23	.	61
<b>All acaricides</b>	<b>10</b>	<b>32</b>	<b>34</b>	<b>.</b>	<b>159</b>	<b>10</b>	<b>&lt;1</b>	<b>23</b>	<b>.</b>	<b>268</b>
<i>Insecticides</i>										
Chlorantraniliprole	62	150	70	.	50	<1	.	.	<1	333
Chlorpyrifos	1,983	4,906	3,081	11	168	4,403	791	.	.	15,343
<i>Cydia pomonella</i> granulovirus	<1	10	.<1	.	2	.	.	.	.	11
Cypermethrin	13	21	16	<1	<1	.	.	1	.	52
Flonicamid	107	304	149	.	5	2	5	<1	.	572
Indoxacarb	30	58	57	1	7	<1	.	33	.	186
Methoxyfenozone	131	360	235	.	128	352	.	.	.	1,205
Pirimicarb	24	76	77	.	58	1	61	378	.	675
Thiacloprid	160	347	154	3	52	386	28	62	.	1,192
Other insecticides <sup>2</sup>	20	60	18	.	492	.	30	46	6	671
<b>All insecticides</b>	<b>2,530</b>	<b>6,290</b>	<b>3,857</b>	<b>16</b>	<b>961</b>	<b>5,144</b>	<b>915</b>	<b>521</b>	<b>6</b>	<b>20,241</b>

<sup>1</sup> Other acaricides include abamectin, clofentezine, fenpyroximate and tebufenpyrad.

<sup>2</sup> Other insecticides include acetamiprid, *Adoxophyes orana* gv strain bv-0001, *Bacillus thuringiensis* var. *kurstaki*, deltamethrin, diflubenzuron, dimethoate, fatty acids, fenoxycarb, lambda-cyhalothrin, polysaccharides, pyrethrins and spinosad.

**Table 6 (cont.)** *Estimated usage of pesticides on orchard crops grown in the United Kingdom, 2014 (kg of active substance)*

	Dessert apples		Culinary apples		Pears	Cider apples & perry pears	Plums	Cherries	Other orchard crops (incl. nuts)	Total all orchard crops
	Cox	Others	Bramley	Others						
<b>Herbicides</b>										
2,4-D	41	269	146	.	128	670	4	.	.	1,258
Amitrole	131	286	107	.	103	10	44	156	5	843
Dicamba/MCPA/mecoprop-P	908	2,539	1,344	1	927	555	205	90	52	6,622
Glufosinate-ammonium	114	202	101	.	79	489	12	92	10	1,100
Glyphosate	1,424	3,735	2,036	8	1,379	2,901	411	460	151	12,505
Propyzamide	75	194	37	.	36	.	.	57	.	400
Other herbicides <sup>1</sup>	5	115	128	.	43	128	33	77	.	529
<b>All herbicides</b>	<b>2,698</b>	<b>7,339</b>	<b>3,900</b>	<b>9</b>	<b>2,696</b>	<b>4,755</b>	<b>709</b>	<b>933</b>	<b>218</b>	<b>23,256</b>

<sup>1</sup> Other herbicides include carfentrazone-ethyl, clopyralid, clopyralid/fluroxypyr/triclopyr, clopyralid/triclopyr, diquat, fluzifop-P-butyl, flufenacet/metribuzin, fluroxypyr, isoxaben, MCPA, mecoprop-P, oxadiazon, pendimethalin and unspecified herbicides.

**Table 6 (cont.)** *Estimated usage of pesticides on orchard crops grown in the United Kingdom, 2014 (kg of active substance)*

	Dessert apples		Culinary apples		Pears	Cider apples & perry pears	Plums	Cherries	Other orchard crops (incl. nuts)	Total all orchard crops
	Cox	Others	Bramley	Others						
<i>Disinfectants</i>										
Other disinfectants <sup>1</sup>	26	71	15	.	.	.	.	165	.	276
<i>Growth regulators</i>										
6-benzyladenine	10	37	1	.	2	45	.	.	.	95
Gibberellins	13	9	5	.	24	10	<1	<1	.	62
Paclobutrazol	325	323	318	.	190	.	5	1	5	1,166
Prohexadione-calcium	150	160	243	2	12	11	.	.	.	577
Other growth regulators <sup>2</sup>	.	20	<1	.	<1	19	1	.	.	40
<b>All growth regulators</b>	<b>497</b>	<b>550</b>	<b>567</b>	<b>2</b>	<b>228</b>	<b>86</b>	<b>6</b>	<b>2</b>	<b>5</b>	<b>1,941</b>
<i>Growth stimulants</i>										
Harpin protein	.	3	.	.	<1	.	2	44	3	53
<i>Physical controls</i>										
Other physical controls <sup>3</sup>	1	3	.	.	.	.	.	.	.	4
<i>Repellents</i>										
Kaolin	.	1	.	.	10,418	.	.	.	.	10,420

<sup>1</sup> Other disinfectants were hydrogen peroxide, peroxyacetic acid and sodium hypochlorite.

<sup>2</sup> Other growth regulators were 1-naphthylacetic acid, 2-chloroethylphosphonic acid and gibberellic acid.

<sup>3</sup> Other physical controls were maltodextrin.

**Table 7** Estimated area (ha) of application of the fifty most extensively used active substances on all orchard crops surveyed in 2014 in the United Kingdom (individual active substance data was not available from the 2012 Scotland survey)

	Active substance	Area treated 2014 (ha)	Area treated 2012 (ha)	% change on 2012	Movement	
1	Captan	80,973	91,309	-11		↓
2	Dithianon	52,185	56,376	-7		↓
3	Myclobutanil	44,580	52,091	-14		↓
4	Urea	41,244	25,090	64	↑	
5	Dodine	39,962	27,978	43	↑	
6	Penconazole	38,811	35,477	9	↑	
7	Pyraclostrobin	26,093	27,654	-6		↓
8	Chlorpyrifos	24,249	22,635	7	↑	
9	Glyphosate	22,121	22,050	<1	↑	
10	Copper oxychloride	21,313	17,398	23	↑	
11	Difenoconazole	20,698	136	15,139	↑	
12	Pyrimethanil	20,627	27,874	-26		↓
13	Gibberellins	19,252	22,413	-14		↓
14	Pacllobutrazol	15,990	15,037	6	↑	
15	Boscalid	14,351	13,486	6	↑	
16	MCPA	12,489	10,330	21	↑	
17	Mecoprop-P	12,391	10,208	21	↑	
18	Dicamba	12,335	9,480	30	↑	
19	Sulphur	11,275	11,929	-5		↓
20	Chlorantraniliprole	9,593	6,910	39	↑	
21	Mancozeb	9,404	10,738	-12		↓
22	Kresoxim-methyl	9,007	7,001	29	↑	
23	Methoxyfenozide	9,000	4,465	102	↑	
24	Fenbuconazole	8,717	19,984	-56		↓
25	Thiacloprid	8,252	8,055	2	↑	
26	Cyflufenamid	8,240	8,381	-2		↓
27	Flonicamid	8,206	5,262	56	↑	
28	Bupirimate	7,626	6,527	17	↑	
29	Prohexadione-calcium	6,089	5,668	7	↑	
30	Meptyldinocap	5,405	4,919	10	↑	
31	Potassium hydrogen carbonate	4,819	9,558	-50		↓
32	Glufosinate-ammonium	4,411	6,795	-35		↓
33	Tebuconazole	4,275	5,009	-15		↓
34	2,4-D	2,752	2,834	-3		↓
35	Indoxacarb	2,731	3,992	-32		↓
36	Pirimicarb	2,716	2,713	<1	↑	
37	Fludioxonil	2,674	1,804	48	↑	
38	Cyprodinil	2,621	1,804	45	↑	
39	Fenhexamid	2,062	2,175	-5		↓
40	Cypermethrin	2,026	2,913	-30		↓
41	Harpin protein	1,965	1,879	5	↑	
42	Amitrole	1,655	1,540	7	↑	
43	Spirodiclofen	1,481	1,093	36	↑	
44	Cydia pomonella granulovirus	1,330	373	256	↑	
45	<i>Anthracorhis</i> spp.	1,300	90	1,344	↑	
46	Kaolin	879	939	-6		↓
47	Propyzamide	846	1,166	-27		↓
48	Fenoxycarb	604	3,684	-84		↓
49	6-benzylaminopurine	569	152	274	↑	
50	Clopyralid	438	50	783	↑	

**Table 8** Estimated amount (kg) of the fifty most extensively used active substances on all orchard crops surveyed in 2014 in the United Kingdom (individual active substance data was not available from the 2012 Scotland survey)

	Active substance	Amount used 2014 (kg)	Amount used 2012 (kg)	% change on 2012	Movement	
1	Captan	121,957	129,617	-6		↓
2	Urea	49,782	38,859	28	↑	
3	Dodine	35,749	22,123	62	↑	
4	Potassium hydrogen carbonate	29,519	47,697	-38		↓
5	Sulphur	26,687	32,483	-18		↓
6	Dithianon	25,026	26,459	-5		↓
7	Copper oxychloride	20,877	14,361	45	↑	
8	Chlorpyrifos	15,343	13,909	10	↑	
9	Mancozeb	14,576	16,977	-14		↓
10	Glyphosate	12,505	12,309	2	↑	
11	Kaolin	10,420	13,232	-21		↓
12	Pyrimethanil	6,266	8,151	-23		↓
13	MCPA	5,506	5,043	9	↑	
14	Pyraclostrobin	4,771	5,216	-9		↓
15	Myclobutanil	3,113	3,235	-4		↓
16	Boscalid	2,831	2,645	7	↑	
17	Penconazole	1,578	1,405	12	↑	
18	Fenhexamid	1,337	1,423	-6		↓
19	2,4-D	1,258	1,111	13	↑	
20	Methoxyfenozone	1,205	484	149	↑	
21	Thiacloprid	1,192	1,068	12	↑	
22	Paclobutrazol	1,166	1,169	<1	↑	
23	Meptyldinocap	1,119	993	13	↑	
24	Glufosinate-ammonium	1,100	1,622	-32		↓
25	Difenoconazole	990	11	8,637	↑	
26	Mecoprop-P	899	925	-3		↓
27	Kresoxim-methyl	896	716	25	↑	
28	Amitrole	843	1,389	-39		↓
29	Bupirimate	740	649	14	↑	
30	Pirimicarb	675	728	-7		↓
31	Tebuconazole	646	757	-15		↓
32	Prohexadione-calcium	577	562	3	↑	
33	Flonicamid	572	371	54	↑	
34	Cyprodinil	571	485	18	↑	
35	Fenbuconazole	455	999	-54		↓
36	Propyzamide	400	564	-29		↓
37	Fludioxonil	392	323	21	↑	
38	Chlorantraniliprole	333	241	38	↑	
39	Dicamba	327	292	12	↑	
40	Polysaccharides	307	24	1,199	↑	
41	Spirodiclofen	207	150	38	↑	
42	Cyflufenamid	202	202	.		
43	Pendimethalin	197	609	-68		↓
44	Indoxacarb	186	277	-33		↓
45	Fatty acids	168	216	-22		↓
46	Sodium hypochlorite	112	442	-75		↓
47	Thiram	94	887	-89		↓
48	Peroxyacetic acid	92	25	273	↑	
49	Oxadiazon	84	164	-49		↓
50	6-benzylaminopurine	76	18	330	↑	

**Table 9 New or newly encountered compounds encountered on all orchard crops in the United Kingdom between 2012 & 2014**

	Active substance	Area treated 2014 (ha)	Amount used 2014 (kg)
1	Hydrogen peroxide	119	73
2	1-naphthylacetic acid	102	1
3	<i>Neoseiulus cucumeris</i>	48	.
4	<i>Adoxophyes orana</i> gv strain bv-0001	40	3
5	Bordeaux mixture	34	5
6	Dimethoate	30	3
7	Chlorine	26	1
8	Flutriafol	16	1
9	Metribuzin	6	1
10	Flufenacet	6	2

**Table 10 Major increases in the use of individual active substances on all orchard crops in the United Kingdom since 2012 (area treated)**

	Active substance	Area treated 2014 (ha)	Area treated 2012 (ha)	% change on 2012
1	Difenoconazole	20,698	136	15,139
2	Triclopyr	312	4	7,194
3	<i>Anthocoris</i> spp.	1,300	90	1,344
4	Polysaccharides	190	16	1,109
5	Peroxyacetic acid	197	17	1,051
6	Clopyralid	438	50	783
7	6-benzylaminopurine	569	152	274
8	<i>Cydia pomonella</i> granulovirus	1,330	373	256
9	Acetamiprid	86	26	233
10	Methoxyfenozide	9,000	4,465	102
11	Lambda-cyhalothrin	328	199	65
12	Urea	41,244	25,090	64
13	<i>Bacillus subtilis</i>	5	3	63
14	Fonicamid	8,206	5,262	56
15	Fludioxonil	2,674	1,804	48
16	Cyprodinil	2,621	1,804	45
17	Dodine	39,962	27,978	43
18	Chlorantraniliprole	9,593	6,910	39
19	6-benzyladenine	173	125	38
20	Spirodiclofen	1,481	1,093	36

**Table 11 Major decreases in the use of individual active substances on all orchard crops in the United Kingdom since 2012 (area treated)**

	Active substance	Area treated 2014 (ha)	Area treated 2012 (ha)	% change on 2012
1	Maltodextrin	6	57	-89
2	Thiram	54	473	-89
3	Fenpyroximate	11	87	-87
4	Fenoxycarb	604	3,684	-84
5	Copper sulphate	60	260	-77
6	Abamectin	64	254	-75
7	Pendimethalin	302	1,168	-74
8	Fatty acids	172	446	-61
9	Carfentrazone-ethyl	15	38	-61
10	Fenbuconazole	8,717	19,984	-56
11	Tebufenpyrad	148	316	-53
12	Isoxaben	20	40	-51
13	Potassium hydrogen carbonate	4,819	9,558	-50
14	Gibberellic acid	11	22	-49
15	<i>Phytoseiulus persimilis</i>	48	93	-48
16	2-chloroethylphosphonic acid	100	173	-42
17	Diiflubenzuron	396	667	-41
18	Glufosinate-ammonium	4,411	6,795	-35
19	Spinosad	271	413	-34
20	Indoxacarb	2,731	3,992	-32
20	Clofentezine	242	251	-3

**Table 12 Comparison of pesticide usage on all orchard crops in the United Kingdom, 2008 - 2014, area treated (ha) and amount used (t)**

Chemical	2008 <sup>1</sup>		2012 <sup>2</sup>		2014	
	ha	t	ha	t	ha	t
Acaricides	1,998	<1	2,087	<1	1,943	<1
Insecticides	50,262	15	63,919	18	71,151	20
Biological control agents	39	.	4,520	.	1,397	.
Fungicides	276,530	205	402,792	295	395,932	274
Sulphur	8,171	19	11,929	32	11,275	27
Growth regulators	33,397	1	43,590	2	42,286	2
Herbicides	41,656	18	46,635	24	45,834	23
Repellents	14	<1	939	13	879	10
Urea	18,050	23	21,301	30	41,244	50
Other pesticides	1,865	4	2,295	1	2,502	<1
Total - all pesticides	431,982	285	600,006	407	614,442	407
Area grown (ha)	20,787		22,458		23,433	

<sup>1</sup>Data for 2008 excludes information from Scotland and Northern Ireland

<sup>2</sup>Data for 2012 excludes information from Scotland



## APPENDIX 2 – DEFINITIONS

- a) 'Pesticide' is used throughout this report to include commercial formulations containing active substances of insecticides, acaricides, molluscicides, fungicides, herbicides, desiccants, soil sterilants, nematocides, and growth regulators.
- b) 'Treated area' is the gross area treated with a pesticide, including all repeat applications. For Tables 7 – 11 this includes repeat applications of individual active substances. All other figures relate to the areas treated with each product, which may include a single or multiple active substances.
- c) 'Reason for application' indicated in the text is the grower's stated reason for use of that particular pesticide on that crop and may not always seem entirely appropriate.
- d) Where individual pesticides are mentioned in the text, they are listed in descending order of use by hectares treated.
- e) The term “formulation(s)” used within the text is used here to describe either single active substances or mixtures of active substances contained within an individual **product**. It does not refer to any of the solvents, pH modifiers, adjuvants also contained within a product that contribute to its efficacy.
- f) For the purposes of this survey the total area of orchard crops was taken as the sum of the areas of the following crops: dessert apples (Cox), dessert apples (others), culinary apples (Bramley), culinary apples (others), pears, cider apples & perry pears, plums, cherries and other orchard crops (including nuts).
- g) Where indicated in the report “Cox” refers to “Cox’s Orange Pippin” and “Bramley” refers to “Bramley’s Seedling”.
- h) Where referred to as a pesticide group, other “pesticides” includes urea, physical control agents, growth stimulants, repellents and disinfectants.
- i) Volumetric rates – some products are applied using a standard dilution rate in a set volume of water. As growers’ water volume rates/hectare vary it is not possible to compare the actual rates with a pre-set maximum product rate.
- j) Pesticide applications include those applied prior to planting, or in some cases to crops that failed and were subsequently re-planted, and as these are associated with that crop they may appear as inappropriate uses.
- k) Where highlighted in the text the amount of active substance is calculated from the weight of product applied per hectare multiplied by the proportion of each individual active substance within a product. Arthropod biological control agents are applied by number rather than weight, so the weight of biological control agents refers only to preparations of bacterial and fungal origin.
- l) Non-registered pesticides, including biological control agents, are those that do not require to be and have not been put through, HSE’s pesticide approval process. They include macro-biological control agents such as predatory mites and parasitic wasps, physical control agents and disinfectants used for general cleansing and disinfection which are subject to the biocidal products regime.
- m) Physical control agents, such as maltodextrin, which is based on potato starch, work by blocking insect spiracles, causing death by suffocation. Other physical control agents include garlic, which repels and prevents insect pests landing on the crop.
- n) Products based on copper, commonly copper oxychloride, whilst listed as fungicides and used as fungicides on apple for canker control also have bactericidal activity on crops such as plums and cherries.
- o) Within this report herbicide usage consists primarily of applications made to a strip at the base of the trees in order to keep the area clear of weeds. The areas reported for herbicide usage are the full orchard area. However, the reported weight of herbicides applied takes into account the proportion of treated strip within each orchard and reflects the actual weight of herbicides used.

## APPENDIX 3 – METHODOLOGY

### METHODS

The samples of holdings to be surveyed were selected using data from the Agricultural Census Returns, June 2013 for England & Wales (Anon., 2014a, 2014b), for Scotland (Anon., 2014c) and Northern Ireland (Anon, 2014d).

The samples were drawn from the census returns so as to represent the area of all orchard crops grown throughout England, Scotland, Wales and Northern Ireland. For England the sample was selected within each of the eight Government Office Regions (GOR's), the Welsh Assembly Government provided a further sample, which represented the area grown in Wales, and for Scotland the country was divided into 11 land-use regions (Wood, 1931).

As part of the Long Term Service Agreement with Defra, there is a requirement for an overall maximum of 5% Relative Standard Error (RSE) by area treated for all of the surveys conducted by the survey team. In the 2012 survey (the last time orchard crops were surveyed), the RSE was 4.2%. As the RSE were so close to the overall target of 5% it was not felt necessary to reduce the sample size for the 2014 survey.

The samples were stratified according to the total area of all orchard crops grown in each region and by size group based on the total area of orchard crops grown on each holding. The area of orchard crops sampled in each size group and each region was proportional to the total area of orchard crops grown on holdings of each size group in each region. All three survey teams followed the same methodology for data collection and used the same forms and instructions for their completion. The size groups, based on the total orchard area are as follows: <10ha (A); >10-<=20 ha (B); >20-<=30 ha (C); >30-<=80 ha (D); and >80 ha (E).

For the purposes of this survey the total area of orchard crops was taken as the sum of the areas of the following crops: dessert apples (Cox), dessert apples (others), culinary apples (Bramley), culinary apples (others), pears, cider apples & perry pears, plums, cherries and other orchard crops (including nuts).

An introductory letter was sent to the occupiers of the selected holdings explaining the purpose of the survey. A total of 283 holdings were surveyed during the winter of 2014/15 and data collected from the grower by an experienced pesticide usage surveyor. Where a holding listed in the original sample was not able to provide data it was replaced with another from the same size group and region, held on a reserve list.

Within England and Wales a total of 306 holdings were contacted, of which 19 (6%) were not growing orchard crops commercially. Of the 287 premises growing orchard crops, 2 (1%) were unwilling to help with the survey; a further 58 (20%) either provided data after the deadline or were willing to help at a later date. A total of 210 orchard premises in the United Kingdom provided farm assurance data for the survey and of these 16 (8%) were registered organic on all or part of their holding.

Commercial farm management software and in-house electronic record keeping systems are now used extensively within many areas of agriculture and horticulture. Electronic record keeping was used by 33% of the holdings contacted in England & Wales, with these records accounting for 55% of the total area of orchards grown and 73% of the total area treated. Of those using electronic record keeping 83% used commercial farm management software systems with the remaining 17% using in-house computer systems developed by the growers themselves.

Where possible, and in order to minimise the burden on individual growers, pesticide usage data were emailed or posted by the growers back to the survey teams. In a few cases, and normally on smaller holdings, information was collected over the telephone. In total, data from 56% of the number of holdings in England & Wales were collected using non-visit methodologies, which together accounted for 51% of the area grown.

One of the requirements placed on growers by their customers is the membership of farm assurance schemes. These schemes require detailed pesticide records (computer based or hand written) which ensure traceability and can be examined by crop assurance auditors at any time, but normally at least once each year. These records are used extensively by members of the survey team. Of the 210 holdings visited in the United Kingdom where assurance information was available, 62% were members of one or more crop assurance schemes, including those who supplied direct to cider manufacturers with their own protocols in place. However, in terms of area grown, membership of a crop assurance scheme or grower group on these farms accounted for 88% of the total area surveyed.

## **The Questionnaire**

The questionnaire for the main part of the survey consisted of two forms, which were completed during an interview with the grower.

Form 1 summarised the areas of orchard crops grown on the designated holding during the 2013/2014 season.

Form 2 dealt with all aspects of pesticide usage on the individual crops grown on the holding and harvested in 2014, a separate form being used for each field/crop combination. These included pesticides applied prior to planting, or in some cases to crops that failed and were subsequently re-planted; as these are associated with that crop they may appear as inappropriate uses. Certain agronomic details that may have influenced pesticide usage (including inter-row and tree base percentages, tree type, orchard management, planting & harvest times, fruit storage, use of adjuvants and the volume of spray applied) were also recorded on form 2.

### ***Raising factors***

The pesticide usage data collected from each holding were raised by a ratio of two factors to give an estimate of regional usage using a standard ratio raising statistical technique; the first factor being dependent on farm size group and region (see Appendix 5) and the second dependent on crop area and region. The data were further adjusted by a third factor to compensate for regions in which specific crops were not sampled and to make estimates of total pesticide usage related to the national cropping areas in the United Kingdom (Thomas, 1999).

The raising factors were based on the areas of orchard crops grown and harvested in 2014 as recorded in the June Survey of Agriculture and Horticulture for England & Wales (Anon., 2015a, b), Scotland (Anon., 2015c) and Northern Ireland (Anon., 2015d). These, combined with data from the Basic Horticultural Statistics (Anon., 2015e), allowed accurate estimates of the total area of individual orchard crops grown in the United Kingdom in 2014 to be made.

Whilst we have confidence in the methodologies used for the pesticide usage surveys and the data collected from individual farmers and growers (see Appendix 4), the raised estimates for individual crops will be subject to higher standard errors simply because available data on National and Regional areas for individual crops is much more limited. Where possible the survey team will use data collected as part of the June Survey to make estimates of national & regional pesticide usage as this survey is subject to the same strict methodologies as our own. However, where these estimates are not available then other sources of data such as the Basic Horticultural Statistics (BHS) or a combination of June Survey data and our own observations will be used and these data may therefore be associated with a higher standard error.

Neither the June Survey nor the BHS data make regional estimates of individual orchard crops; these data therefore have to be estimated using a combination of our first raising factor, rf1, and the sampled area. In calculating our second raising factor we ensured that the sum of all orchard crops grown within a region matched the total regional area as recorded in the June Survey. A comparison of the BHS estimates and the June Survey shows that the June Survey area is the larger of the two. As the original sampling frame was obtained using the June Survey data we have used this as our guide to the total area of orchards, rather than using the BHS estimates for the UK. However, the BHS estimates have been useful in estimating the relative proportions of each crop grown.

Throughout our data manipulations it was felt that estimates of other dessert apples and cherries underestimated the total area grown within the UK. However, the absence of other reliable data sets and the potential for oversampling these crops within this survey has meant that our existing estimates are likely to be the best available.

### ***Rounding***

Due to rounding of figures, the sum of constituent items in the tables may not agree exactly with the totals shown.

### ***Error checking***

Extensive checks are made on the data before, at the time of and following data entry. Data checking routines are used to verify the authenticity of the data collected including: the approval status of all crop/pesticide combinations; high and low rates of application; the methods of application used to apply pesticides; crop growth stages at the time of application; the timing of pesticide applications and consistency within a tank mix.

Further checks are made on the integrity of the relational database used to store the raw data collected ensuring that links to product databases are in place prior to the production of the report. The product databases used for the pesticide usage surveys are maintained alongside the commercial product database, *LIAISON*, which is used extensively by agronomists and the major farm management software companies.

Where inconsistencies are found, for example where there are high rates of application or non-approved product usage, these are checked first against the farm records and secondly with the grower and amended if necessary.

Reports are written and checked within the team after which they are sent to reviewers within the Working Party on Pesticide Usage Surveys for their comments and checking.

The final report is pre-announced and published via the ONS Publication Hub and the Fera website in line with the Code of Practice for Official Statistics.

### ***Data limitations and use of data***

Our experience has shown that the proposed face to face interview and ‘main contact plus reserves approach’ delivers the highest quality data and minimises non response bias; no other approach is likely to yield fit for purpose data to meet the quality requirements of the UKSA Code of Practice for Official Statistics. Drawing a fresh stratified random sample each year is clearly an appropriate survey methodology. The population of horticultural growers sampled for the PUS is much smaller than the number of arable holdings in England, so that, especially in the strata of larger enterprises, the same growers come around fairly often so this sample is already closer to a panel than a sample from a larger population might be. These larger enterprises are vital to the statistical validity of the survey in that individually they can represent a significant proportion of the total area of orchards grown.

As part of this survey Fera has implemented the UK Statistics Authority Code of Practice for Official Statistics, published in 2009. Whilst all eight principles apply, we acknowledge in particular, the following:

- Integrity – in particular, that statistical reports must be issued separately from other statements or comments about the figures, that the public interest prevails.
- Confidentiality – the identity of individuals or their information is not revealed, information is kept secure and respondents are informed how their confidentiality will be protected.
- Proportionate burden - seeking participation through informed consent.
- Accessibility – to all users, providing information on the quality and reliability of the statistics, adopting formats that enhance clarity and consistency, disseminate in formats that encourage analysis and re-use.

In accordance with the UKSA Code of Practice for Official Statistics, we work with Defra and HSE statisticians to build on our existing extensive and effective relationships with users of the surveys to further enhance user engagement. There are a broad spectrum of users and stakeholders across policy, research, agricultural supply industry (including consultancies), farming and horticultural businesses, NGOs and members of the public. Over the years we have an excellent record of listening to our users and incorporating their feedback into the way we collect and report our statistics.

## APPENDIX 4 – STANDARD ERROR CALCULATIONS

Helene Thygesen & Roy Macarthur, Statisticians, Fera

### Introduction, Data and Method

The results presented in this report come from the Pesticide Usage Survey (PUS) data for orchards in the UK (England, Wales, Scotland and Northern Ireland) in 2014. The total areas of orchards and total numbers of holdings growing orchards by region were obtained from the June 2014 Survey (Anon, 2015 a, b, c, d).

In the PUS survey, data were collected from 283 holdings in the UK. Data from the PUS were available for individual crops (e.g. Dessert apples or Pears); however such level of detail was not available from the June Survey at the regional level. It was therefore not possible to derive, for individual crops, standard errors for the overall estimates of areas treated and amount applied at the UK level. As a result, it was decided to provide overall estimates for all orchard crops combined. The numbers of holdings sampled as part of the PUS and the total numbers in the June Survey are presented by region in table A.1 below.

For each commodity the country was split into strata: region and holding size. This is because it was expected that pesticide usage may vary more between these strata than it varies between growers within strata. Separate estimates were then made of area under cultivation within each stratum using the June Survey. To make estimates at the national or regional level the estimates for each stratum were multiplied by the area under cultivation within that stratum and added together. The reason for making estimates in this way is that the uncertainty associated with national and regional estimates is smaller than simply surveying randomly selected growers, if the “correct” stratification is conducted. If the stratification is “incorrect” then the estimates are still valid, but we don’t benefit from the reduced uncertainty compared to using no stratification. This approach has been used in previous reports (e.g. “Arable crops - 2014”, Garthwaite, et. al., 2015).

The standard error of each of the estimates is then calculated and used to estimate the size of the uncertainty that is associated with each estimate. There are a number of different valid approaches that can be used to calculate this standard error. Two approaches are:

- i. Use the estimate of the standard error within each stratum in an approximation (Taylor series expansion) that calculates the standard error of the result of combining a number of strata.
- ii. Make a large number of estimates, where each stratum in the estimate is based on a bootstrap sample of the holdings within that stratum. The standard deviation of the “large number of estimates” gives the standard error that is associated with the central estimate made using the survey results.

The standard errors presented in this report have been estimated using the bootstrapping method (10,000 bootstrap samples were used for each estimate).

Because of the small number of holdings for some regions in both the PUS and June Surveys, it was decided to group the holding size strata as it was felt that there was not sufficient information for each region/holding/size group category to appropriately estimate variability at that level from the PUS data. As a result, only “region” was used to stratify survey results in these cases. It was assumed that the “ratio” (i.e. the pesticide-treated area (respective of the weight of active substances) per unit area of the fruit grown) was constant across all holding sizes within a region. Further, because of the very low numbers of holdings growing orchards in some regions (see Tab. A.1), it was also decided to group adjacent regions (“North East”, “North West” and “Yorkshire & the Humber”). An underlying assumption here is that “ratio” was also constant between those adjacent regions. However, the North was represented by only 5 growers, East Midlands by 5 and Scotland by 4. Hence, it was not possible to produce meaningful estimates for the North, East Midlands and Scotland using this method.

By contrast, the South West region has a large number of growers, 38, but the RSE are still high (25.3% by area treated). The most likely explanation for this is the relatively large number of untreated holdings, mainly traditional cider orchards, within the region. The contrast between conventionally treated holdings and those that remain untreated has resulted in the higher RSE.

**Table A.1: Summary of the number of holdings growing orchards sampled in the UK as part of the Pesticide Usage Survey and in the June Survey 2014**

Region	PUS	June Survey
East Midlands	5	136
Eastern	28	340
North East	2	31
North West	1	107
Northern Ireland	52	219
Scotland	4	186
London & South East	84	688
South West	38	1,066
Wales	6	781
West Midlands	61	690
Yorkshire & the Humber	2	91
<b>Overall</b>	<b>283</b>	<b>4,335</b>

### Results and conclusions

Table A.2 shows, for all orchards combined, the calculated relative standard errors (RSE) of the estimates (expressed as a proportion). It also shows that the relative standard errors of the estimates are close to, but have exceeded the target of 5% for both the area treated and the weight applied (6.2% and 6.4% respectively).

The overall figures shown in table A2 below (RSE) clearly show that the relative standard errors for the survey data (area treated and weight applied at the national level) derived from the June Survey estimates of holding numbers and the sampled number of holdings in each region and size group are low within the major regions and therefore give the reader confidence in the methodologies used for data collection.

**Table A.2: Calculated standard errors and relative standard errors (RSE) for all orchards in the United Kingdom 2014**

Region	Total spray (ha)	Area treated SE	Weight applied (kg)	Weight SE	RSE <sup>1</sup> – Area treated	RSE <sup>1</sup> – Weight applied
East Midlands	11,364	4,234	4,189	NA	NA	NA
Eastern	56,720	4,341	31,924	2,531	0.077	0.079
North	998	50	330	NA	NA	NA
Northern Ireland	34,708	2,659	25,952	1,725	0.077	0.066
Scotland	1,172	801	680	NA	NA	NA
London & South East	393,047	29,676	278,571	21,378	0.076	0.077
South West	21,413	5,421	16,942	3,576	0.253	0.211
Wales	5,000	186	3,004	118	0.037	0.039
West Midlands	122,974	11,889	64,104	5,819	0.097	0.091
<b>UK</b>	<b>681,577</b>	<b>41,956</b>	<b>463,754</b>	<b>29,649</b>	<b>0.062</b>	<b>0.064</b>

<sup>1</sup> Relative Standard Error (RSE), i.e. the Standard Error divided by the estimate

## APPENDIX 5 – FIRST RAISING FACTORS FOR ORCHARD CROPS

<i>Region/Country</i>	<i>Farm size group</i>	<i>rf1</i>	<i>Regional area (ha)</i>	<i>Area surveyed (ha)</i>	<i>Number of farms visited</i>
East Midlands	A	18.67	132	7	*
	B	6.22	66	11	*
Eastern	A	14.21	572	40	13
	B	4.03	395	98	7
	C	1.89	103	55	*
	D	2.61	606	232	*
	E	2.06	202	98	*
London & South East	A	20.29	1,115	55	16
	B	4.61	1,089	236	17
	C	3.56	872	245	10
	D	1.93	2,473	1,278	29
	E	1.71	3,746	2,191	12
North East	A	15.36	20	1	*
North West	B	2.72	37	14	*
Northern Ireland	A	3.62	441	122	26
	B	2.33	488	209	15
	C	1.14	217	190	8
	D	2.83	368	130	*
Scotland	A	6.48	89	14	*
South West	A	24.65	1,401	57	22
	B	8.37	465	56	*
	C	2.57	427	166	7
	D	1.84	517	282	*
Wales	A	37.15	219	6	*
	D	1.57	113	72	*
	E	0.97	164	169	*
West Midlands	A	24.77	1,233	50	15
	B	5.84	752	129	9
	C	4.61	1,024	222	9
	D	1.74	2,118	1,214	24
	E	2.70	1,544	572	*
Yorkshire & the Humber	A	53.35	63	1	*

For confidentiality reasons a \* has been used where 5 or less holdings have been sampled

The first raising factor (rf1) is the largest of the three raising factors and gives an indication of the robustness of the sample with smaller numbers indicating a larger area sampled within each size group and region.

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## REFERENCES

**Anon.** (2014a) Agricultural Statistics in England 2013. London: HMSO

**Anon.** (2014b) Agricultural Statistics in Wales 2013. London: HMSO

**Anon.** (2014c) Agricultural Statistics in Scotland 2013. Edinburgh: HMSO

**Anon.** (2014d) Agricultural Statistics, Northern Ireland 2013. Belfast: HMSO

**Anon.** (2015a) Agricultural Statistics in England 2014. London: HMSO

**Anon.** (2015b) Agricultural Statistics in Wales 2014. London: HMSO

**Anon.** (2015c) Agricultural Statistics in Scotland 2014. Edinburgh: HMSO

**Anon.** (2015d) Agricultural Statistics, Northern Ireland 2014. Belfast: HMSO

Anon, (2015e), Basic Horticultural Statistics 2014, Defra,  
<https://www.gov.uk/government/statistics/horticulture-statistics-2014>, (last accessed 17.08.2015)

**Garthwaite, D. G., Hudson, S., Barker, I., Parrish, G., Smith, L. & Pietravalle, S. (2013)** *Pesticide Usage Survey Report 252 – Orchards in the United Kingdom, 2012*. London: Defra

**Garthwaite, D. G., Barker, I., Laybourn, R., Huntly, A., Parrish, G., Hudson, S. & Thygesen, H. (2015)** *Pesticide Usage Survey Report 263 – Arable Crops in the United Kingdom, 2014*. London: Defra

Thomas, M. R., (1999), Guidelines for the Collection of Pesticide Usage Statistics within Agriculture and Horticulture, OECD, Eurostat, <http://www.oecd.org/chemicalsafety/pesticides-biocides/2078031.pdf> (last accessed 02.08.2015)

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