

PESTICIDE USAGE SURVEY REPORT 273

ORCHARDS

IN THE

UNITED KINGDOM

2016



D. Garthwaite, I. Barker, L. Ridley, A. Mace, G. Parrish, R. MacArthur & Y. Lu

Land Use & Sustainability Team
Fera Science Ltd.
Sand Hutton
York
YO41 1LZ

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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

Telephone: 01904 462 032

Alternatively please contact: Fera Science Ltd. at: info@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;
- 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 pesticide risk assessment (authorisation) process
- 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 2016. 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 2016/2017 from 3,110 examples (orchards) grown on 293 holdings throughout the United Kingdom. Orchards grown on the sampled 293 holdings accounted for 31% of the total area of orchard crops grown in the United Kingdom during the 2016 season (autumn 2015, spring & summer 2016). Organic holdings were included in the survey and accounted for 10% 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 66% of the total pesticide-treated area of orchard crops in the United Kingdom in 2016, insecticides 11%, herbicides 9%, growth regulators 6%, sulphur 2% (used as a pesticide for powdery mildew control) and acaricides less than 1%. 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 (natural plant extracts), disinfectants and repellents (kaolin) comprised a further 6%.

By weight applied fungicides accounted for 72% of pesticides used, other pesticides (urea, repellents, disinfectants, growth stimulants and physical controls) 12%, sulphur 6%, herbicides 7%, insecticides 2%, growth regulators and acaricides less than 1% each.

The most extensively used fungicide formulation was captan, being used on 74,751 ha; thiacloprid was the most extensively used insecticide being applied to 15,007 ha; the herbicide glyphosate was applied to 28,849 ha and the gibberellins were the most extensively used growth regulators, being applied to 15,941 ha of orchard crops.

Potassium phosphonate was recorded for the first time in 2016, being a co-formulant with some dithianon products. Penthioopyrad, prohexadione and cyantraniliprole were among new active substances encountered on orchard crops for the first time in 2016.

There were large increases in the use of the insecticides acetamiprid and spinosad since 2014, presumably reflecting the impact of the withdrawal of chlorpyrifos, and the use of alternative insecticides in some crops as part of anti-resistance strategies. The neonicotinoids, (thiacloprid and acetamiprid) accounted for 25% of the insecticide-treated area, diamides (chlorantraniliprole) 20%, diacylhydrazines (methoxyfenozide) 15%, other insecticides (including flonicamid and spinosad) accounting for 11%, oxadiazines (indoxacarb) 8% and carbamates (pirimicarb) 2%. Chlorpyrifos, which accounted for 34% of the area treated in 2014, was only applied to 8% of the treated area in 2016 following its withdrawal from use during the survey period, and a resultant decrease in weight applied from 15,343 kg in 2014 to 2,853 kg in 2016, a reduction of 81% since 2014.

The only major increases in pesticide usage in the principal 10 active substances were of glyphosate, increasing by 30% in terms of area treated, myclobutanil 19% and pyraclostrobin by 7%.

Since 2014, the area of orchard crops grown in England, Wales and Northern Ireland has increased by 11%. The area treated with pesticides has also increased by 3%, however the weight applied has decreased by 5%. Over this period, the use of insecticides has increased by 7%, fungicides by 2%, herbicide usage by 20% and acaricide usage by 8%. 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 pears.

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 Science Ltd., 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 and Rural Economy Directorate and the Agri-Food & Biosciences Institute (AFBI), Department of Agriculture, Environment and Rural Affairs, Northern Ireland (DAERA), conducted surveys of pesticide usage in orchard crops in 2015/16 by visiting holdings throughout the United Kingdom during the winter of 2016/17.

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 third survey of pesticide usage on orchard crops in the United Kingdom. The previous report for the United Kingdom was published in 2015 covering pesticide usage on orchard crops in 2014 (Garthwaite et. al., 2015).

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, or for Wales or the Defra regions of England, may be obtained from the Pesticide Usage Survey Team at Fera Science Ltd., Sand Hutton, York, UK YO41 1LZ.

For further information please contact:

The survey team – e-mail: PUS@fera.co.uk Telephone: 01904 462 032

Or visit the website: <https://secure.fera.defra.gov.uk/pusstats/surveys/index.cfm>

Alternatively, please contact: Fera Science Ltd. at: info@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:

<https://www.afbini.gov.uk/articles/pesticide-usage-monitoring-reports>

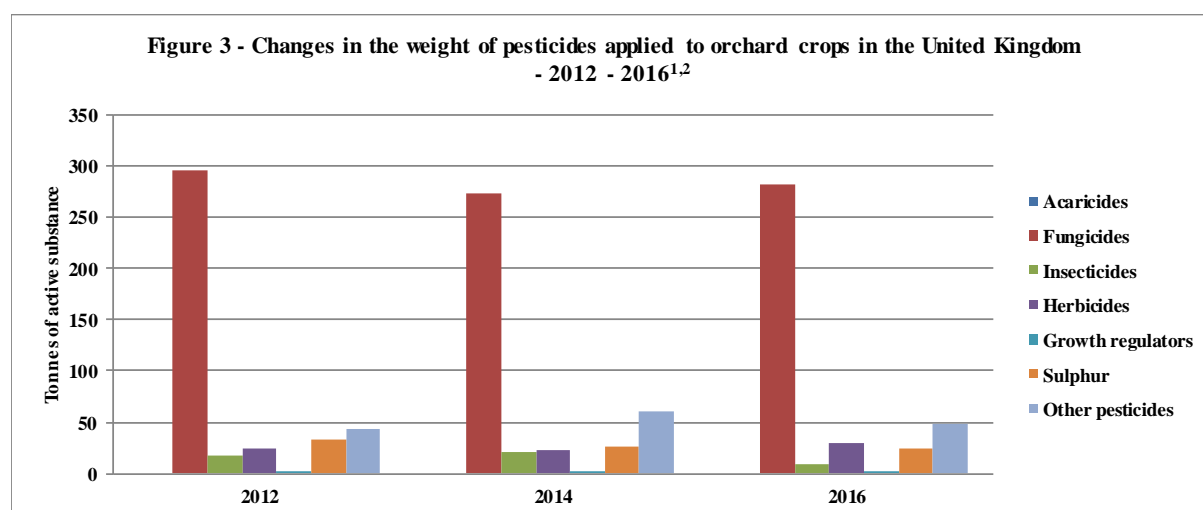
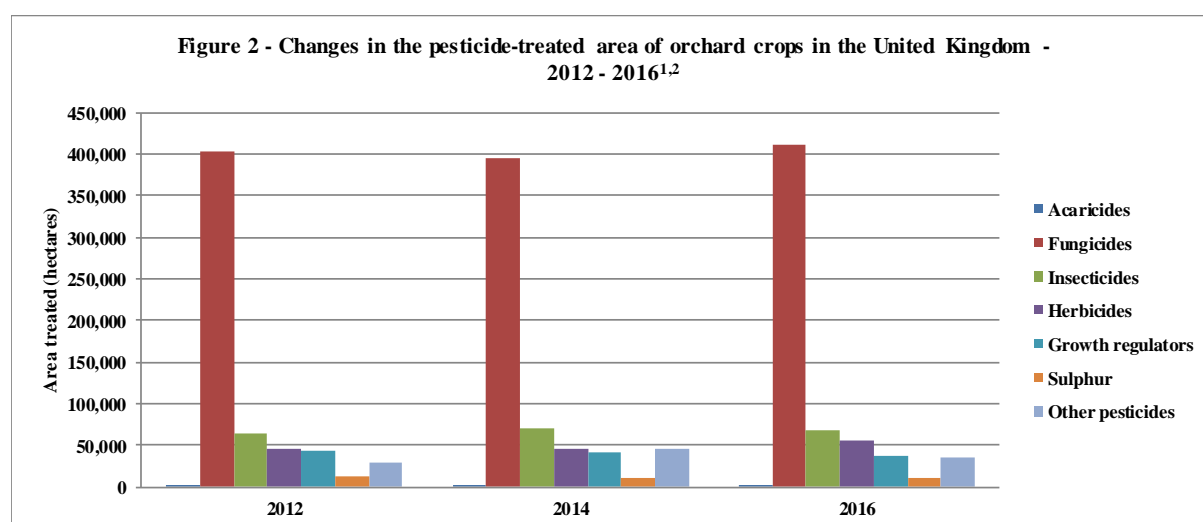
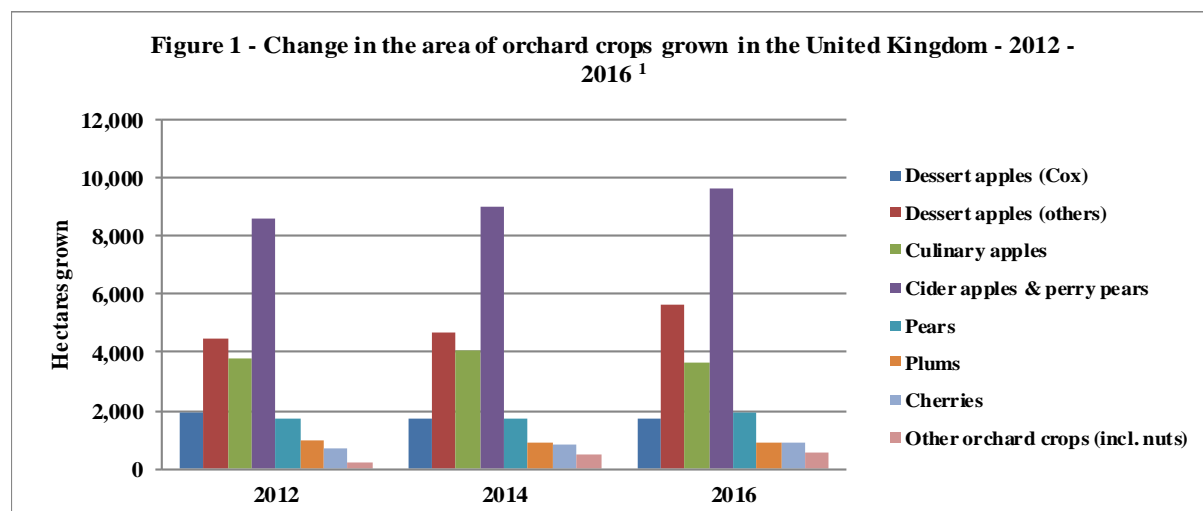
Recently-published reports for the United Kingdom, Great Britain, England & Wales and Northern Ireland can also be viewed and downloaded on the Internet at:

<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

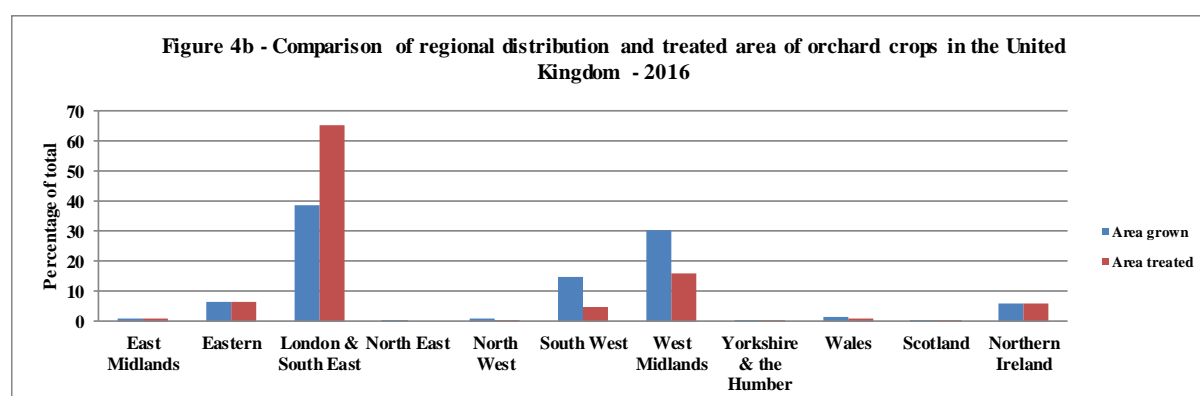
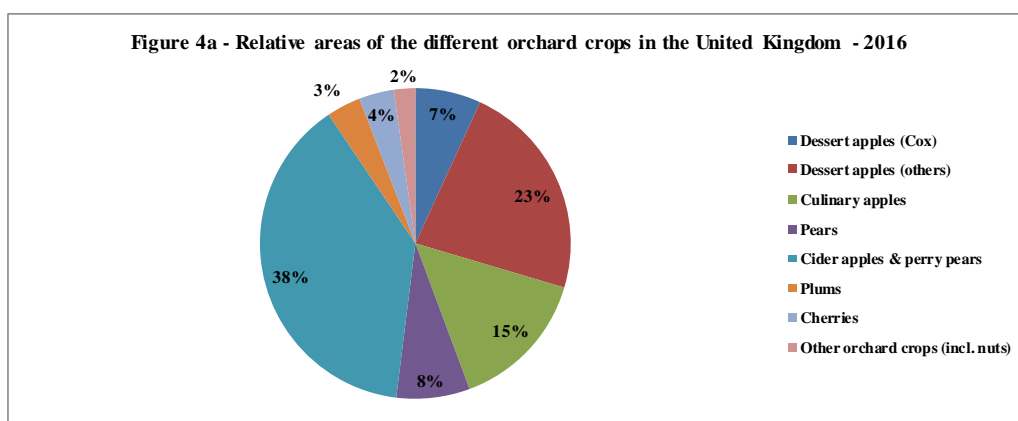
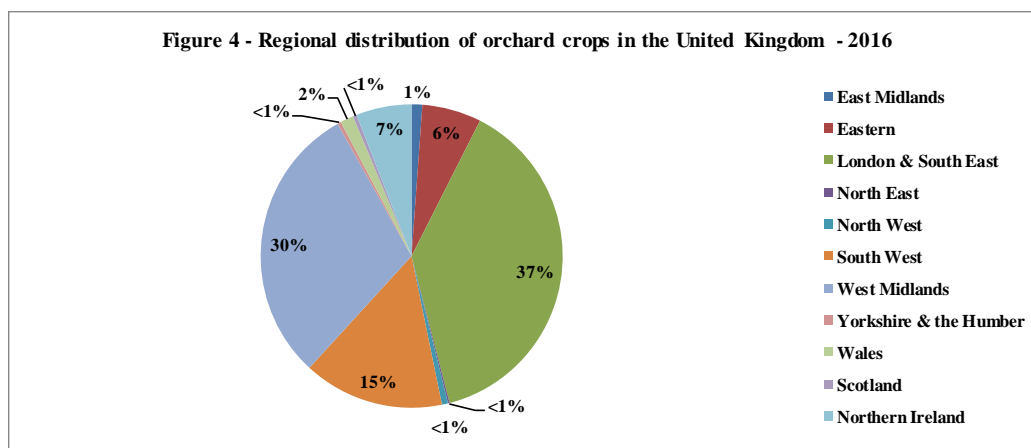


¹Data for 2012 excludes information from Scotland

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

CROPS

Information is given concerning eight types of orchard crops; dessert apples (Cox and others), culinary apples, cider apples & perry pears, pears, plums, cherries and other orchard crops including nuts. Data on pesticide usage were collected from 3,110 examples (orchards) grown on 293 holdings throughout the United Kingdom. The sample accounted for 31% of the total area of orchard crops grown in the United Kingdom during the 2016 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>

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.

PESTICIDE USAGE

Figure 5 - Regional distribution of pesticide usage on orchard crops in the United Kingdom - 2016 - percentage area treated

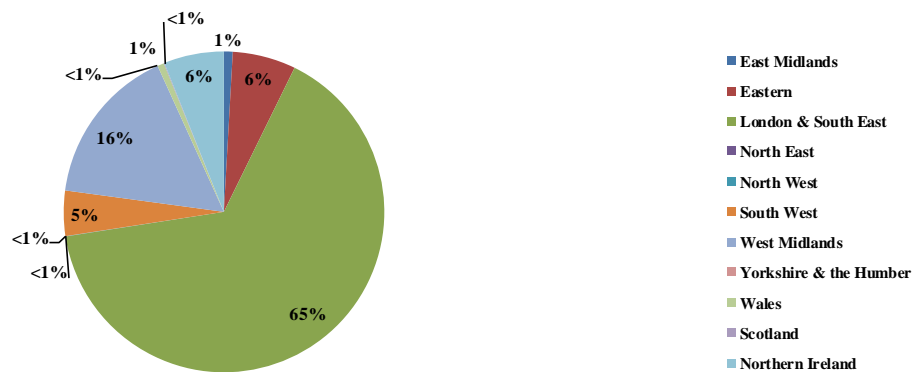


Figure 6 - Usage of pesticides on orchard crops in the United Kingdom - 2016

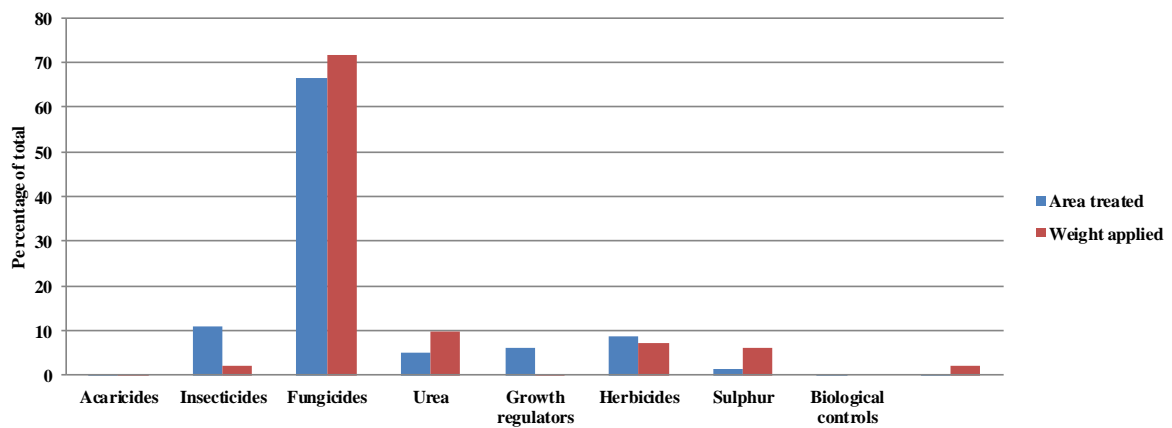
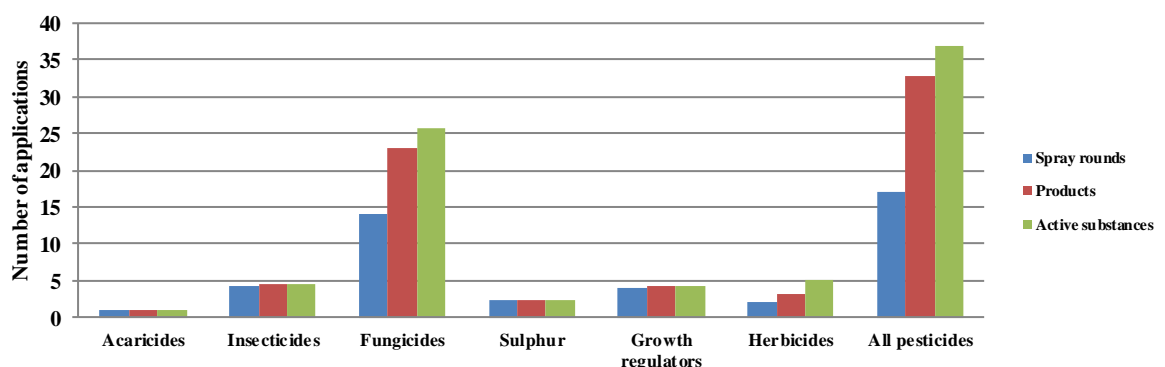


Figure 7 - Average number of applications made to orchard crops in the United Kingdom - 2016



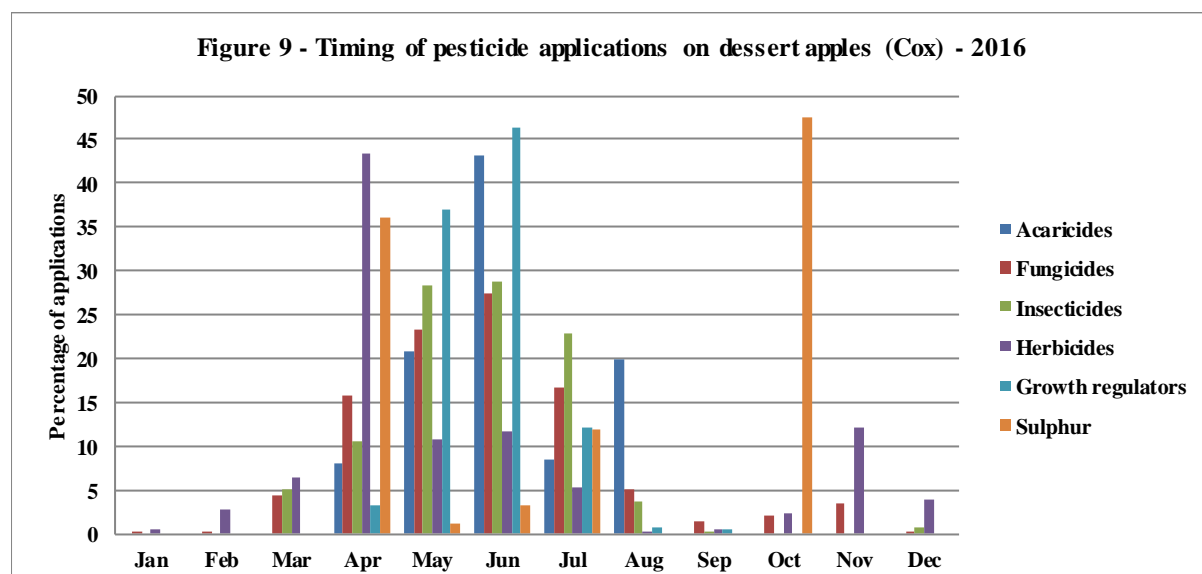
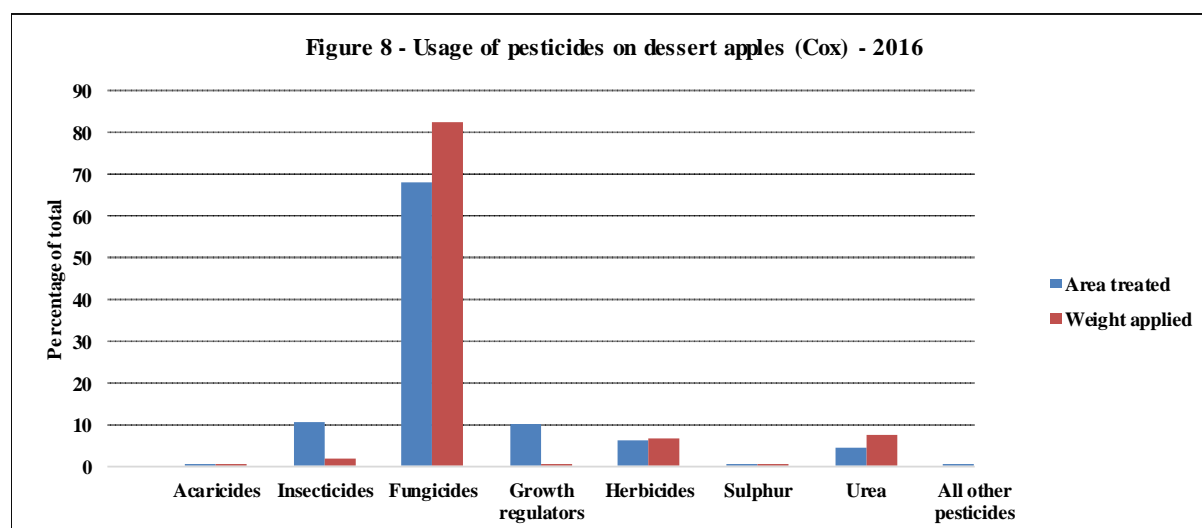
PESTICIDE USAGE ON POME FRUITS

Dessert apples (Cox)

- 1,704 hectares of dessert apples (Cox) grown in the United Kingdom
- 69,491 treated hectares
- 44.32 tonnes applied
- 4% of dessert apples (Cox) remained untreated
- Dessert apples (Cox) received on average 17 fungicides, 5 growth regulators, 4 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.

Cox apples continued to be reported on separately to other dessert apples due to the difference in the way that they are treated, particularly in respect of the usage of plant growth regulators.

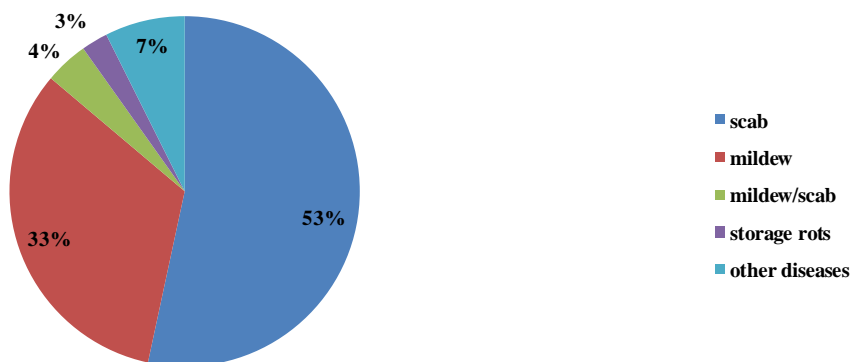


Dessert apples (Cox) – Fungicides

- **Formulation area treated: 47,163 hectares**
- **Weight of active substances applied: 36.6 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 | 8,957 | 13,168 | 0.19 | 0.92 | 5.69 | 0.85 |
| Myclobutanil | 7,387 | 444 | 0.16 | 0.94 | 4.61 | 0.67 |
| Penconazole | 3,532 | 146 | 0.07 | 0.73 | 2.85 | 0.83 |
| Dithianon | 3,294 | 1,623 | 0.07 | 0.77 | 2.51 | 0.79 |
| Difenoconazole | 2,184 | 108 | 0.05 | 0.62 | 2.08 | 0.99 |

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

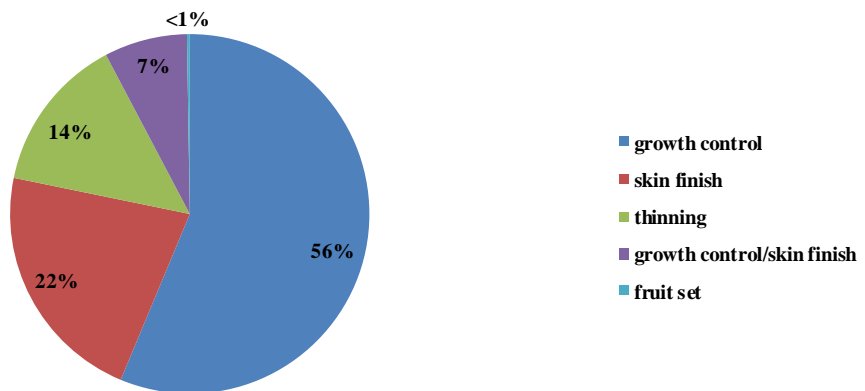


Dessert apples (Cox) – Growth regulators

- **Formulation area treated: 6,969 hectares**
- **Weight of active substances applied: 0.33 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 |
|----------------------|-------------------------------|-----------------------------|---|--------------------------|--|--|
| Gibberellins | 3,609 | 11 | 0.51 | 0.52 | 4.05 | 0.58 |
| Paclobutrazol | 1,751 | 150 | 0.25 | 0.29 | 3.56 | 0.34 |
| Prohexadione | 984 | 102 | 0.14 | 0.40 | 1.46 | 0.46 |
| Prohexadione-calcium | 393 | 39 | 0.06 | 0.11 | 2.09 | 0.79 |
| 6-benzyladenine | 121 | 17 | 0.02 | 0.07 | 1.00 | 0.94 |

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

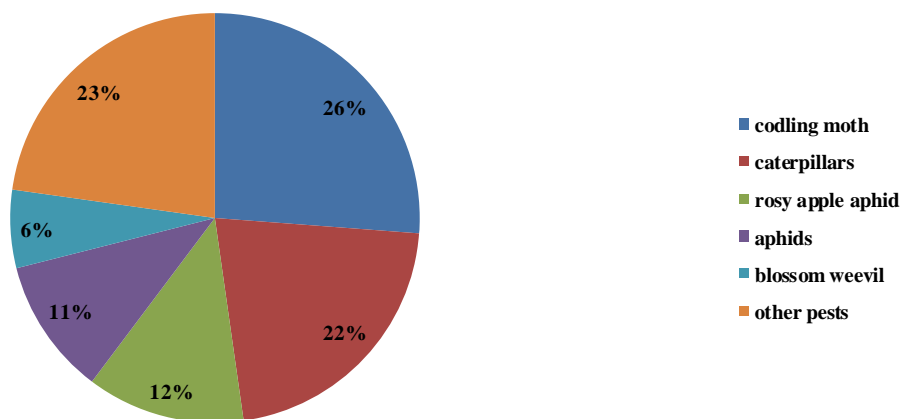


Dessert apples (Cox) – Insecticides

- **Formulation area treated: 7,330 hectares**
- **Weight of active substances applied: 0.89 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 |
|---------------------|-------------------------------|-----------------------------|--|--------------------------|--|--|
| Thiacloprid | 1,801 | 300 | 0.25 | 0.74 | 1.42 | 0.92 |
| Chlorantraniliprole | 1,742 | 60 | 0.24 | 0.67 | 1.53 | 0.99 |
| Methoxyfenozide | 1,240 | 146 | 0.17 | 0.53 | 1.36 | 0.82 |
| Indoxacarb | 894 | 64 | 0.12 | 0.42 | 1.25 | 0.95 |
| Flonicamid | 834 | 58 | 0.11 | 0.43 | 1.15 | 0.99 |

Figure 12 - Dessertapples - Cox - Reasons for use of insecticides (where given)

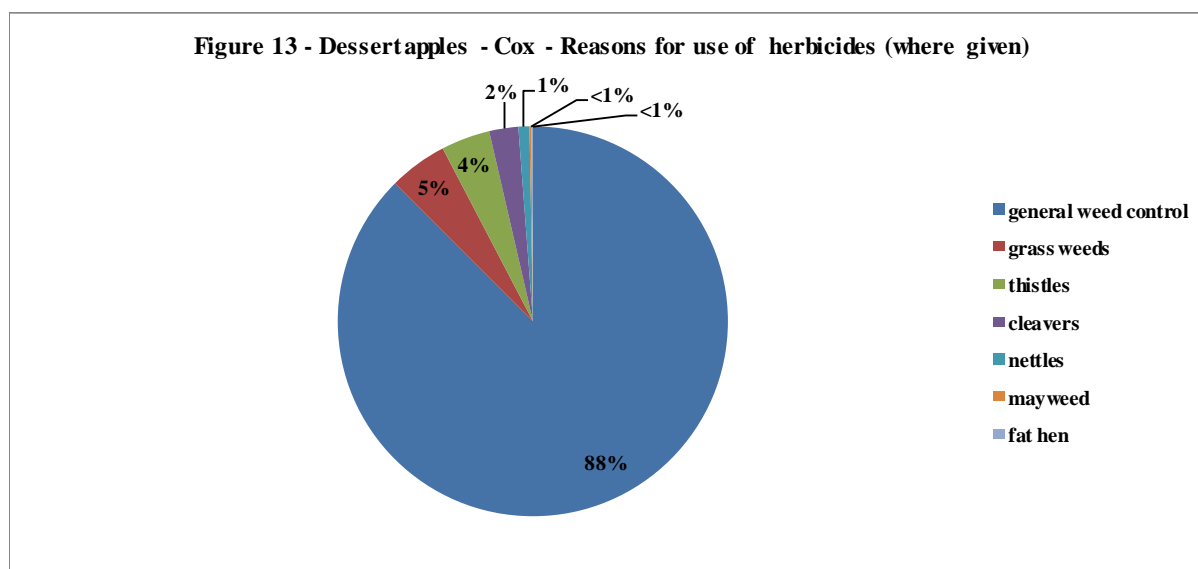


Dessert apples (Cox) – Herbicides

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: 4,505 hectares**
- **Weight of active substances applied: 3.0 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 | 2,245 | 1,633 | 0.50 | 0.84 | 1.56 | 0.33 |
| Dicamba/MCPA/mecoprop-P | 810 | 673 | 0.18 | 0.28 | 1.67 | 0.48 |
| 2,4-D | 692 | 402 | 0.16 | 0.33 | 1.22 | 0.42 |
| Propyzamide | 230 | 88 | 0.05 | 0.14 | 1.00 | 0.23 |
| Glufosinate-ammonium | 180 | 56 | 0.04 | 0.11 | 1.00 | 0.41 |



Dessert apples (Cox) – Other pesticides

All other pesticide groups applied to Cox apples together accounted for 5% or less of the total treated area and 8% of the weight applied. The discrepancy between the area treated and the weight applied is due to the use of urea, applied at relatively high rates per hectare.

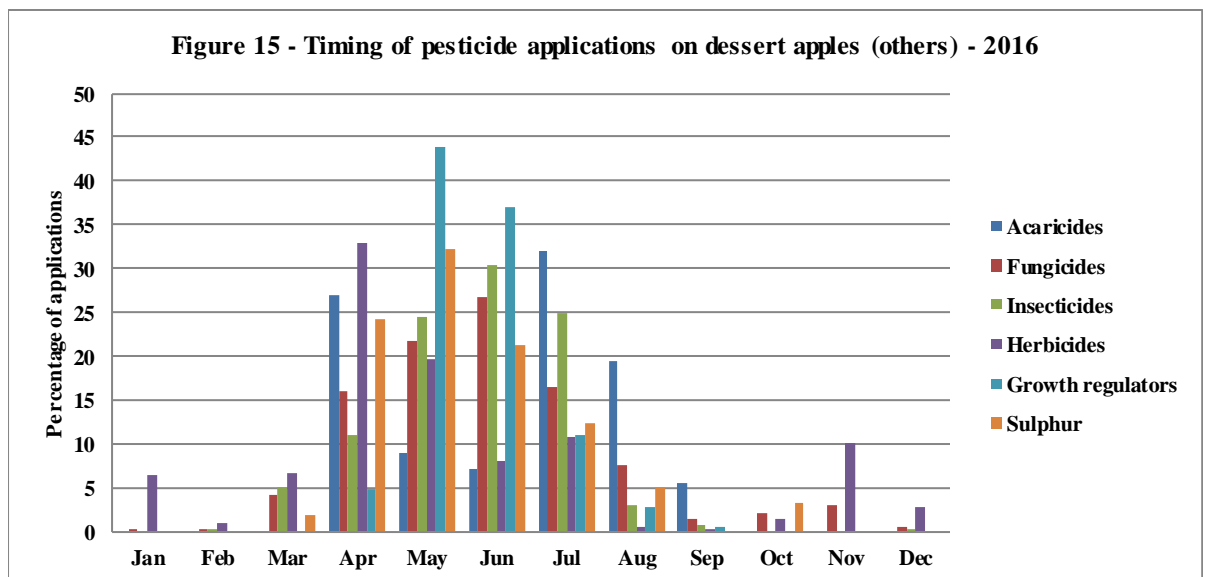
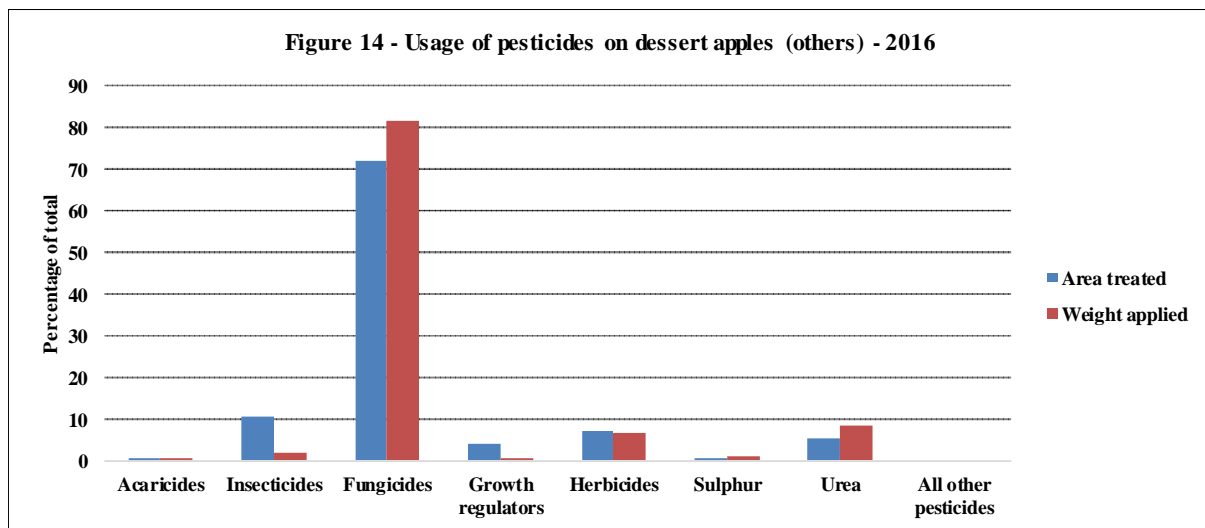
Other pesticide groups included urea, acaricides and growth stimulants.

However, in terms of weight applied, urea accounted for 99.2 % of the total weight of other pesticides applied.

The use of sulphur, primarily for rust mite control, accounted for less than 1% of the treated area and less than 1% of the weight applied.

Dessert apples (others)

- 5,670 hectares of dessert apples (other) grown in the United Kingdom
- 230,578 treated hectares
- 136.5 tonnes applied
- 9% of dessert apples (other) remained untreated
- Dessert apples (other) received on average 17 fungicides, 5 insecticides, 3 growth regulators and 2 herbicides
- Gala (and clones) and Braeburn were the two main varieties grown, accounting for 43% and 17% of the total respectively

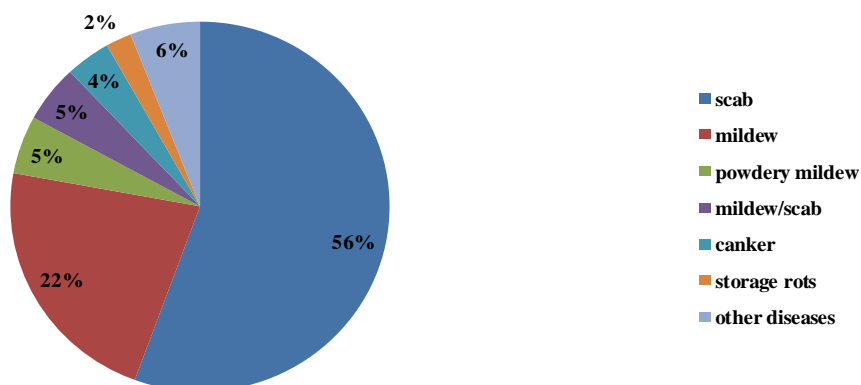


Dessert apples (others) – Fungicides

- **Formulation area treated: 165,896 hectares**
- **Weight of active substances applied: 111.0 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 | 32,831 | 49,281 | 0.20 | 0.84 | 6.89 | 0.84 |
| Myclobutanil | 24,453 | 1,532 | 0.15 | 0.80 | 5.41 | 0.70 |
| Penconazole | 13,783 | 564 | 0.08 | 0.74 | 3.27 | 0.82 |
| Dithianon | 10,676 | 5,667 | 0.06 | 0.70 | 2.68 | 0.86 |
| Difenoconazole | 10,216 | 508 | 0.06 | 0.70 | 2.58 | 0.99 |

Figure 16 - Dessertapples - (others) - Reasons for use of fungicides (where given)



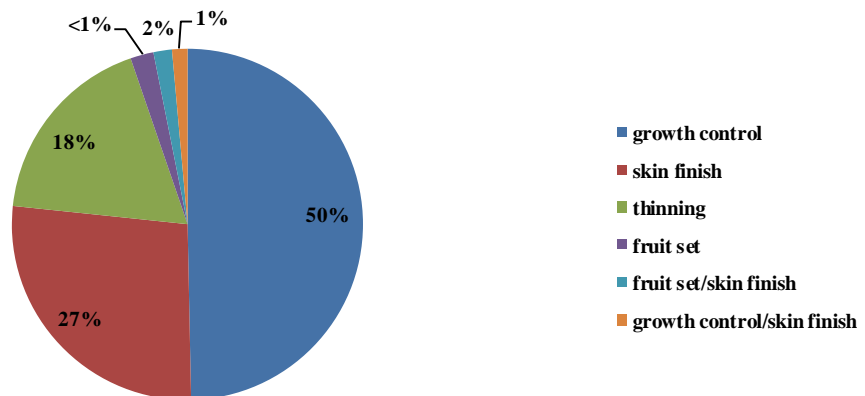
Sulphur accounted for less than 1% of the overall area of dessert apples (others) but 1% of the weight applied. It was used primarily for the control of rust mites, powdery mildew and other diseases.

Dessert apples (others) – Growth regulators

- **Formulation area treated: 9,500 hectares**
- **Weight of active substances applied: 0.51 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 |
|----------------------|-------------------------------|-----------------------------|---|--------------------------|--|--|
| Gibberellins | 3,565 | 9 | 0.36 | 0.23 | 2.77 | 0.48 |
| Paclobutrazol | 2,073 | 161 | 0.21 | 0.12 | 3.11 | 0.31 |
| Prohexadione | 1,821 | 171 | 0.18 | 0.25 | 1.31 | 0.40 |
| Prohexadione-calcium | 690 | 69 | 0.07 | 0.09 | 1.34 | 0.80 |
| 6-benzyladenine | 626 | 73 | 0.06 | 0.11 | 1.00 | 0.78 |

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

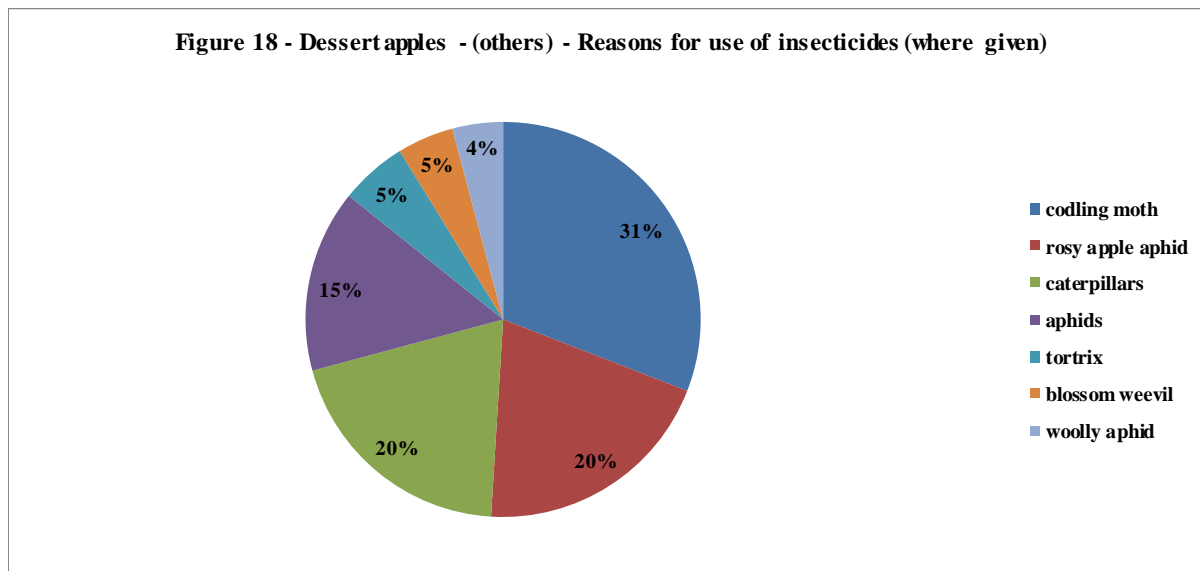


Dessert apples (others) – Insecticides

- **Formulation area treated: 24,381 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 insecticide – treated area | Proportion of area grown | Average number of applications (where applied) | Average proportion of maximum product label rate |
|---------------------|-------------------------------|-----------------------------|--|--------------------------|--|--|
| Thiacloprid | 6,092 | 1,027 | 0.25 | 0.70 | 1.53 | 0.94 |
| Chlorantraniliprole | 5,994 | 207 | 0.25 | 0.65 | 1.62 | 0.99 |
| Methoxyfenozide | 3,689 | 432 | 0.15 | 0.56 | 1.16 | 0.81 |
| Flonicamid | 2,730 | 185 | 0.11 | 0.43 | 1.11 | 0.97 |
| Indoxacarb | 2,209 | 144 | 0.09 | 0.32 | 1.18 | 0.87 |

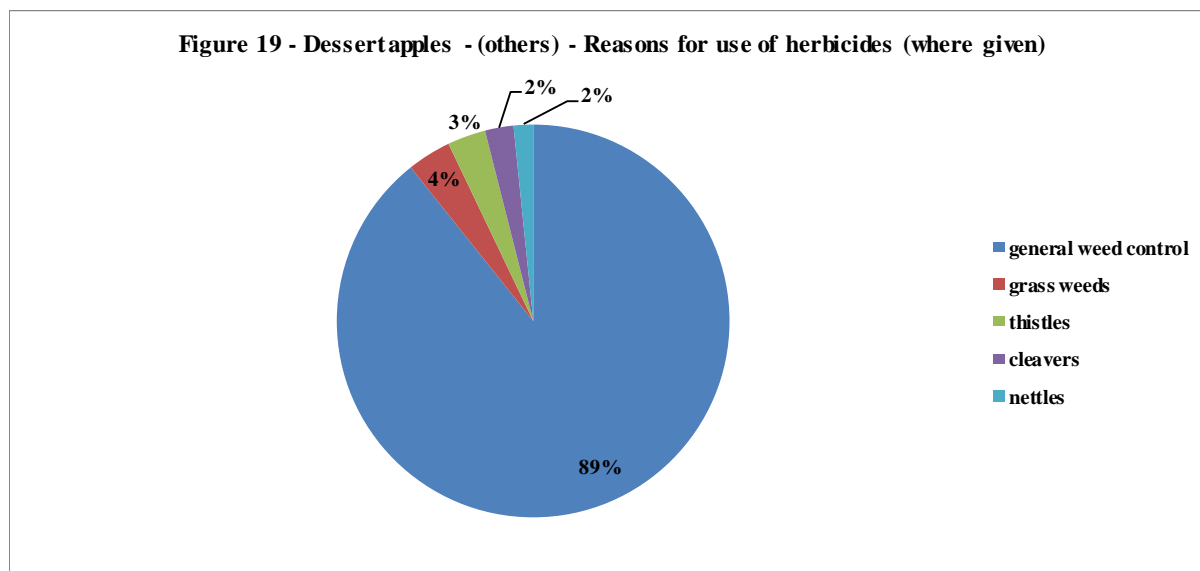
Figure 18 - Dessert apples - (others) - Reasons for use of insecticides (where given)



Dessert apples (others) – Herbicides

- **Formulation area treated: 17,277 hectares**
- **Weight of active substances applied: 9.3 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 | 7,025 | 4,387 | 0.42 | 0.78 | 1.56 | 0.30 |
| Dicamba/MCPA/mecoprop-P | 3,202 | 2,092 | 0.19 | 0.37 | 1.53 | 0.38 |
| 2,4-D | 2,644 | 1,500 | 0.16 | 0.38 | 1.24 | 0.40 |
| Propyzamide | 990 | 357 | 0.06 | 0.16 | 1.03 | 0.21 |
| Glufosinate-ammonium | 912 | 212 | 0.05 | 0.14 | 1.12 | 0.31 |



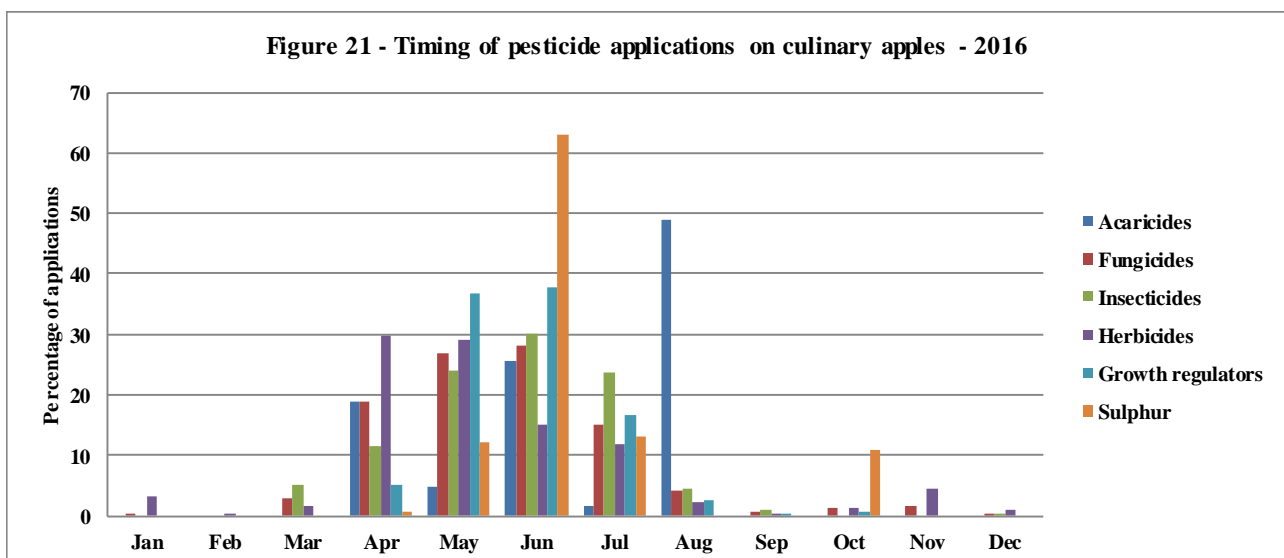
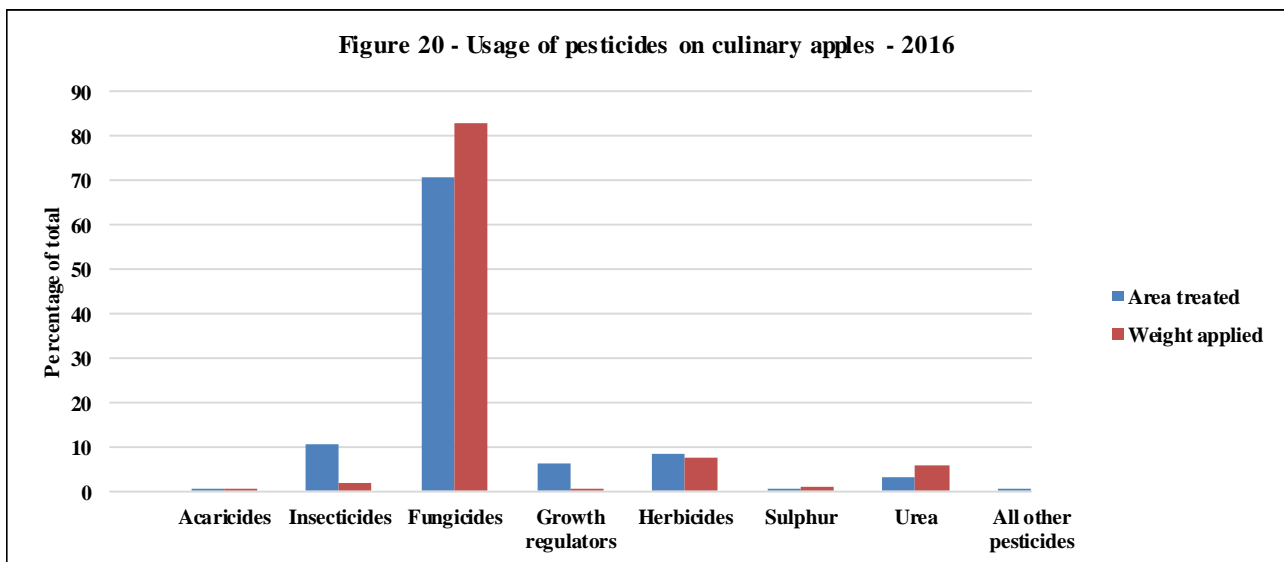
Dessert apples (others) – Other pesticides

All other pesticide groups applied to dessert apples (others) accounted for 5% of the total treated area and included urea, acaricides and growth stimulants. However, in terms of weight, urea accounted for 8% of the total weight of active substances applied.

Culinary apples

The culinary apple and Bramley apple reports have been combined this year for the first time. The area of other culinary apples (excluding Bramley) is now so small that grower confidentiality is at risk by reporting them as a separate crop category.

- 3,672 hectares of culinary apples grown in the United Kingdom, of which Bramley apples comprised 99% of the total
- 121,373 treated hectares
- 68.5 tonnes applied
- 6% of culinary apples remained untreated
- Culinary apples received on average 15 fungicides, 4 insecticides, 3 growth regulators and 2 herbicides
- 39% of the area of culinary apples was grown in Northern Ireland

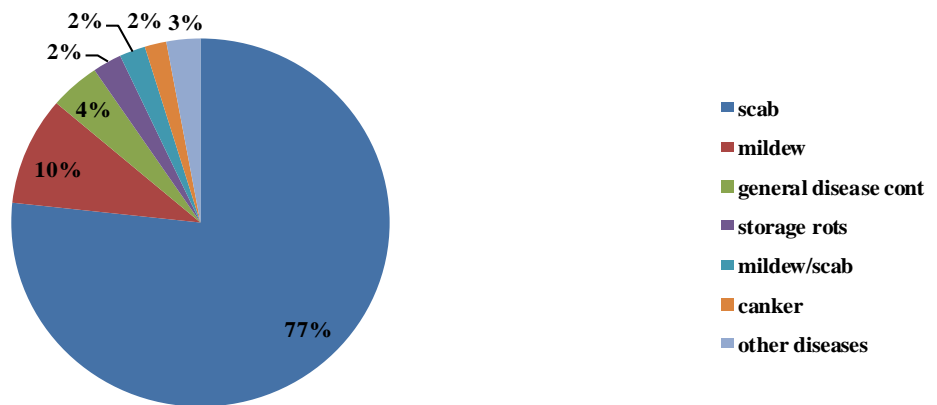


Culinary apples – Fungicides

- **Formulation area treated: 85,758 hectares**
- **Weight of active substances applied: 56.7 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 |
|--------------|-------------------------------|-----------------------------|--------------------------------------|--------------------------|--|--|
| Captan | 14,244 | 19,136 | 0.17 | 0.77 | 5.01 | 0.67 |
| Myclobutanil | 10,084 | 630 | 0.12 | 0.69 | 3.98 | 0.69 |
| Dithianon | 7,202 | 3,515 | 0.08 | 0.57 | 3.42 | 0.82 |
| Mancozeb | 6,926 | 9,864 | 0.08 | 0.42 | 4.54 | 0.59 |
| Pyrimethanil | 6,833 | 2,251 | 0.08 | 0.80 | 2.31 | 0.76 |

Figure 22 - Culinary apples - Reasons for use of fungicides (where given)



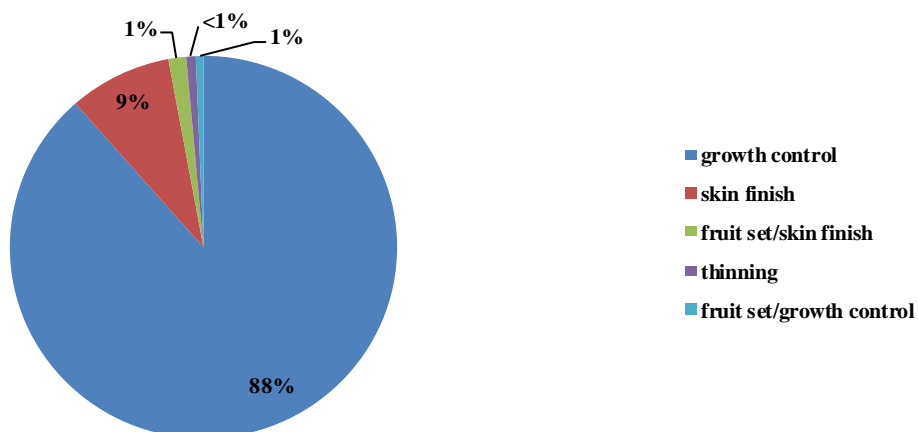
The use of sulphur accounted for 1% of the area of Bramley apples treated, but for 2% of the total weight of pesticides applied, reflecting the relatively high rate of application of this product.

Culinary apples – Growth regulators

- **Formulation area treated: 7,439 hectares**
- **Weight of active substances applied: 0.51 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 | 2,522 | 217 | 0.34 | 0.18 | 3.64 | 0.34 |
| Prohexadione | 2,042 | 194 | 0.27 | 0.34 | 1.62 | 0.41 |
| Gibberellins | 1,612 | 4 | 0.21 | 0.24 | 1.79 | 0.50 |
| Prohexadione-calcium | 1,242 | 95 | 0.16 | 0.22 | 1.54 | 0.61 |
| Metamitron | 88 | 23 | 0.01 | 0.02 | 1.00 | 0.80 |

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

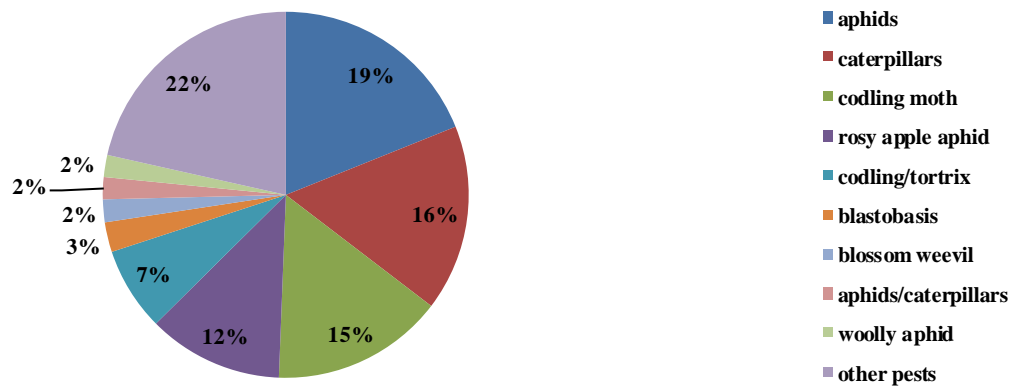


Culinary apples – Insecticides

- **Formulation area treated: 12,977 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 insecticide – treated area | Proportion of area grown | Average number of applications (where applied) | Average proportion of maximum product label rate |
|---------------------|-------------------------------|-----------------------------|--|--------------------------|--|--|
| Chlorantraniliprole | 2,375 | 80 | 0.18 | 0.45 | 1.42 | 0.97 |
| Methoxyfenozide | 2,348 | 299 | 0.18 | 0.47 | 1.35 | 0.88 |
| Thiacloprid | 2,125 | 360 | 0.16 | 0.40 | 1.46 | 0.94 |
| Cypermethrin | 2,114 | 50 | 0.16 | 0.33 | 1.72 | 0.94 |
| Flonicamid | 1,880 | 131 | 0.14 | 0.42 | 1.21 | 1.00 |

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

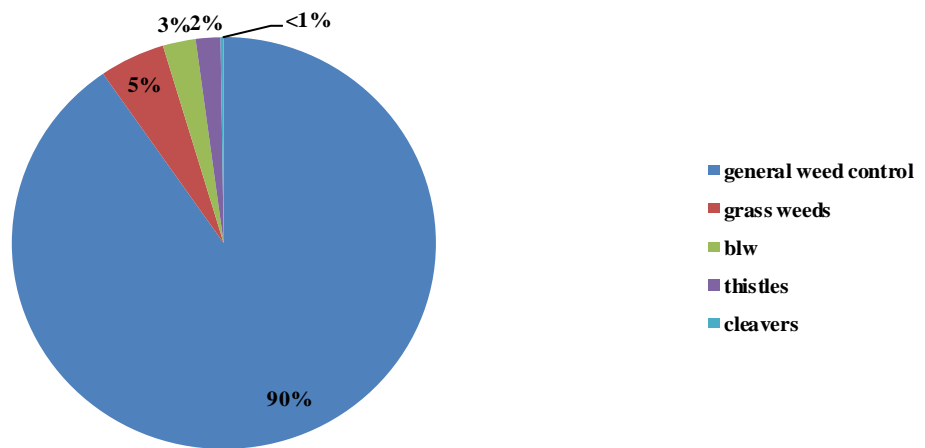


Culinary apples – Herbicides

- **Formulation area treated: 10,265 hectares**
- **Weight of active substances applied: 5.2 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 | 4,986 | 2,748 | 0.49 | 0.86 | 1.56 | 0.29 |
| Dicamba/MCPA/mecoprop-P | 2,284 | 1,300 | 0.22 | 0.41 | 1.50 | 0.32 |
| 2,4-D | 846 | 487 | 0.08 | 0.21 | 1.12 | 0.40 |
| MCPA | 623 | 228 | 0.06 | 0.11 | 1.51 | 0.21 |
| Propyzamide | 258 | 87 | 0.03 | 0.07 | 1.00 | 0.20 |

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

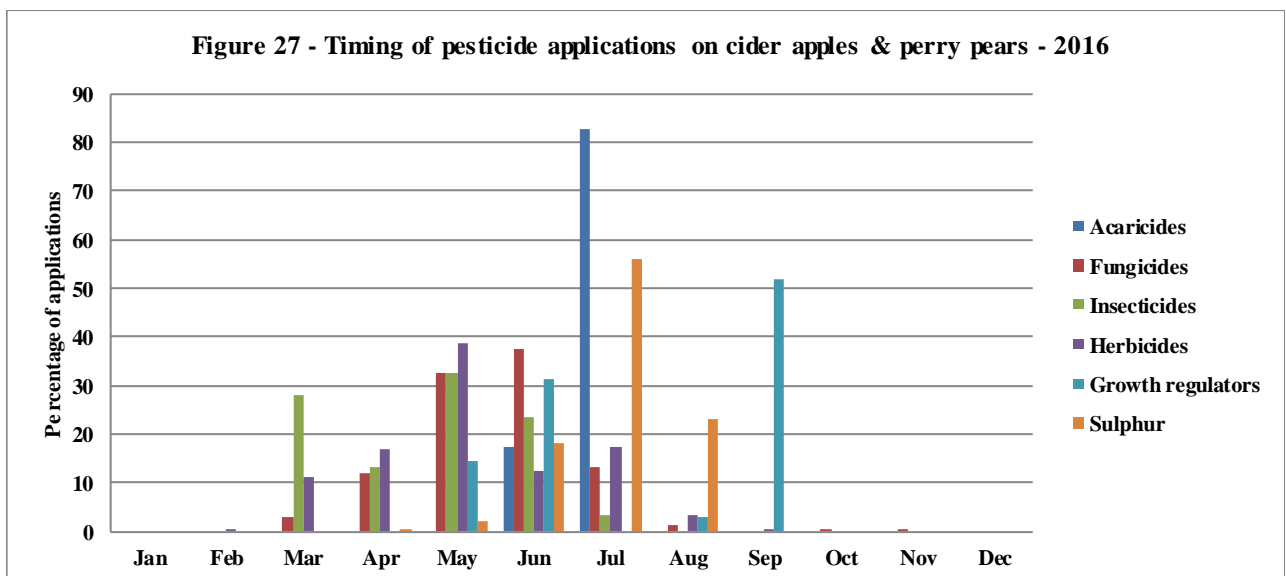
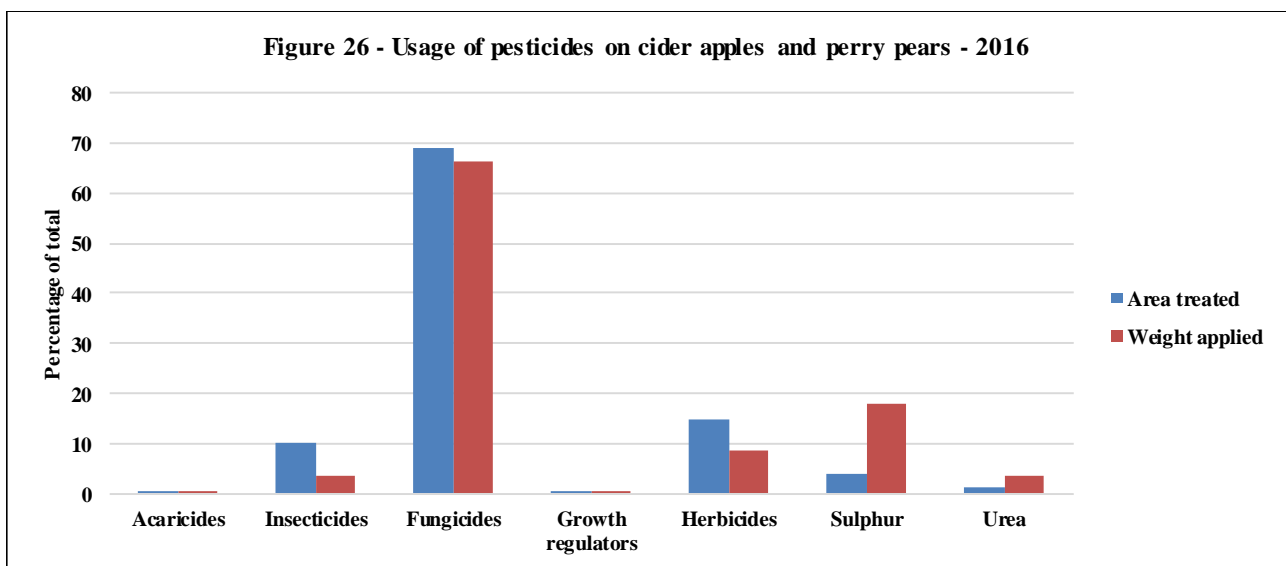


Culinary apples – Other pesticides

All other pesticide groups applied to culinary apples accounted for 3% of the total treated area and included urea, acaricides and growth stimulants. However, in terms of weight applied, urea accounted for 6% of the total.

Cider apples & perry pears

- 9,617 hectares of cider apples & perry pears grown in the United Kingdom
- 95,658 treated hectares
- 60.4 tonnes applied
- 24% 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 6 fungicides, 1 insecticide, 2 herbicides and 1 sulphur application

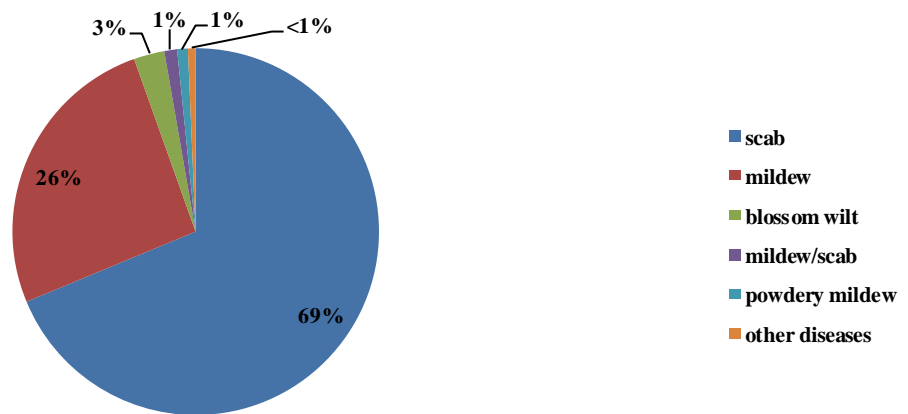


Cider apples & perry pears – Fungicides

- **Formulation area treated: 66,020 hectares**
- **Weight of active substances applied: 39.9 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 | 18,641 | 16,509 | 0.28 | 0.71 | 2.72 | 0.89 |
| Dithianon | 8,792 | 4,659 | 0.13 | 0.32 | 2.85 | 0.69 |
| Myclobutanil | 8,116 | 685 | 0.12 | 0.35 | 2.41 | 0.94 |
| Dithianon/pyraclostrobin | 6,115 | 2,380 | 0.09 | 0.32 | 2.00 | 0.97 |
| Penconazole | 5,555 | 260 | 0.08 | 0.34 | 1.70 | 0.93 |

Figure 28 - Cider apples & perry pears - Reasons for use of fungicides (where given)



Cider apples & perry pears – Sulphur

- **Formulation area treated: 3,759 hectares**
- **Weight of active substances applied: 10.8 tonnes**

The only reason specified for sulphur usage was mildew control.

Cider apples & perry pears – Growth regulators

- **Formulation area treated: 675 hectares**
- **Weight of active substances applied: 0.14 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 |
|------------------------------|--------------------------------------|------------------------------------|--|---------------------------------|---|---|
| | | | | | | |
| 2-chloroethylphosphonic acid | 412 | 120 | 0.61 | 0.04 | 1.00 | 0.81 |
| Prohexadione-calcium | 149 | 12 | 0.22 | 0.01 | 1.36 | 0.64 |
| 1-naphthylacetic acid | 53 | 1 | 0.08 | 0.01 | 1.00 | volumetric |
| 6-benzyladenine | 53 | 7 | 0.08 | 0.01 | 1.00 | 0.87 |
| Prohexadione | 7 | 1 | 0.01 | 0.00 | 1.00 | 0.49 |

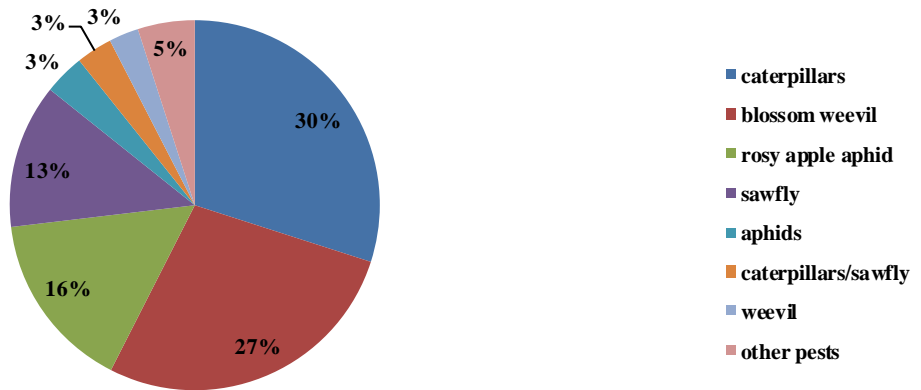
Fruit ripening was the main reason specified for 80% of applications and growth control the remaining 20%.

Cider apples & perry pears – Insecticides

- **Formulation area treated: 9,743 hectares**
- **Weight of active substances applied: 2.1 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 |
|---------------------|-------------------------------|-----------------------------|--|--------------------------|--|--|
| Thiacloprid | 2,965 | 382 | 0.30 | 0.26 | 1.19 | 0.72 |
| Chlorpyrifos | 2,616 | 1,369 | 0.27 | 0.27 | 1.00 | 0.55 |
| Methoxyfenozide | 1,630 | 223 | 0.17 | 0.17 | 1.00 | 0.95 |
| Chlorantraniliprole | 954 | 32 | 0.10 | 0.09 | 1.10 | 0.96 |
| Fonicamid | 622 | 43 | 0.06 | 0.06 | 1.03 | 0.98 |

Figure 29 - Cider apples & perry pears - Reasons for use of insecticides (where given)



Cider apples & perry pears – Herbicides

- **Formulation area treated: 14,097 hectares**
- **Weight of active substances applied: 5.3 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 | 8,475 | 3,298 | 0.60 | 0.63 | 1.40 | 0.21 |
| 2,4-D | 2,283 | 668 | 0.16 | 0.19 | 1.22 | 0.21 |
| Dicamba/MCPA/mecoprop-P | 1,687 | 759 | 0.12 | 0.16 | 1.10 | 0.26 |
| 2,4-D/glyphosate | 776 | 352 | 0.06 | 0.08 | 1.00 | 0.23 |
| Glufosinate-ammonium | 673 | 133 | 0.05 | 0.07 | 1.00 | 0.26 |

Almost all (94%) herbicide usage was for general weed control with 5% being for nettle/dock control and 1% for thistle control.

Cider apples & perry pears – Other pesticides

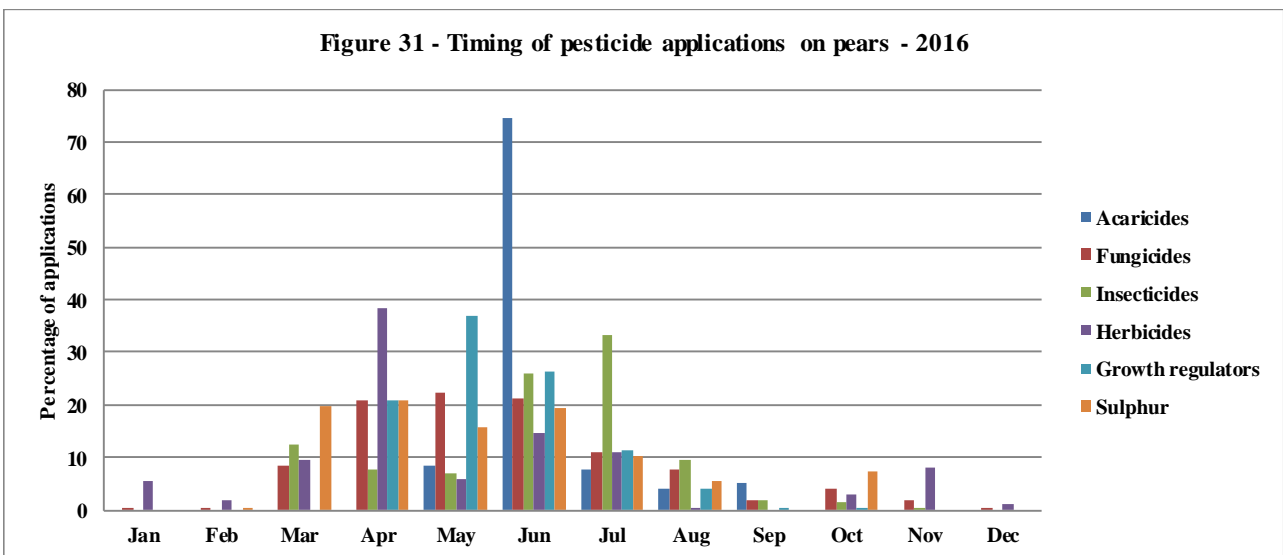
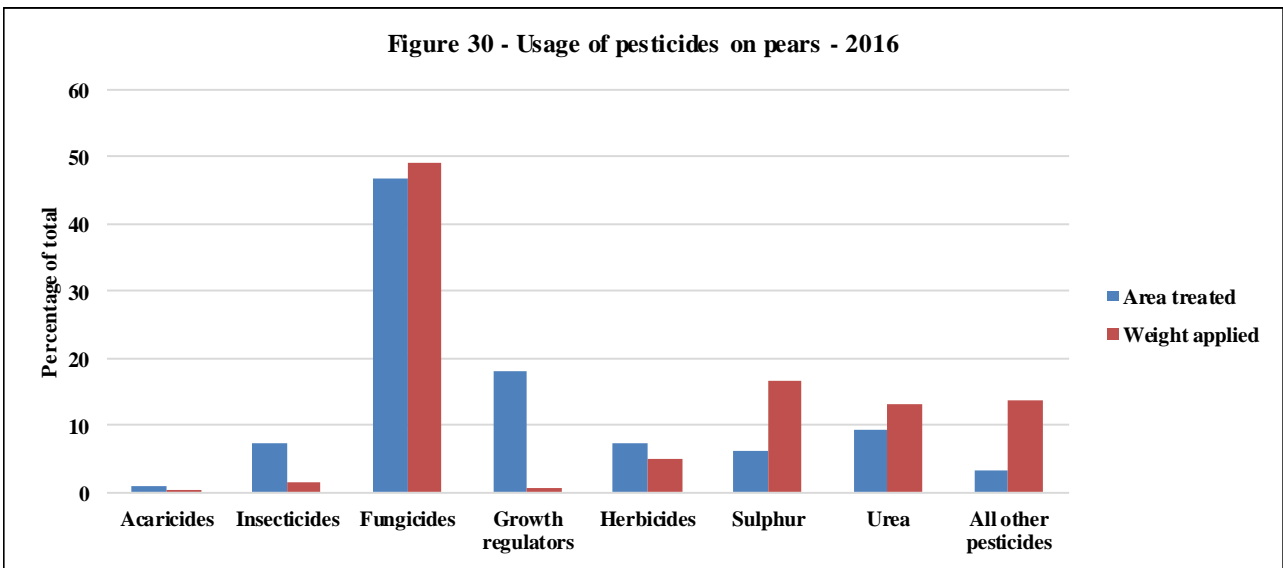
Other pesticides encountered included urea and acaricides.

Usage of acaricides was minimal.

Urea accounted for 1% of the overall treated area and 3% of the weight applied.

Pears

- 1,907 hectares of pears grown in the United Kingdom
- 68,353 treated hectares
- 64.4 tonnes applied
- 3% of pears remained untreated
- Pears received on average 15 fungicides, 7 growth regulators, 3 sulphur applications, 3 insecticides, 2 herbicides and 1 acaricide

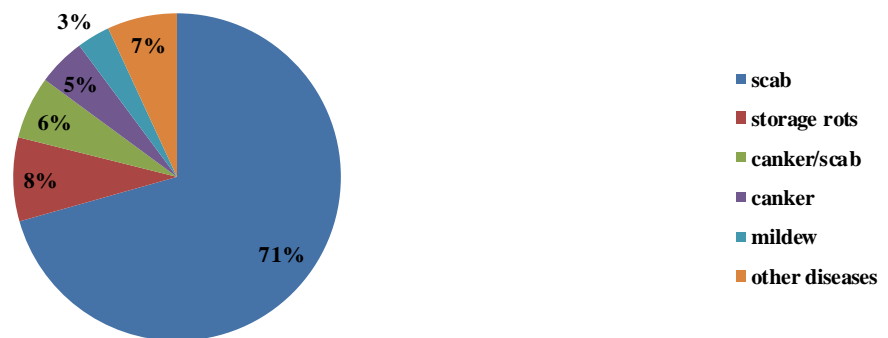


Pears – Fungicides

- **Formulation area treated: 32,089 hectares**
- **Weight of active substances applied: 31.7 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 |
|--------------------|-------------------------------|-----------------------------|--------------------------------------|--------------------------|--|--|
| Captan | 13,338 | 20,217 | 0.42 | 0.95 | 7.35 | 0.85 |
| Copper oxychloride | 2,848 | 2,731 | 0.09 | 0.74 | 2.02 | 0.40 |
| Dithianon | 2,697 | 1,483 | 0.08 | 0.61 | 2.31 | 0.87 |
| Dodine | 2,645 | 2,251 | 0.08 | 0.75 | 1.85 | 0.85 |
| Pyrimethanil | 1,813 | 543 | 0.06 | 0.57 | 1.67 | 0.71 |

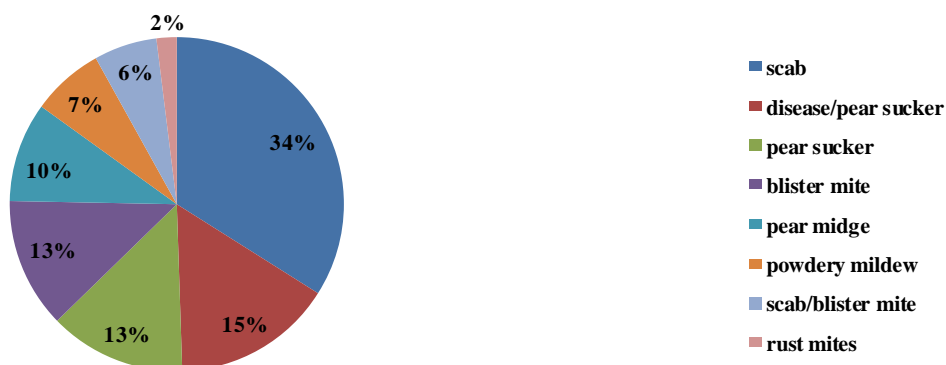
Figure 32 - Pears - Reasons for use of fungicides (where given)



Pears – Sulphur

- **Formulation area treated: 4,221 hectares**
- **Weight of active substances applied: 10.8 tonnes**

Figure 33 - Pears - Reasons for use of sulphur (where given)

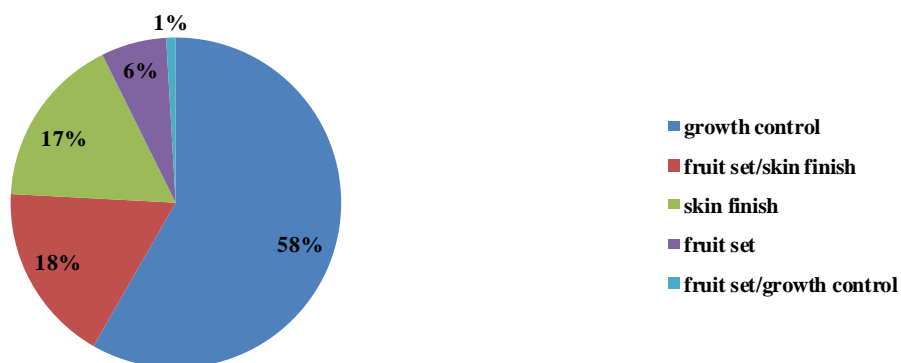


Pears – Growth regulators

- **Formulation area treated: 12,340 hectares**
- **Weight of active substances applied: 0.4 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 | 7,047 | 24 | 0.57 | 0.85 | 4.30 | 0.66 |
| Paclobutrazol | 4,284 | 282 | 0.35 | 0.51 | 4.38 | 0.26 |
| Prohexadione | 652 | 40 | 0.05 | 0.29 | 1.19 | 0.49 |
| Prohexadione-calcium | 250 | 14 | 0.02 | 0.13 | 1.00 | 0.45 |
| Gibberellic acid | 96 | 1 | 0.01 | 0.03 | 1.45 | 1.00 |

Figure 34 - Pears - Reasons for use of growth regulators (where given)

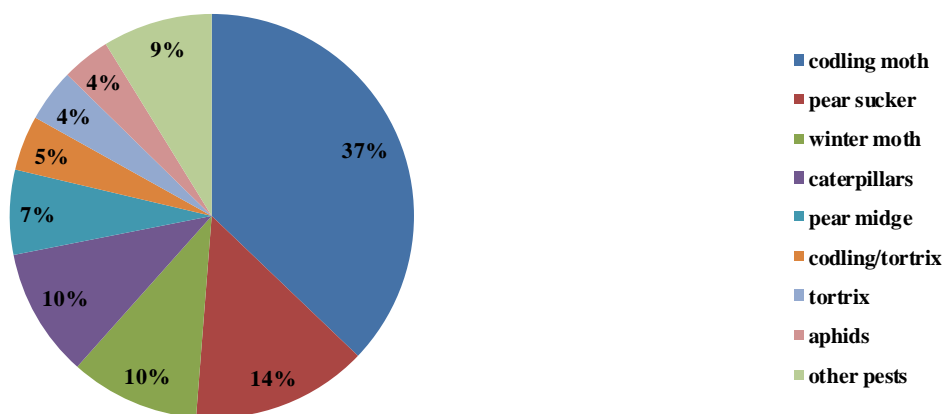


Pears – Insecticides

- **Formulation area treated: 5,022 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 | 1,609 | 56 | 0.32 | 0.57 | 1.49 | 0.99 |
| Methoxyfenozide | 1,119 | 138 | 0.22 | 0.48 | 1.21 | 0.85 |
| Thiacloprid | 586 | 101 | 0.12 | 0.23 | 1.32 | 0.96 |
| Chlorpyrifos | 509 | 244 | 0.10 | 0.27 | 1.00 | 0.50 |
| Indoxacarb | 379 | 23 | 0.08 | 0.16 | 1.24 | 0.82 |

Figure 35 - Pears - Reasons for use of insecticides (where given)

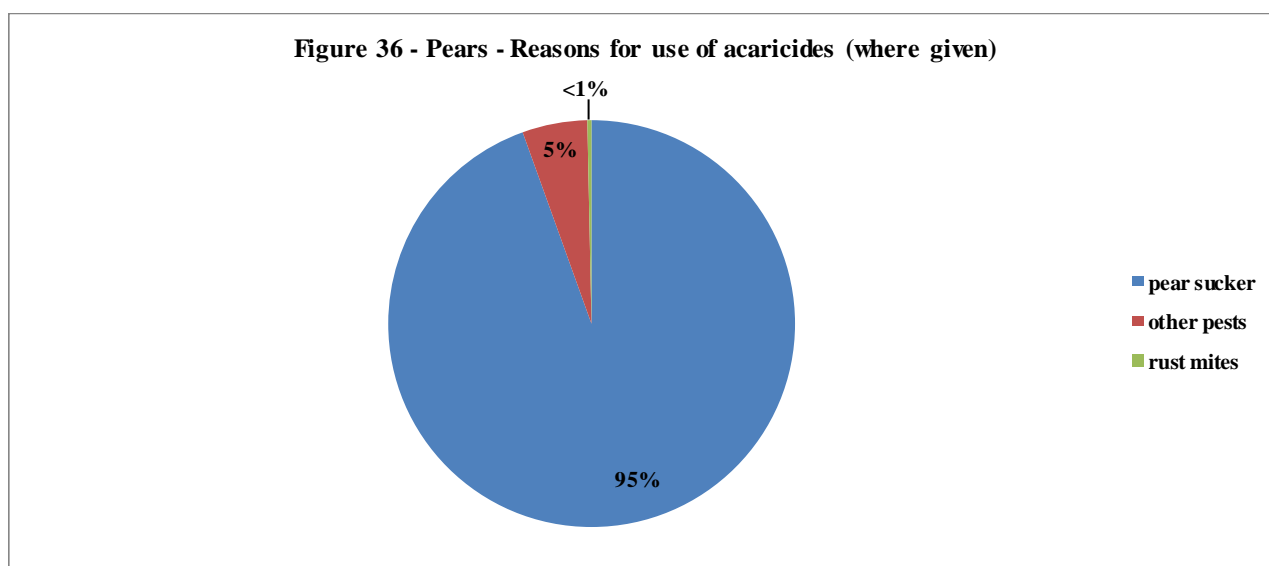


Pears – Acaricides

- **Formulation area treated: 750 hectares**
- **Weight of active substances applied: <0.1 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 | 677 | 97 | 0.90 | 0.35 | 1.01 | 0.99 |
| Abamectin | 73 | 1 | 0.10 | 0.03 | 1.16 | 0.86 |

Figure 36 - Pears - Reasons for use of acaricides (where given)



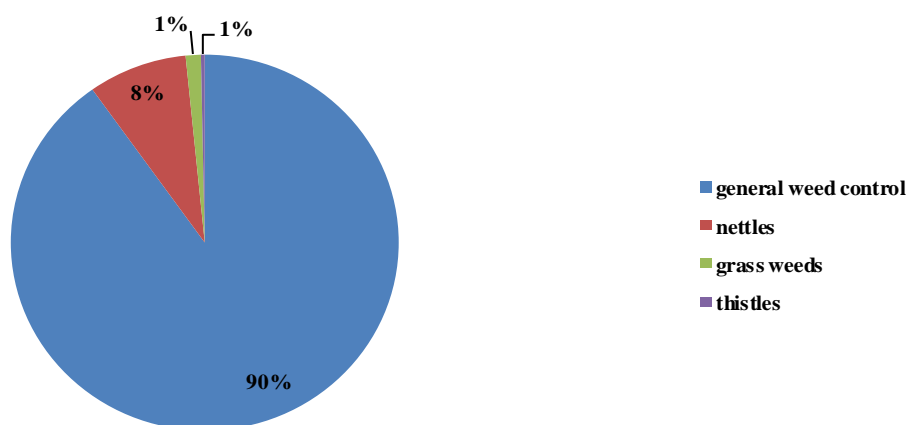
The reasons for use show that active substances, such as abamectin and spirodiclofen, whilst registered primarily for acaricide usage and classified within this report as acaricides, can have both acaricidal and insecticidal uses.

Pears – Herbicides

- **Formulation area treated: 5,170 hectares**
- **Weight of active substances applied: 3.2 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 | 2,473 | 1,692 | 0.48 | 0.84 | 1.51 | 0.32 |
| Dicamba/MCPA/mecoprop-P | 1,139 | 803 | 0.22 | 0.37 | 1.60 | 0.41 |
| 2,4-D | 678 | 453 | 0.13 | 0.28 | 1.28 | 0.46 |
| Glufosinate-ammonium | 342 | 83 | 0.07 | 0.15 | 1.22 | 0.32 |
| Propyzamide | 197 | 67 | 0.04 | 0.08 | 1.00 | 0.20 |

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



Pears – Other pesticides

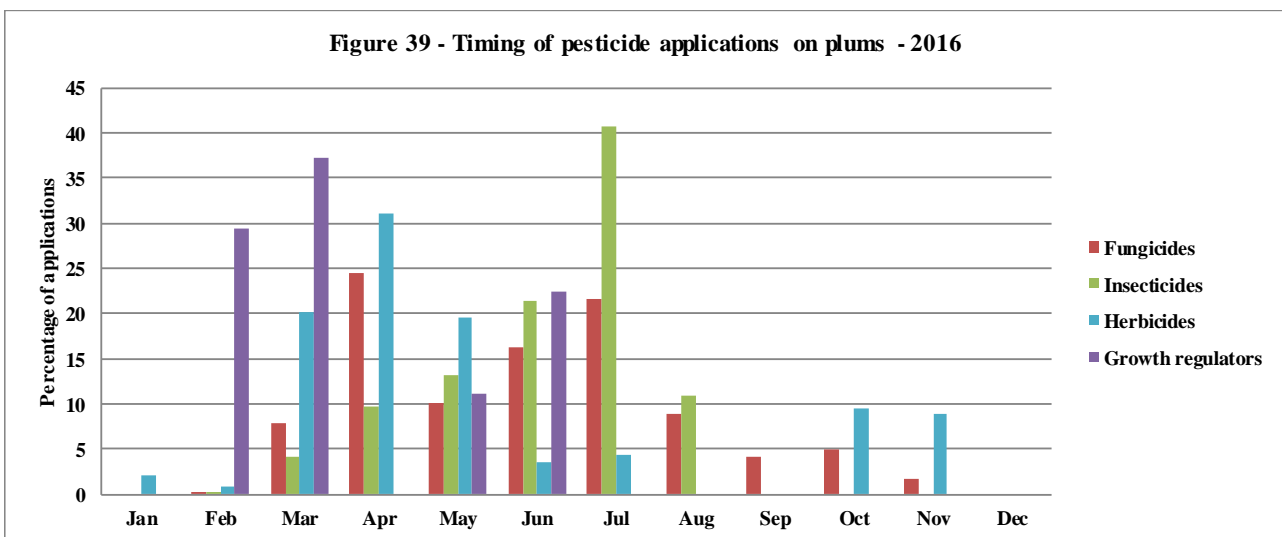
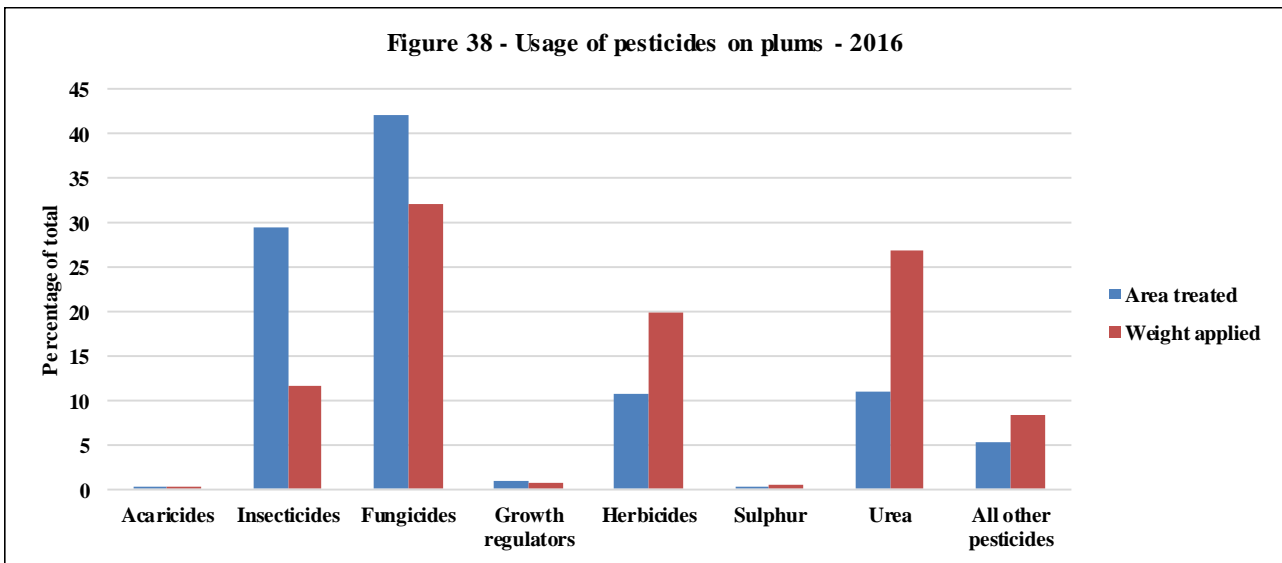
Urea accounted for 9% of the area of pesticides used on pears, biological control agents 2%, repellents 1% and growth stimulants less than one percent. By weight applied, urea comprised 13% of the total.

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

- 888 hectares of plums grown in the United Kingdom
- 8,715 treated hectares
- 3.3 tonnes applied
- 27% of plums remained untreated
- Plums received on average 10 fungicides, 6 insecticides, 2 herbicides and 2 growth regulators

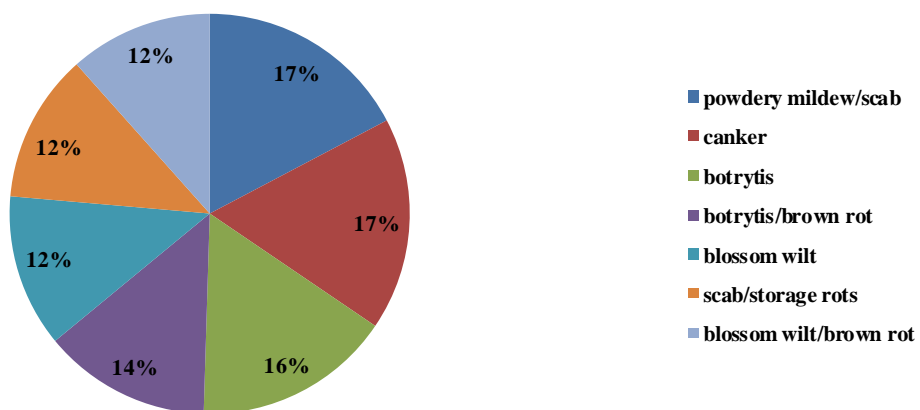


Plums – Fungicides

- **Formulation area treated: 3,658 hectares**
- **Weight of active substances applied: 1.1 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 |
|-------------------------|-------------------------------|-----------------------------|--------------------------------------|--------------------------|--|--|
| Fenbuconazole | 920 | 62 | 0.25 | 0.54 | 1.91 | 0.91 |
| Myclobutanil | 841 | 74 | 0.23 | 0.37 | 2.59 | 0.77 |
| Copper oxychloride | 562 | 482 | 0.15 | 0.34 | 1.88 | 0.35 |
| Cyprodinil/fludioxonil | 545 | 152 | 0.15 | 0.38 | 1.63 | 0.72 |
| Boscalid/pyraclostrobin | 463 | 110 | 0.13 | 0.35 | 1.51 | 0.95 |

Figure 40 - Plums - Reasons for use of fungicides (where given)

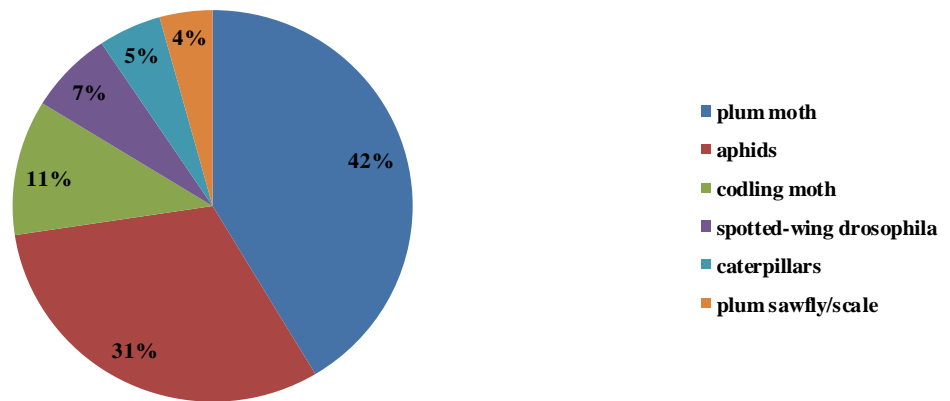


Plums – Insecticides

- **Formulation area treated: 2,567 hectares**
- **Weight of active substances applied: 0.38 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 |
|-----------------|-------------------------------|-----------------------------|--|--------------------------|--|--|
| Methoxyfenozide | 539 | 63 | 0.21 | 0.48 | 1.26 | 0.98 |
| Thiacloprid | 483 | 63 | 0.19 | 0.45 | 1.20 | 0.91 |
| Diflubenzuron | 397 | 53 | 0.15 | 0.32 | 1.42 | 0.92 |
| Spinosad | 370 | 44 | 0.14 | 0.31 | 1.33 | 0.98 |
| Deltamethrin | 190 | 1 | 0.07 | 0.18 | 1.16 | volumetric |

Figure 41 - Plums - Reasons for use of insecticides (where given)



Plums – Herbicides

- **Formulation area treated: 942 hectares**
- **Weight of active substances applied: 0.7 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 | 453 | 343 | 0.48 | 0.34 | 1.52 | 0.34 |
| Dicamba/MCPA/mecoprop-P | 157 | 128 | 0.17 | 0.09 | 1.91 | 0.47 |
| 2,4-D | 129 | 109 | 0.14 | 0.11 | 1.35 | 0.40 |
| Pendimethalin | 101 | 55 | 0.11 | 0.11 | 1.00 | 0.42 |
| Propyzamide | 43 | 14 | 0.05 | 0.05 | 1.00 | 0.19 |

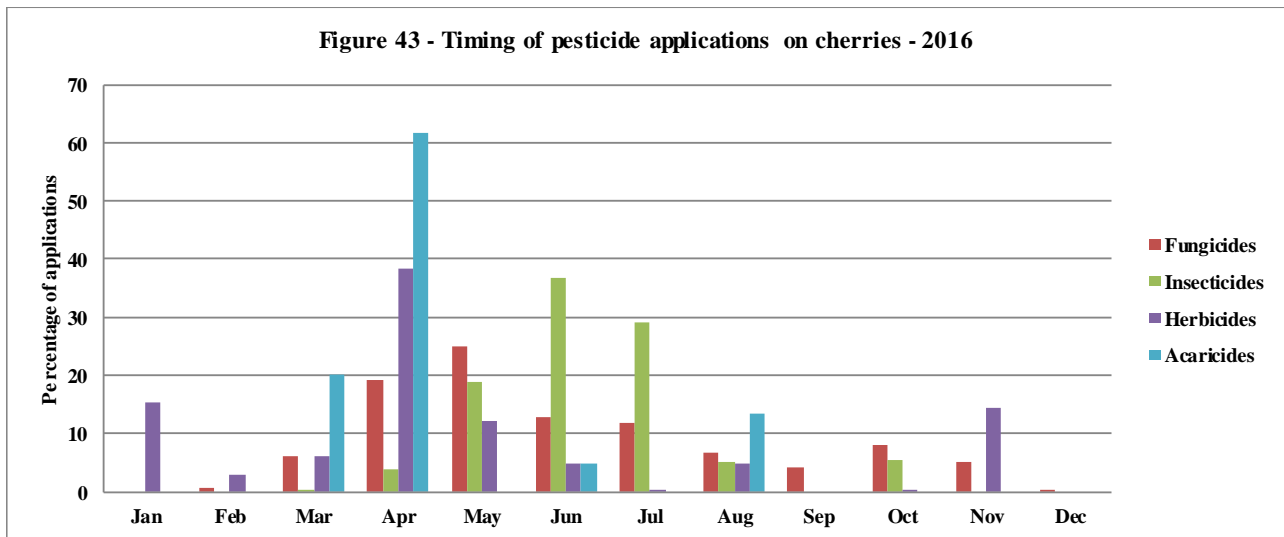
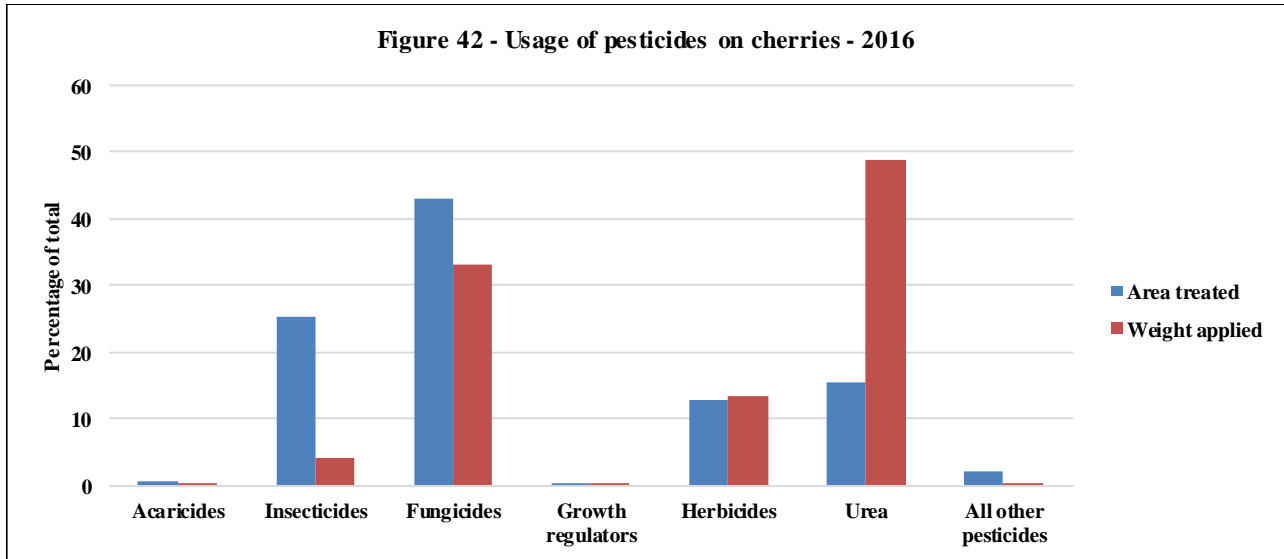
General weed control (99%) and thistle control were the only reasons specified for herbicide usage.

Plums – Other pesticides

All other pesticide groups applied to plums accounted for 16% of the total treated area and included urea, growth stimulants, physical controls, disinfectants and acaricides. Urea accounted for 11% of the area treated. In terms of weight applied urea accounted for 27% of the weight of all pesticides applied to plums.

Cherries

- 902 hectares of cherries grown in the United Kingdom
- 21,928 treated hectares
- 14.9 tonnes applied
- 1% of cherries remained untreated
- Cherries received on average 14 fungicides, 7 insecticides, 2 herbicides and 3 growth stimulants

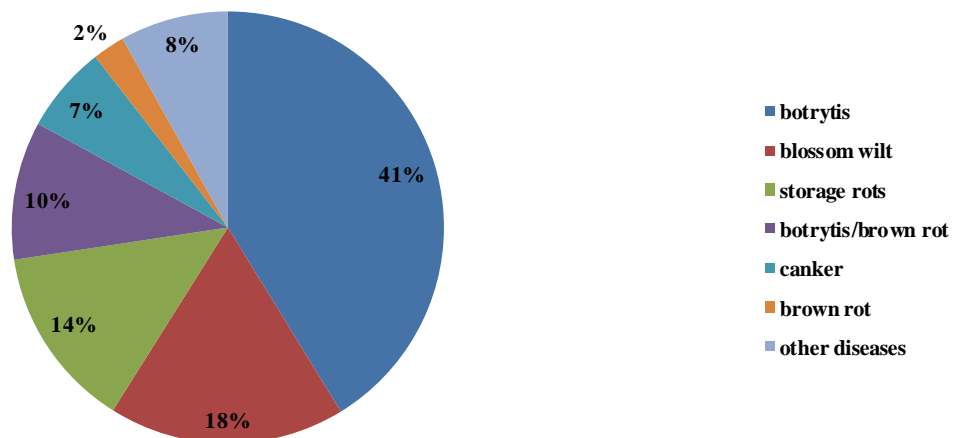


Cherries – Fungicides

- **Formulation area treated: 9,438 hectares**
- **Weight of active substances applied: 4.9 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 | 2,502 | 2,788 | 0.27 | 0.75 | 3.71 | 0.48 |
| Fenhexamid | 1,793 | 1,328 | 0.19 | 0.86 | 2.32 | 0.99 |
| Boscalid/pyraclostrobin | 1,752 | 436 | 0.19 | 0.84 | 2.32 | 0.99 |
| Cyprodinil/fludioxonil | 1,620 | 278 | 0.17 | 0.82 | 2.18 | 0.39 |
| Fenbuconazole | 1,362 | 67 | 0.14 | 0.85 | 1.77 | 0.99 |

Figure 44 - Cherries - Reasons for use of fungicides (where given)

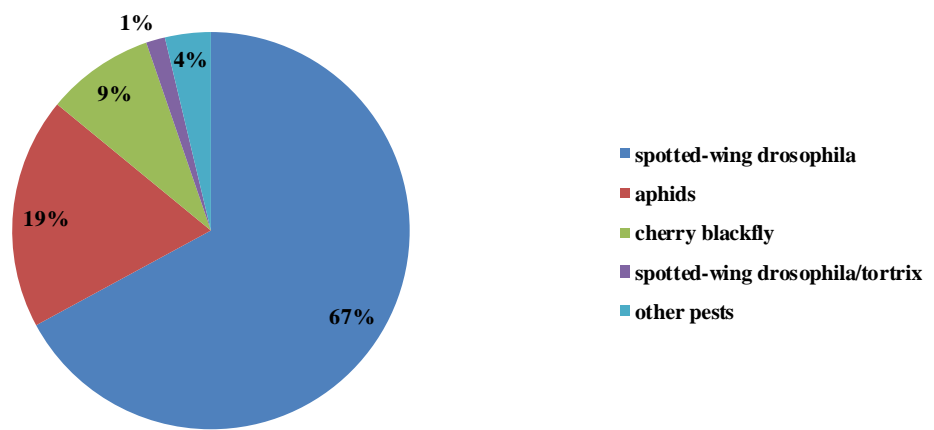


Cherries – Insecticides

- **Formulation area treated: 5,571 hectares**
- **Weight of active substances applied: 0.66 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 |
|------------------|-------------------------------|-----------------------------|--|--------------------------|--|--|
| Spinosad | 999 | 113 | 0.18 | 0.65 | 1.70 | 0.94 |
| Cyantraniliprole | 933 | 84 | 0.17 | 0.62 | 1.67 | 1.00 |
| Indoxacarb | 756 | 44 | 0.14 | 0.61 | 1.37 | 0.92 |
| Thiacloprid | 739 | 103 | 0.13 | 0.79 | 1.04 | 0.93 |
| Pirimicarb | 650 | 176 | 0.12 | 0.44 | 1.65 | 0.97 |

Figure 45 - Cherries - Reasons for use of insecticides (where given)



In 2016, the control of spotted-wing drosophila on cherries accounted for 67% of reasons given for insecticide use, in contrast with only 7% in 2014; this reflects the increasing importance of this newly emerging pest.

Cherries – Herbicides

- **Formulation area treated: 2,824 hectares**
- **Weight of active substances applied: 2.0 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 | 1,199 | 933 | 0.42 | 0.77 | 1.73 | 0.34 |
| Dicamba/MCPA/mecoprop-P | 605 | 484 | 0.21 | 0.24 | 2.74 | 0.46 |
| Glufosinate-ammonium | 373 | 173 | 0.13 | 0.27 | 1.51 | 0.62 |
| Pendimethalin | 241 | 183 | 0.09 | 0.27 | 1.00 | 0.58 |
| Propyzamide | 189 | 197 | 0.07 | 0.21 | 1.00 | 0.61 |

General weed control accounted for 96% of all herbicide applications with grass weed control accounting for the remaining 4%.

Cherries – Other pesticides

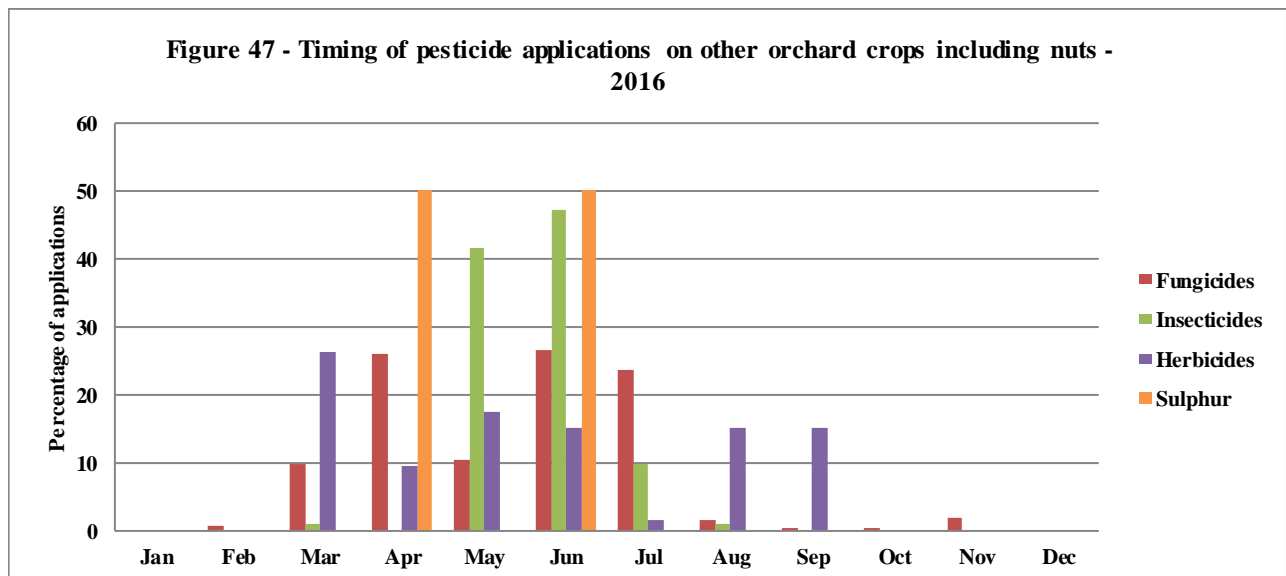
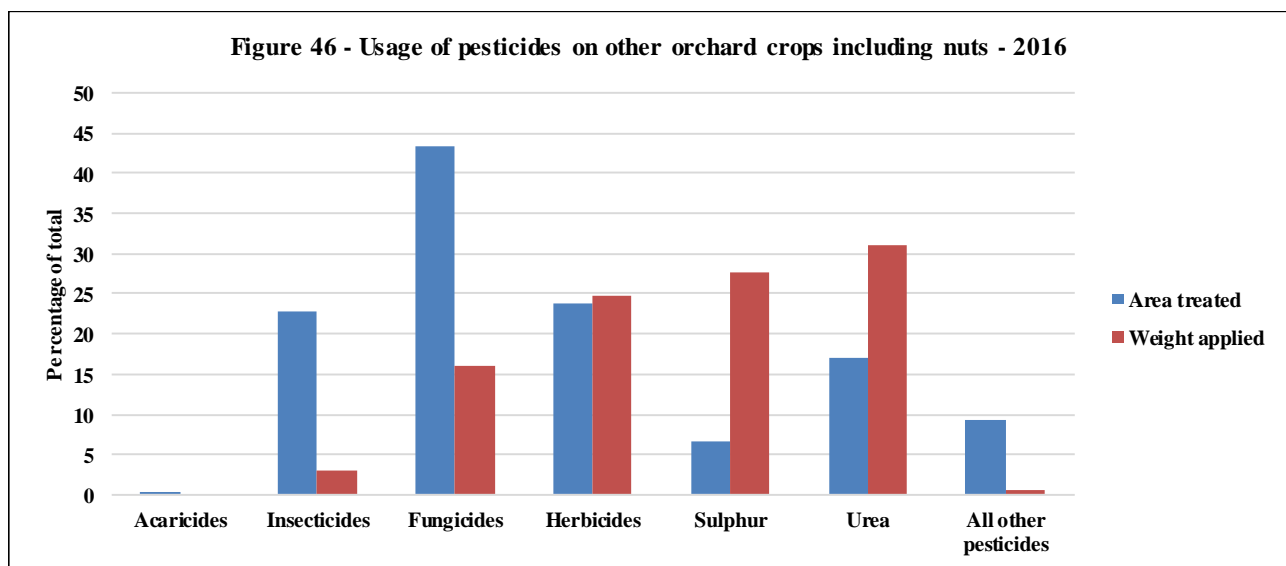
The growth stimulant harpin protein, used to prevent fruit split, accounted for 2% of the total area of cherries treated, but less than 1% of the weight applied.

Other groups recorded included urea (16% of the area treated, 49% of the weight of all pesticides applied), acaricides, biological controls, molluscicides, disinfectants and growth stimulants.

Phytoseiulus persimilis was the only biological control agent recorded on cherries.

Other orchard crops including nuts

- 561 hectares of other orchard crops including nuts grown in the United Kingdom
- 3,879 treated hectares
- 2.2 tonnes applied
- 30% of other orchard crops including nuts remained untreated
- Other orchard crops including nuts received on average 6 fungicides, 1 insecticide and 1 herbicide
- Other orchard crops included apricots, hazelnuts, quinces, walnuts, sweet chestnut, almond and peaches
- 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: 1,365 hectares**
- **Weight of active substances applied: 0.34 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 | 582 | 33 | 0.43 | 0.28 | 3.75 | 2.46 |
| Boscalid/pyraclostrobin | 302 | 74 | 0.22 | 0.28 | 1.95 | 0.98 |
| Cyprodinil/fludioxonil | 223 | 78 | 0.16 | 0.28 | 1.43 | 0.91 |
| Tebuconazole | 166 | 23 | 0.12 | 0.18 | 1.65 | 0.90 |
| Copper oxychloride | 62 | 115 | 0.05 | 0.09 | 1.23 | 1.30 |

Most fungicide applications, 42%, were used for mildew control, with 37% for blossom wilt and 21% for scab.

Other orchard crops including nuts – Herbicides

- **Formulation area treated: 753 hectares**
- **Weight of active substances applied: 0.52 tonnes**
- **The five 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 | 430 | 329 | 0.57 | 0.40 | 1.91 | 0.43 |
| 2,4-D | 110 | 74 | 0.15 | 0.19 | 1.02 | 0.32 |
| Dicamba/MCPA/mecoprop-P | 106 | 91 | 0.14 | 0.19 | 1.00 | 0.50 |
| Glufosinate-ammonium | 106 | 32 | 0.14 | 0.19 | 1.00 | 0.40 |
| Pendimethalin | 2 | 2 | 0.00 | 0.00 | 1.00 | 0.67 |

Other orchard crops including nuts – Insecticides

- **Formulation area treated: 717 hectares**
- **Weight of active substances applied: <0.1 tonnes**
- **The five 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 | 343 | 3 | 0.48 | 0.33 | 1.85 | 0.95 |
| Thiacloprid | 218 | 39 | 0.30 | 0.20 | 1.94 | 1.00 |
| Indoxacarb | 106 | 3 | 0.15 | 0.19 | 1.00 | 1.00 |
| Bacillus thuringiensis var. kurstaki | 35 | 13 | 0.05 | 0.06 | 1.00 | 1.00 |
| Chlorpyrifos | 6 | 3 | 0.01 | 0.01 | 1.00 | 0.50 |

Other orchard crops including nuts – Other pesticides

Other pesticides recorded on other orchard crops including nuts were urea, growth stimulants, acaricides and physical controls. They accounted for 21% of the area treated and 31% of the weight applied.

APPENDIX 1 – FOLIAR APPLICATION TABLES

Table 1 Area of orchard crops grown in the United Kingdom, 2016 (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) | 28 | 330 | 1,101 | . | 6 | 94 | 145 | . | . | . | . | 1,704 |
| Dessert apples (others) | 42 | 470 | 4,041 | 19 | 62 | 495 | 479 | . | . | 32 | 29 | 5,670 |
| Culinary apples | 155 | 298 | 1,591 | 22 | 1 | 44 | 110 | . | . | 3 | 1,447 | 3,672 |
| Pears | 2 | 266 | 1,438 | . | 5 | 81 | 103 | . | 1 | 5 | 6 | 1,907 |
| Cider apples & perry pears | 57 | . | 13 | . | . | 2,939 | 6,159 | 95 | 354 | . | . | 9,617 |
| Plums | . | 170 | 453 | . | 81 | 88 | 64 | . | 1 | 28 | 3 | 888 |
| Cherries | . | 10 | 540 | . | . | 8 | 315 | . | . | 30 | . | 902 |
| Other top fruit (incl. nuts) | . | 34 | 412 | . | 11 | . | 103 | . | . | . | . | 561 |
| All crops | 285 | 1,578 | 9,589 | 41 | 166 | 3,748 | 7,479 | 95 | 356 | 98 | 1,484 | 24,921 |

Table 2 Treated area of orchard crops in the United Kingdom, 2016, 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 | | | | | | | |
| Acaricides | 185 | 847 | 272 | 750 | 36 | 15 | 142 | 6 | 2,253 |
| Insecticides | 7,330 | 24,381 | 12,977 | 5,022 | 9,743 | 2,567 | 5,571 | 717 | 68,308 |
| Fungicides | 47,163 | 165,896 | 85,758 | 32,089 | 66,020 | 3,658 | 9,438 | 1,365 | 411,387 |
| Growth regulators | 7,019 | 9,943 | 7,527 | 675 | 12,376 | 77 | 92 | . | 37,709 |
| Herbicides | 4,455 | 16,834 | 10,177 | 14,097 | 5,133 | 942 | 2,824 | 753 | 55,214 |
| Sulphur | 180 | 691 | 545 | 4,221 | 3,759 | 21 | . | 212 | 9,628 |
| Urea | 3,156 | 11,985 | 4,111 | 6,446 | 1,329 | 965 | 3,402 | 536 | 31,929 |
| Biological controls | . | . | . | 1,548 | . | . | 88 | . | 1,636 |
| All other pesticides | 3 | <1 | 5 | 768 | . | 471 | 372 | 290 | 1,909 |
| All pesticides | 69,491 | 230,578 | 121,373 | 68,353 | 95,658 | 8,715 | 21,927 | 3,879 | 619,973 |
| Area grown | 1,704 | 5,670 | 3,672 | 1,907 | 9,617 | 888 | 902 | 561 | 24,921 |

Table 2a Treated weight of orchard crops in the United Kingdom, 2016, by crop group (kg active substance 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 | | | | | | | |
| Acaricides | 27 | 128 | 37 | 97 | 4 | 2 | 27 | <1 | 322 |
| Insecticides | 885 | 2,733 | 1,381 | 975 | 2,129 | 384 | 616 | 62 | 9,165 |
| Fungicides | 36,563 | 110,993 | 56,681 | 31,742 | 39,939 | 1,066 | 4,939 | 344 | 282,266 |
| Growth regulators | 339 | 612 | 536 | 141 | 370 | 26 | 2 | . | 2,026 |
| Herbicides | 2,956 | 9,239 | 5,141 | 5,276 | 3,171 | 662 | 2,029 | 528 | 29,003 |
| Sulphur | 215 | 1,396 | 740 | 10,809 | 10,825 | 16 | . | 593 | 24,594 |
| Urea | 3,385 | 11,393 | 4,046 | 2,106 | 8,466 | 892 | 7,286 | 665 | 38,240 |
| Biological controls | . | . | . | . | . | . | . | . | . |
| All other pesticides | <1 | <1 | <1 | 8,798 | . | 277 | 26 | 12 | 9,116 |
| All pesticides | 44,370 | 136,494 | 68,562 | 59,944 | 64,904 | 3,325 | 14,925 | 2,204 | 394,732 |

Table 3 Usage of pesticides on orchard crops in the United Kingdom, 2016 - percentage area of crops treated with pesticides

| | Insecticides | Acaricides | Biological control agents | Fungicides | Sulphur | Herbicides | Growth regulators | Not treated |
|----------------------------------|---------------------|-------------------|----------------------------------|-------------------|----------------|-------------------|--------------------------|--------------------|
| Dessert apples (Cox) | 95.5 | 8.8 | . | 96.4 | 8.7 | 85.8 | 75.9 | 3.6 |
| Dessert apples (others) | 85.9 | 12.6 | . | 90.4 | 5.9 | 81.9 | 59.3 | 8.8 |
| Culinary apples | 89.6 | 7.1 | . | 93.3 | 6.5 | 88.3 | 61.4 | 6.3 |
| Pears | 63 | 0.4 | . | 75.4 | 27.8 | 67.9 | 5.5 | 23.7 |
| Cider apples & perry pears | 90.4 | 36.8 | 42.6 | 96.6 | 67.4 | 87.7 | 86.6 | 3.2 |
| Plums | 69.9 | 1.4 | . | 60.2 | 2.3 | 36.3 | 6.7 | 27.1 |
| Cherries | 93.8 | 13.6 | 4.9 | 96.1 | . | 87.1 | 10 | 1.4 |
| Other orchard crops (incl. nuts) | 67.5 | 1.1 | . | 40.8 | 18.9 | 40 | . | 29.7 |
| All crops | 77.9 | 8 | 3.4 | 84 | 19.3 | 75.8 | 37.1 | 14.2 |

Table 4a Usage of pesticides on orchard crops in the United Kingdom, 2016 – mean number of spray rounds applied to treated crops

| | Insecticides | Acaricides | Biological control agents | Fungicides | Sulphur | Herbicides | Growth regulators | All pesticides |
|----------------------------------|---------------------|-------------------|----------------------------------|-------------------|----------------|-------------------|--------------------------|-----------------------|
| Dessert apples (Cox) | 4.4 | 1.2 | . | 17.1 | 1.2 | 2.2 | 4.7 | 19.7 |
| Dessert apples (others) | 4.7 | 1.1 | . | 17.2 | 2.7 | 2.3 | 2.9 | 20.1 |
| Culinary apples | 3.5 | 1.1 | . | 14.5 | 1.8 | 1.8 | 3.3 | 16.9 |
| Pears | 1.4 | 1 | . | 6.2 | 1.4 | 1.7 | 1.1 | 8.1 |
| Cider apples & perry pears | 3 | 1 | 1.8 | 13.8 | 3.1 | 1.9 | 7.1 | 17.7 |
| Plums | 5.6 | 1 | . | 7.9 | 1 | 2 | 2 | 11.1 |
| Cherries | 7 | 1 | . | 11.1 | . | 2.4 | 1 | 15.8 |
| Other orchard crops (incl. nuts) | 1.4 | 1 | . | 5.8 | 2 | 1.4 | . | 6.1 |
| All crops | 4.4 | 1.1 | 1.8 | 14.1 | 2.4 | 2.1 | 3.9 | 17 |

Table 4b Usage of pesticides on orchard crops in the United Kingdom, 2016 – mean number of products applied to treated crops

| | Insecticides | Acaricides | Biological control agents | Fungicides | Sulphur | Herbicides | Growth regulators | All pesticides |
|----------------------------------|---------------------|-------------------|----------------------------------|-------------------|----------------|-------------------|--------------------------|-----------------------|
| Dessert apples (Cox) | 4.6 | 1.2 | . | 31.4 | 1.2 | 3.5 | 5.5 | 43.5 |
| Dessert apples (others) | 5 | 1.1 | . | 32.1 | 2.7 | 3.7 | 3.1 | 42.6 |
| Culinary apples | 3.6 | 1.1 | . | 24.2 | 1.8 | 2.9 | 3.5 | 32.6 |
| Pears | 1.4 | 1 | . | 8.7 | 1.4 | 2 | 1.3 | 11.7 |
| Cider apples & perry pears | 3 | 1 | 1.8 | 17.1 | 3.1 | 2.9 | 7.9 | 32.8 |
| Plums | 5.6 | 1.2 | . | 8.3 | 1 | 3.4 | 2 | 15.9 |
| Cherries | 7.6 | 1 | . | 11.5 | . | 4.2 | 1 | 22.7 |
| Other orchard crops (incl. nuts) | 1.6 | 1 | . | 6.8 | 2 | 1.6 | . | 7.7 |
| All crops | 4.6 | 1.1 | 1.8 | 23.1 | 2.4 | 3.3 | 4.3 | 32.8 |

Table 4c Usage of pesticides on orchard crops in the United Kingdom, 2016 – mean number of active substances applied to treated crops

| | Insecticides | Acaricides | Biological control agents | Fungicides | Sulphur | Herbicides | Growth regulators | All pesticides |
|----------------------------------|---------------------|-------------------|----------------------------------|-------------------|----------------|-------------------|--------------------------|-----------------------|
| Dessert apples (Cox) | 4.6 | 1.2 | . | 34.7 | 1.2 | 5.3 | 5.5 | 48.3 |
| Dessert apples (others) | 5 | 1.1 | . | 35 | 2.7 | 5.5 | 3.1 | 47 |
| Culinary apples | 3.6 | 1.1 | . | 26.8 | 1.8 | 4.2 | 3.5 | 36.5 |
| Pears | 1.4 | 1 | . | 9.7 | 1.4 | 2.4 | 1.3 | 13 |
| Cider apples & perry pears | 3 | 1 | 1.8 | 18.9 | 3.1 | 4.4 | 7.9 | 35.9 |
| Plums | 5.6 | 1.2 | . | 10.4 | 1 | 5.4 | 2 | 19.1 |
| Cherries | 7.6 | 1 | . | 15.8 | . | 7.2 | 1 | 29.4 |
| Other orchard crops (incl. nuts) | 1.6 | 1 | . | 9.8 | 2 | 1.8 | . | 10 |
| All crops | 4.6 | 1.1 | 1.8 | 25.8 | 2.4 | 5 | 4.3 | 36.9 |

Table 5 *Estimated usage of pesticides on orchard crops grown in the United Kingdom, 2016 (spray hectares)*

| | Dessert apples - Cox | Dessert apples - others | Culinary apples | Pears | Cider apples & perry pears | Plums | Cherries | Other orchard crops (incl. nuts) | Total all orchard crops |
|--|-------------------------|----------------------------|--------------------|---------------|-------------------------------|--------------|--------------|--|----------------------------|
| Fungicides | | | | | | | | | |
| Boscalid/pyraclostrobin | 1,591 | 6,584 | 3,985 | 1,760 | 578 | 463 | 1,752 | 302 | 17,015 |
| Bupirimate | 1,189 | 2,371 | 834 | 15 | 1,537 | . | . | . | 5,946 |
| Captan | 8,957 | 32,831 | 14,244 | 13,338 | 5,370 | 4 | <1 | 6 | 74,751 |
| Copper oxychloride ¹ | 2,149 | 8,285 | 2,708 | 2,848 | 1,192 | 562 | 2,502 | 62 | 20,307 |
| Cyflufenamid | 2,020 | 5,746 | 1,790 | 132 | 1,352 | . | . | . | 11,039 |
| Cyprodinil/fludioxonil | 393 | 1,291 | 904 | 327 | 6 | 545 | 1,620 | 223 | 5,310 |
| Difenoconazole | 2,184 | 10,216 | 4,206 | 1,014 | 3,634 | . | . | . | 21,254 |
| Dithianon | 3,294 | 10,676 | 7,202 | 2,697 | 8,793 | . | . | . | 32,662 |
| Dithianon/potassium phosphonate (phosphite) | 1,943 | 4,572 | 3,127 | 1,006 | . | . | . | . | 10,648 |
| Dithianon/pyraclostrobin | 741 | 2,173 | 1,619 | 330 | 6,115 | . | . | . | 10,979 |
| Dodine | 2,064 | 8,265 | 6,342 | 2,645 | 18,641 | . | . | . | 37,957 |
| Fenbuconazole | 192 | 1,034 | 2,857 | 170 | 1,281 | 920 | 1,362 | 16 | 7,831 |
| Fenhexamid | . | . | <1 | . | . | 322 | 1,793 | 6 | 2,122 |
| Fludioxonil | 406 | 1,298 | 569 | 696 | . | . | . | . | 2,969 |
| Kresoxim-methyl | 2,025 | 6,615 | 1,988 | 23 | 562 | . | . | . | 11,212 |
| Mancozeb | 51 | 2,198 | 6,926 | 613 | 47 | . | . | . | 9,835 |
| Meptyldinocap | 1,306 | 3,642 | 773 | 9 | 498 | . | . | . | 6,228 |
| Myclobutanil | 7,387 | 24,453 | 10,084 | 1,291 | 8,116 | 841 | 402 | 582 | 53,157 |
| Penconazole | 3,532 | 13,783 | 4,751 | 238 | 5,555 | . | . | . | 27,859 |
| Penthiopyrad | 1,119 | 4,307 | 2,368 | 260 | 841 | . | . | . | 8,895 |
| Potassium hydrogen carbonate | 1,473 | 2,810 | 401 | 162 | 436 | . | . | . | 5,282 |
| Pyrimethanil | 2,168 | 9,192 | 6,833 | 1,813 | 1,415 | 1 | <1 | 2 | 21,425 |
| Tebuconazole | 954 | 3,546 | 1,220 | 701 | 53 | . | . | 166 | 6,639 |
| Other fungicides ² | 25 | 9 | 27 | . | . | . | 6 | . | 67 |
| All fungicides | 47,162 | 165,897 | 85,757 | 32,089 | 66,020 | 3,659 | 9,436 | 1,365 | 411,387 |
| Sulphur | 180 | 689 | 545 | 4,221 | 3,759 | 21 | . | 212 | 9,627 |
| Urea | 3,156 | 11,985 | 4,111 | 6,446 | 1,329 | 965 | 3,402 | 542 | 31,935 |

¹ Copper fungicides are also used for their bactericidal activity against bacterial canker in cherries and plums

² Other fungicides include *Bacillus subtilis*, copper sulphate, mancozeb/metalaxyl-m and thiophanate-methyl

Table 5 (cont.) Estimated usage of pesticides on orchard crops grown in the United Kingdom, 2016 (spray hectares)

| | Dessert apples - Cox | Dessert apples - others | Culinary apples | Pears | Cider apples & perry pears | Plums | Cherries | Other orchard crops (incl. nuts) | Total all orchard crops |
|---------------------------------|----------------------|-------------------------|-----------------|--------------|----------------------------|--------------|--------------|----------------------------------|-------------------------|
| <i>Acaricides</i> | | | | | | | | | |
| Spirodiclofen | 133 | 442 | 203 | 677 | 13 | 4 | 26 | . | 1,499 |
| Other acaricides ¹ | 52 | 405 | 69 | 73 | 23 | 11 | 116 | 6 | 754 |
| All acaricides | 185 | 847 | 272 | 750 | 36 | 15 | 142 | 6 | 2,253 |
| <i>Insecticides</i> | | | | | | | | | |
| Acetamiprid | 114 | 650 | 159 | . | 140 | 169 | 568 | . | 1,800 |
| Chlorantraniliprole | 1,742 | 5,994 | 2,375 | 1,609 | 954 | . | . | . | 12,675 |
| Chlorpyrifos | 462 | 1,262 | 689 | 509 | 2,616 | 183 | . | 6 | 5,727 |
| Cyantraniliprole | . | 16 | <1 | 4 | . | 93 | 933 | . | 1,047 |
| Cypermethrin | 48 | 927 | 2,114 | 23 | . | . | . | . | 3,112 |
| Diflubenzuron | 48 | 55 | 27 | 102 | . | 397 | 1 | . | 631 |
| Flonicamid | 834 | 2,730 | 1,880 | 69 | 622 | . | . | . | 6,135 |
| Indoxacarb | 894 | 2,209 | 979 | 379 | 257 | 14 | 756 | 106 | 5,594 |
| Lambda-cyhalothrin | . | 91 | . | 114 | . | 48 | 309 | 343 | 905 |
| Methoxyfenozide | 1,240 | 3,689 | 2,348 | 1,119 | 1,630 | 539 | <1 | . | 10,565 |
| Pirimicarb | 66 | 293 | 172 | 1 | 190 | 15 | 650 | . | 1,388 |
| Pyrethrins | 4 | 54 | . | 4 | 277 | 56 | 615 | . | 1,009 |
| Spinosad | 22 | 26 | 3 | 8 | . | 370 | 999 | 6 | 1,434 |
| Thiacloprid | 1,801 | 6,092 | 2,125 | 586 | 2,965 | 483 | 739 | 218 | 15,007 |
| Other insecticides ² | 55 | 294 | 107 | 92 | 495 | 199 | 0 | 38 | 1,280 |
| All insecticides | 7,330 | 24,382 | 12,976 | 9,743 | 5,022 | 2,566 | 5,570 | 717 | 68,308 |

¹Other acaricides include abamectin, clofentezine, fenpyroximate and tebufenpyrad

²Other insecticides include *Bacillus thuringiensis* var. kurstaki, *Cydia pomonella* granulovirus, deltamethrin, fatty acids, fenoxycarb and polysaccharides

Table 5 (cont.) Estimated usage of pesticides on orchard crops grown in the United Kingdom, 2016 (spray hectares)

| | Dessert apples - Cox | Dessert apples - others | Culinary apples | Pears | Cider apples & perry pears | Plums | Cherries | Other orchard crops (incl. nuts) | Total all orchard crops |
|-------------------------------|-------------------------|----------------------------|--------------------|---------------|-------------------------------|------------|--------------|--|----------------------------|
| <i>Herbicides</i> | | | | | | | | | |
| 2,4-D | 692 | 2,644 | 846 | 678 | 2,283 | 129 | 43 | 110 | 7,426 |
| 2,4-D/glyphosate | 45 | 615 | 126 | . | 777 | . | . | . | 1,563 |
| Dicamba/MCPA/mecoprop-P | 810 | 3,202 | 2,284 | 1,139 | 1,687 | 157 | 605 | 106 | 9,990 |
| Fluroxypyr | 74 | 366 | 211 | 81 | 50 | . | 3 | . | 785 |
| Glufosinate-ammonium | 180 | 912 | 224 | 342 | 673 | 35 | 373 | 106 | 2,845 |
| Glyphosate | 2,245 | 7,025 | 4,986 | 2,473 | 8,475 | 453 | 1,199 | 430 | 27,286 |
| MCPA | . | 6 | 623 | . | 48 | . | . | . | 677 |
| Pendimethalin | 83 | 282 | 67 | 77 | 7 | 101 | 241 | 2 | 859 |
| Propyzamide | 230 | 990 | 258 | 198 | . | 43 | 189 | . | 1,907 |
| Other herbicides ¹ | 72 | 547 | 97 | 412 | 132 | . | . | . | 1,260 |
| All herbicides | 4,455 | 16,833 | 10,177 | 14,096 | 5,134 | 942 | 2,824 | 753 | 55,214 |

¹Other herbicides include 2,4-D/MCPA, amitrole, carfentrazone-ethyl, clopyralid, clopyralid/triclopyr, dicamba/mecoprop-p, diquat, florasulam/pyroxsulam, fluzifop-p-butyl, isoxaben, metribuzin, metsulfuron-methyl/tribenuron-methyl and napropamide

Table 5 (cont.) Estimated usage of pesticides on orchard crops grown in the United Kingdom, 2016 (spray hectares)

| | Dessert apples - Cox | Dessert apples - others | Culinary apples | Pears | Cider apples & perry pears | Plums | Cherries | Other orchard crops (incl. nuts) | Total all orchard crops |
|--|----------------------|-------------------------|-----------------|--------------|----------------------------|-----------|-----------|----------------------------------|-------------------------|
| Biological control agents | | | . | | | | | | |
| <i>Anthocoris</i> spp. | . | . | . | 1,548 | . | . | . | . | 1548 |
| Other biological control agents ¹ | . | . | . | . | . | . | 88 | . | 88 |
| All biological control agents | . | . | . | 1,548 | . | . | 88 | . | 1,636 |
| | | | . | | | | | | |
| Disinfectants | | | . | | | | | | |
| Other disinfectants ² | . | . | . | . | . | 22 | 5 | . | 27 |
| | | | . | | | | | | |
| Growth regulators | | | . | | | | | | |
| 1-naphthylacetic acid | 89 | 622 | <1 | . | 54 | . | . | . | 764 |
| 6-benzyladenine | 121 | 626 | 13 | 11 | 54 | . | . | . | 823 |
| Gibberellins | 3,609 | 3,566 | 1,612 | 7,047 | . | 26 | 81 | . | 15,941 |
| Paclobutrazol | 1,751 | 2,073 | 2,522 | 4,284 | . | 51 | 10 | . | 10,690 |
| Prohexadione | 984 | 1,821 | 2,042 | 653 | 7 | . | . | . | 5,507 |
| Prohexadione-calcium | 393 | 690 | 1,242 | 250 | 149 | . | . | . | 2,724 |
| Other growth regulators ³ | 72 | 547 | 97 | 412 | 132 | . | . | . | 1,260 |
| All growth regulators | 7,019 | 9,943 | 7,527 | 675 | 12,376 | 77 | 92 | . | 37,709 |
| | | | . | | | | | | |
| Growth stimulants | | | . | | | | | | |
| Harpin protein | 3 | <1 | 5 | 28 | . | 395 | 360 | 284 | 1,075 |
| | | | . | | | | | | |
| Physical controls | | | . | | | | | | |
| Other physical controls ⁴ | . | . | . | . | . | 54 | 2 | . | 56 |
| | | | . | | | | | | |
| Repellents | | | . | | | | | | |
| Kaolin | . | . | . | 741 | . | . | . | . | 741 |

¹Other biological control agents include *Phytoseiulus persimilis*

²Other disinfectants include peroxyacetic acid

³Other growth regulators include 2-chloroethylphosphonic acid, gibberellic acid and metamitron.

⁴Other physical controls include natural plant extracts

Table 6 Estimated usage of pesticides on orchard crops grown in the United Kingdom, 2016 (kg active substance)

| | Dessert apples - Cox | Dessert apples - others | Culinary apples | Pears | Cider apples & perry pears | Plums | Cherries | Other orchard crops (incl. nuts) | Total all orchard crops |
|---|----------------------|-------------------------|-----------------|---------------|----------------------------|--------------|--------------|----------------------------------|-------------------------|
| Fungicides | | | | | | | | | |
| Boscalid/pyraclostrobin | 476 | 1,988 | 1,159 | 536 | 157 | 110 | 436 | 74 | 4,935 |
| Bupirimate | 97 | 222 | 91 | 1 | 142 | . | . | . | 554 |
| Captan | 13,168 | 49,281 | 19,136 | 20,217 | 7,646 | 7 | 2 | 10 | 109,466 |
| Copper oxychloride ¹ | 2,705 | 8,982 | 4,177 | 2,731 | 1,012 | 482 | 2,788 | 115 | 22,993 |
| Cyflufenamid | 50 | 141 | 45 | 3 | 30 | . | . | . | 269 |
| Cyprodinil/fludioxonil | 173 | 619 | 450 | 163 | 3 | 152 | 278 | 78 | 1,916 |
| Difenoconazole | 108 | 508 | 210 | 51 | 177 | . | . | . | 1,054 |
| Dithianon | 1,623 | 5,667 | 3,515 | 1,483 | 4,659 | . | . | . | 16,947 |
| Dithianon/potassium phosphonate (phosphite) | 3,296 | 7,626 | 5,315 | 1,715 | . | . | . | . | 17,952 |
| Dithianon/pyraclostrobin | 295 | 863 | 610 | 132 | 2,380 | . | . | . | 4,279 |
| Dodine | 1,702 | 6,899 | 5,267 | 2,251 | 16,509 | . | . | . | 32,627 |
| Fenbuconazole | 9 | 57 | 143 | 9 | 75 | 63 | 67 | <1 | 424 |
| Fenhexamid | . | . | <1 | . | . | 179 | 1,328 | 9 | 1,517 |
| Fludioxonil | 91 | 292 | 123 | 156 | . | . | . | . | 662 |
| Kresoxim-methyl | 202 | 659 | 198 | 2 | 56 | . | . | . | 1,116 |
| Mancozeb | 77 | 3,156 | 9,864 | 836 | 72 | . | . | . | 14,004 |
| Meptyldinocap | 267 | 738 | 155 | 2 | 86 | . | . | . | 1,248 |
| Myclobutanil | 444 | 1,532 | 630 | 78 | 685 | 74 | 40 | 33 | 3,516 |
| Penconazole | 146 | 564 | 190 | 12 | 260 | . | . | . | 1,172 |
| Penthiopyrad | 168 | 643 | 347 | 39 | 126 | . | . | . | 1,322 |
| Potassium hydrogen carbonate | 10,643 | 17,055 | 2,549 | 688 | 5,393 | . | . | . | 36,329 |
| Pyrimethanil | 672 | 2,987 | 2,251 | 543 | 467 | <1 | <1 | <1 | 6,921 |
| Tebuconazole | 132 | 509 | 177 | 93 | 5 | . | . | 23 | 938 |
| Other fungicides ² | 18 | 7 | 81 | . | . | . | . | . | |
| All fungicides | 36,562 | 110,993 | 56,680 | 31,742 | 39,939 | 1,066 | 4,938 | 342 | 282,265 |
| Sulphur | 215 | 1,394 | 740 | 10,809 | 10,825 | 16 | . | 593 | 24,593 |
| Urea | 3,385 | 11,393 | 4,046 | 2,106 | 8,466 | 892 | 7,286 | 665 | 38,240 |

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

² Other fungicides include *Bacillus subtilis*, copper sulphate, mancozeb/metalaxyl-m and thiophanate-methyl

Table 6 (cont.) Estimated usage of pesticides on orchard crops grown in the United Kingdom, 2016 (kg active substance)

| | Dessert apples - Cox | Dessert apples - others | Culinary apples | Pears | Cider apples & perry pears | Plums | Cherries | Other orchard crops (incl. nuts) | Total all orchard crops |
|---------------------------------|----------------------|-------------------------|-----------------|------------|----------------------------|------------|------------|----------------------------------|-------------------------|
| <i>Acaricides</i> | | | | | | | | | |
| Spirodiclofen | 19 | 62 | 28 | 97 | 2 | <1 | 4 | . | 212 |
| Other acaricides ¹ | 7 | 66 | 9 | 0 | 2 | 0 | 23 | . | 109 |
| All acaricides | 26 | 128 | 37 | 97 | 4 | . | 27 | . | 321 |
| <i>Insecticides</i> | | | | | | | | | |
| Acetamiprid | 7 | 42 | 12 | . | 9 | 9 | 42 | . | 120 |
| Chlorantraniliprole | 60 | 207 | 80 | 56 | 32 | . | . | . | 436 |
| Chlorpyrifos | 214 | 556 | 332 | 244 | 1,369 | 135 | . | 3 | 2,853 |
| Cyantraniliprole | . | 2 | <1 | <1 | . | 8 | 84 | . | 94 |
| Cypermethrin | 1 | 23 | 50 | <1 | . | . | . | . | 74 |
| Diflubenzuron | 6 | 7 | 4 | 15 | . | 53 | <1 | . | 85 |
| Flonicamid | 58 | 185 | 131 | 5 | 43 | . | . | . | 422 |
| Indoxacarb | 64 | 144 | 69 | 23 | 8 | <1 | 44 | 3 | 356 |
| Lambda-cyhalothrin | . | <1 | . | 1 | . | <1 | 3 | 3 | 8 |
| Methoxyfenozide | 146 | 432 | 299 | 138 | 223 | 63 | <1 | . | 1,301 |
| Pirimicarb | 18 | 81 | 40 | <1 | 48 | 1 | 176 | . | 364 |
| Pyrethrins | <1 | 3 | . | <1 | 15 | 4 | 51 | . | 74 |
| Spinosad | 2 | 3 | <1 | 1 | . | 44 | 113 | <1 | 163 |
| Thiacloprid | 300 | 1,027 | 360 | 101 | 382 | 63 | 103 | 39 | 2,375 |
| Other insecticides ² | 7 | 20 | 4 | 390 | 0 | 3 | 0 | 13 | 439 |
| All insecticides | 884 | 2,732 | 1,380 | 974 | 2,128 | 383 | 616 | 61 | 9,165 |

¹Other acaricides include abamectin, clofentezine, fenpyroximate and tebufenpyrad

²Other insecticides include *Bacillus thuringiensis* var. kurstaki, *Cydia pomonella* granulovirus, deltamethrin, fatty acids, fenoxycarb and polysaccharides

Table 6 (cont.) *Estimated usage of pesticides on orchard crops grown in the United Kingdom, 2016 (kg active substance)*

| | Dessert apples - Cox | Dessert apples - others | Culinary apples | Pears | Cider apples & perry pears | Plums | Cherries | Other orchard crops (incl. nuts) | Total all orchard crops |
|-------------------------------|-------------------------|----------------------------|--------------------|--------------|-------------------------------|------------|--------------|--|----------------------------|
| Herbicides | | | | | | | | | |
| 2,4-D | 402 | 1,500 | 487 | 453 | 668 | 109 | 39 | 74 | 3,732 |
| 2,4-D/glyphosate | 28 | 399 | 81 | . | 352 | . | . | . | 860 |
| Dicamba/MCPA/mecoprop-P | 673 | 2,092 | 1,300 | 803 | 759 | 128 | 484 | 91 | 6,329 |
| Fluroxypyr | 5 | 30 | 25 | 9 | 3 | . | <1 | . | 73 |
| Glufosinate-ammonium | 56 | 212 | 47 | 83 | 133 | 9 | 173 | 32 | 745 |
| Glyphosate | 1,633 | 4,387 | 2,748 | 1,692 | 3,298 | 343 | 933 | 329 | 15,362 |
| MCPA | . | 1 | 228 | . | 50 | . | . | . | 280 |
| Pendimethalin | 59 | 167 | 48 | 51 | 4 | 55 | 183 | 2 | 569 |
| Propyzamide | 89 | 357 | 87 | 67 | . | 14 | 197 | . | 810 |
| Other herbicides ¹ | 11 | 92 | 89 | 9 | 13 | 4 | 19 | . | 241 |
| All herbicides | 2,955 | 9,237 | 5,140 | 5,275 | 3,171 | 662 | 2,028 | 528 | 29,000 |

¹Other herbicides include 2,4-D/MCPA, amitrole, carfentrazone-ethyl, clopyralid, clopyralid/triclopyr, dicamba/mecoprop-p, diquat, florasulam/pyroxulam, fluazifop-p-butyl, isoxaben, metribuzin, metsulfuron-methyl/tribenuron-methyl and napropamide

Table 6 (cont.) *Estimated usage of pesticides on orchard crops grown in the United Kingdom, 2016 (kg active substance)*

| | Dessert apples - Cox | Dessert apples - others | Culinary apples | Pears | Cider apples & perry pears | Plums | Cherries | Other orchard crops (incl. nuts) | Total all orchard crops |
|--|---------------------------------|------------------------------------|----------------------------|--------------|---|--------------|-----------------|---|------------------------------------|
| <i>Other disinfectants</i> | | | | | | | | | |
| Other disinfectants ¹ | . | . | . | . | . | 3 | <1 | . | 4 |
| | | | | | | | | | |
| <i>Growth regulators</i> | | | | | | | | | |
| 1-naphthylacetic acid | 1 | 6 | <1 | . | <1 | . | . | . | 8 |
| 6-benzyladenine | 17 | 73 | 2 | 2 | 7 | . | . | . | 100 |
| Gibberellins | 11 | 9 | 4 | 24 | . | <1 | <1 | . | 48 |
| Pacllobutrazol | 150 | 161 | 217 | 282 | . | 26 | 1 | . | 837 |
| Prohexadione | 102 | 171 | 194 | 40 | <1 | . | . | . | 508 |
| Prohexadione-calcium | 39 | 69 | 95 | 14 | 12 | . | . | . | 229 |
| Other growth regulators ² | 20 | 123 | 25 | 120 | 8 | . | . | . | 296 |
| All growth regulators | 339 | 612 | 536 | 139 | 370 | 26 | 1 | 0 | 2,026 |
| | | | | | | | | | |
| <i>Growth stimulant</i> | | | | | | | | | |
| Harpin protein | <1 | <1 | <1 | 4 | . | 5 | 18 | <1 | 28 |
| | | | | | | | | | |
| <i>Other physical control agents</i> | | | | | | | | | |
| Other physical control agents ³ | 0 | 0 | 0 | 0 | 0 | 269 | 8 | . | 277 |
| | | | | | | | | | |
| | | | | | | | | | |
| <i>Molluscicides & repellents</i> | | | | | | | | | |
| Kaolin | . | . | . | 8,794 | . | . | . | . | 8,794 |

¹Other disinfectants include peroxyacetic acid

²Other growth regulators include 2-chloroethylphosphonic acid, gibberellic acid and metamitron

³Other physical control agents include natural plant extracts

Table 7 Estimated area (ha) of application of the fifty most extensively used active substances on all orchard crops surveyed in 2016 in the United Kingdom

| | Active substance | Area treated 2016 (ha) | Area treated 2014 (ha) | % change on 2014 | Movement | |
|----|--|------------------------|------------------------|------------------|----------|---|
| | | | | | | |
| 1 | Captan | 74,751 | 80,973 | -8 | | ↓ |
| 2 | Dithianon | 54,288 | 52,185 | 4 | ↑ | |
| 3 | Myclobutanil | 53,157 | 44,580 | 19 | ↑ | |
| 4 | Dodine | 37,957 | 39,962 | -5 | | ↓ |
| 5 | Urea | 31,935 | 41,244 | -23 | | ↓ |
| 6 | Glyphosate | 28,849 | 22,121 | 30 | ↑ | |
| 7 | Pyraclostrobin | 27,994 | 26,093 | 7 | ↑ | |
| 8 | Penconazole | 27,859 | 38,811 | -28 | | ↓ |
| 9 | Pyrimethanil | 21,425 | 20,627 | 4 | ↑ | |
| 10 | Difenoconazole | 21,254 | 20,698 | 3 | ↑ | |
| 11 | Copper oxychloride | 20,307 | 21,313 | -5 | | ↓ |
| 12 | Boscalid | 17,015 | 14,351 | 19 | ↑ | |
| 13 | Gibberellins | 15,941 | 19,252 | -17 | | ↓ |
| 14 | Thiacloprid | 15,007 | 8,252 | 82 | ↑ | |
| 15 | Chlorantraniliprole | 12,675 | 9,593 | 32 | ↑ | |
| 16 | Kresoxim-methyl | 11,212 | 9,007 | 24 | ↑ | |
| 17 | Cyflufenamid | 11,039 | 8,240 | 34 | ↑ | |
| 18 | MCPA | 10,692 | 12,489 | -14 | | ↓ |
| 19 | Paclbutrazol | 10,690 | 15,990 | -33 | | ↓ |
| 20 | Potassium phosphonate (phosphite) ¹ | 10,648 | 0 | . | ↑ | |
| 21 | Methoxyfenozide | 10,565 | 9,000 | 17 | ↑ | |
| 22 | Mecoprop-P | 10,237 | 12,391 | -17 | | ↓ |
| 23 | Dicamba | 10,237 | 12,335 | -17 | | ↓ |
| 24 | Mancozeb | 9,857 | 9,404 | 5 | ↑ | |
| 25 | Sulphur | 9,626 | 11,275 | -15 | | ↓ |
| 26 | 2,4-D | 9,013 | 2,752 | 228 | ↑ | |
| 27 | Penthiopyrad ¹ | 8,895 | 0 | . | ↑ | |
| 28 | Fludioxonil | 8,279 | 2,674 | 210 | ↑ | |
| 29 | Fenbuconazole | 7,831 | 8,717 | -10 | | ↓ |
| 30 | Tebuconazole | 6,639 | 4,275 | 55 | ↑ | |
| 31 | Meptyldinocap | 6,228 | 5,405 | 15 | ↑ | |
| 32 | Fonicamid | 6,135 | 8,206 | -25 | | ↓ |
| 33 | Bupirimate | 5,946 | 7,626 | -22 | | ↓ |
| 34 | Chlorpyrifos | 5,727 | 24,249 | -76 | | ↓ |
| 35 | Indoxacarb | 5,594 | 2,731 | 105 | ↑ | |
| 36 | Prohexadione ¹ | 5,507 | 0 | . | ↑ | |
| 37 | Cyprodinil | 5,310 | 2,621 | 103 | ↑ | |
| 38 | Potassium hydrogen carbonate | 5,282 | 4,819 | 10 | ↑ | |
| 39 | Cypermethrin | 3,112 | 2,026 | 54 | ↑ | |
| 40 | Glufosinate-ammonium | 2,845 | 4,411 | -35 | | ↓ |
| 41 | Prohexadione-calcium | 2,724 | 6,089 | -55 | | ↓ |
| 42 | Fenhexamid | 2,122 | 2,062 | 3 | ↑ | |
| 43 | Propyzamide | 1,907 | 846 | 125 | ↑ | |
| 44 | Acetamiprid | 1,800 | 86 | 1,991 | ↑ | |
| 45 | Anthocorids | 1,511 | 1,268 | 19 | ↑ | |
| 46 | Spirodiclofen | 1,499 | 1,481 | 1 | ↑ | |
| 47 | Spinosad | 1,434 | 271 | 429 | ↑ | |
| 48 | Pirimicarb | 1,388 | 2,716 | -49 | | ↓ |
| 49 | Harpin protein | 1,075 | 1,965 | -45 | | ↓ |
| 50 | Cyantraniliprole ¹ | 1,047 | 0 | . | ↑ | |

¹Not encountered in 2014

Table 8 Estimated amount (kg) of the fifty most extensively used active substances on all orchard crops surveyed in 2016 in the United Kingdom

| | Active substance | Amount used 2016 (kg) | Amount used 2014 (kg) | % change on 2014 | Movement | |
|----|--|-----------------------|-----------------------|------------------|----------|---|
| 1 | Captan | 109,466 | 121,957 | -10 | | ↓ |
| 2 | Urea | 38,124 | 49,782 | -23 | | ↓ |
| 3 | Potassium hydrogen carbonate | 36,329 | 29,519 | 23 | ↑ | |
| 4 | Dodine | 32,627 | 35,749 | -9 | | ↓ |
| 5 | Sulphur | 24,592 | 26,687 | -8 | | ↓ |
| 6 | Copper oxychloride | 22,993 | 20,877 | 10 | ↑ | |
| 7 | Dithianon | 21,287 | 25,026 | -15 | | ↓ |
| 8 | Glyphosate | 15,878 | 12,505 | 27 | ↑ | |
| 9 | Potassium phosphonate (phosphite) ¹ | 14,681 | 0 | . | ↑ | |
| 10 | Mancozeb | 14,018 | 14,576 | -4 | | ↓ |
| 11 | Kaolin | 8,794 | 10,420 | -16 | | ↓ |
| 12 | Pyrimethanil | 6,921 | 6,266 | 10 | ↑ | |
| 13 | MCPA | 5,477 | 5,506 | -1 | | ↓ |
| 14 | Pyraclostrobin | 4,787 | 4,771 | 0 | ↑ | |
| 15 | 2,4-D | 4,080 | 1,258 | 224 | ↑ | |
| 16 | Myclobutanil | 3,516 | 3,113 | 13 | ↑ | |
| 17 | Boscalid | 3,358 | 2,831 | 19 | ↑ | |
| 18 | Chlorpyrifos | 2,853 | 15,343 | -81 | | ↓ |
| 19 | Thiacloprid | 2,375 | 1,192 | 99 | ↑ | |
| 20 | Fenhexamid | 1,517 | 1,337 | 13 | ↑ | |
| 21 | Fludioxonil | 1,429 | 392 | 265 | ↑ | |
| 22 | Penthiopyrad ¹ | 1,322 | 0 | . | ↑ | |
| 23 | Methoxyfenozide | 1,301 | 1,205 | 8 | ↑ | |
| 24 | Meptyldinocap | 1,248 | 1,119 | 12 | ↑ | |
| 25 | Penconazole | 1,171 | 1,578 | -26 | | ↓ |
| 26 | Cyprodinil | 1,150 | 571 | 101 | ↑ | |
| 27 | Kresoxim-methyl | 1,116 | 896 | 25 | ↑ | |
| 28 | Difenoconazole | 1,054 | 990 | 6 | ↑ | |
| 29 | Tebuconazole | 938 | 646 | 45 | ↑ | |
| 30 | Mecoprop-P | 881 | 899 | -2 | | ↓ |
| 31 | Pacllobutrazol | 837 | 1,166 | -28 | | ↓ |
| 32 | Propyzamide | 810 | 400 | 103 | ↑ | |
| 33 | Glufosinate-ammonium | 745 | 1,100 | -32 | | ↓ |
| 34 | Pendimethalin | 569 | 197 | 188 | ↑ | |
| 35 | Bupirimate | 553 | 740 | -25 | | ↓ |
| 36 | Prohexadione ¹ | 508 | 0 | . | ↑ | |
| 37 | Chlorantraniliprole | 436 | 333 | 31 | ↑ | |
| 38 | Fenbuconazole | 424 | 455 | -7 | | ↓ |
| 39 | Flonicamid | 422 | 572 | -26 | | ↓ |
| 40 | Pirimicarb | 364 | 675 | -46 | | ↓ |
| 41 | Indoxacarb | 356 | 186 | 92 | ↑ | |
| 42 | Dicamba | 305 | 327 | -7 | | ↓ |
| 43 | Fatty acids | 298 | 168 | 77 | ↑ | |
| 44 | Natural plant extracts ¹ | 277 | 0 | . | ↑ | |
| 45 | Cyflufenamid | 269 | 202 | 33 | ↑ | |
| 46 | Prohexadione-calcium | 229 | 577 | -60 | | ↓ |
| 47 | Spirodiclofen | 212 | 207 | 2 | ↑ | |
| 48 | Spinosad | 163 | 32 | 415 | ↑ | |
| 49 | Metamitron ¹ | 149 | 0 | . | ↑ | |
| 50 | 2-chloroethylphosphonic acid | 146 | 39 | 274 | ↑ | |

¹Not encountered in 2014

Table 9 New or newly encountered compounds encountered on all orchard crops in the United Kingdom between 2014 & 2016

| | Active substance | Area treated 2016 (ha) | Amount used 2016 (kg) |
|----|-----------------------------------|------------------------|-----------------------|
| 1 | Potassium phosphonate (phosphite) | 10,648 | 14,681 |
| 2 | Penthiopyrad | 8,895 | 1,322 |
| 3 | Prohexadione | 5,507 | 508 |
| 4 | Cyantraniliprole | 1,047 | 94 |
| 5 | Metamitron | 618 | 149 |
| 6 | Metsulfuron-methyl | 253 | 1 |
| 7 | Tribenuron-methyl | 253 | 1 |
| 8 | Florasulam | 62 | <1 |
| 9 | Pyroxulam | 62 | <1 |
| 10 | Natural plant extracts | 56 | 277 |
| 11 | Metalaxyl-M | 21 | 1 |
| 12 | Thiophanate-methyl | 13 | 11 |
| 13 | Napropamide | 4 | 3 |

Table 10 Major increases in the use of individual active substances on all orchard crops in the United Kingdom since 2016 (area treated)

| | Active substance | Area treated 2016 (ha) | Area treated 2014 (ha) | % change on 2014 |
|----|------------------------------|------------------------|------------------------|------------------|
| 1 | Acetamiprid | 1,800 | 86 | 1,991 |
| 2 | Gibberellic acid | 96 | 11 | 739 |
| 3 | 1-naphthylacetic acid | 764 | 102 | 648 |
| 4 | 2-chloroethylphosphonic acid | 546 | 100 | 447 |
| 5 | Spinosad | 1,434 | 271 | 429 |
| 6 | Isoxaben | 96 | 20 | 383 |
| 7 | Carfentrazone-ethyl | 64 | 15 | 334 |
| 8 | Pyrethrins | 1,009 | 248 | 306 |
| 9 | 2,4-D | 9,013 | 2,752 | 228 |
| 10 | Fludioxonil | 8,279 | 2,674 | 210 |
| 11 | Pendimethalin | 859 | 302 | 184 |
| 12 | Lambda-cyhalothrin | 905 | 328 | 176 |
| 13 | Diquat | 390 | 172 | 127 |
| 14 | Propyzamide | 1,907 | 846 | 125 |
| 15 | Indoxacarb | 5,594 | 2,731 | 105 |
| 16 | Cyprodinil | 5,310 | 2,621 | 103 |
| 17 | Fluroxypyr | 785 | 388 | 102 |
| 18 | Clofentezine | 472 | 238 | 99 |
| 19 | Phytoseiulus persimilis | 88 | 48 | 82 |
| 20 | Thiacloprid | 15,007 | 8,252 | 82 |

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 2016 (ha) | Area treated 2014 (ha) | % change on 2014 |
|----|------------------------------|------------------------|------------------------|------------------|
| 1 | Amitrole | 172 | 1,655 | -90 |
| 2 | Peroxyacetic acid | 27 | 197 | -86 |
| 3 | Bacillus thuringiensis var. | 59 | 429 | -86 |
| 4 | Cydia pomonella granulovirus | 231 | 1,330 | -83 |
| 5 | Fluazifop-P-butyl | 11 | 56 | -81 |
| 6 | Chlorpyrifos | 5,727 | 24,249 | -76 |
| 7 | Polysaccharides | 45 | 190 | -76 |
| 8 | Copper sulphate | 27 | 60 | -55 |
| 9 | Prohexadione-calcium | 2,724 | 6,089 | -55 |
| 10 | Pirimicarb | 1,388 | 2,716 | -49 |
| 11 | Harpin protein | 1,075 | 1,965 | -45 |
| 12 | Metribuzin | 4 | 6 | -36 |
| 13 | Glufosinate-ammonium | 2,845 | 4,411 | -35 |
| 14 | Fenoxycarb | 399 | 604 | -34 |
| 15 | Paclobutrazol | 10,690 | 15,990 | -33 |
| 16 | Penconazole | 27,859 | 38,811 | -28 |
| 17 | Fonicamid | 6,135 | 8,206 | -25 |
| 18 | Urea | 31,935 | 41,244 | -23 |
| 19 | Bupirimate | 5,946 | 7,626 | -22 |
| 20 | 6-benzyladenine | 135 | 173 | -22 |

Table 12 Comparison of pesticide usage on all orchard crops in the United Kingdom, 2010 - 2016, area treated (ha) and amount used (t)

| Chemical | 2012 ¹ | | 2014 | | 2016 | |
|----------------------------|-------------------|-----|---------|-----|---------|-----|
| | ha | t | ha | t | ha | t |
| Acaricides | 2,087 | <1 | 1,943 | <1 | 2,253 | <1 |
| Insecticides | 63,919 | 18 | 71,151 | 20 | 68,308 | 9 |
| Biological control agents | 4,520 | . | 1,397 | . | 1,636 | . |
| Fungicides | 402,792 | 295 | 395,932 | 274 | 411,387 | 282 |
| Sulphur | 11,929 | 32 | 11,275 | 27 | 9,628 | 25 |
| Growth regulators | 43,590 | 2 | 42,286 | 2 | 37,709 | 2 |
| Herbicides | 46,635 | 24 | 45,834 | 23 | 55,214 | 29 |
| Molluscicides & repellents | 939 | 13 | 879 | 10 | 745 | 9 |
| Urea | 21,301 | 30 | 41,244 | 50 | 31,929 | 38 |
| Other pesticides | 2,295 | 1 | 2,502 | <1 | 1,164 | <1 |
| Total - all pesticides | 600,006 | 407 | 614,442 | 407 | 619,973 | 395 |
| Area grown (ha) | 22,458 | | 23,433 | | 24,921 | |

¹Data 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 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 considers 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 2015 for England & Wales (Anon., 2016a, 2016b), for Scotland (Anon., 2016c) and Northern Ireland (Anon, 2016d).

The samples were drawn from the census returns 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 (GORs), 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 the surveys conducted by the survey team. In the 2014 survey (the last time orchard crops were surveyed), the RSE was 6.2%. As the RSE were 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 293 holdings were surveyed during the winter of 2016/17 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 330 holdings were contacted, of which 28 (8%) were not growing orchard crops commercially. Of the 302 premises growing orchard crops, 20 (6%) were unwilling to help with the survey; a further 6 (2%) either provided data after the deadline or were willing to help at a later date. A total of 227 orchard premises in the United Kingdom provided farm assurance data for the survey and of these 22 (10%) 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 46% of the holdings contacted in England & Wales, with these records accounting for 69% of the total area of orchards grown and 83% of the total area treated. Of those using electronic record keeping 75% used commercial farm management software systems with the remaining 25% 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 42% of the number of holdings in England & Wales were collected using non-visit methodologies, which together accounted for 34% 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 227 holdings visited in the United Kingdom where assurance information was available, 59% 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 82% 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 2015/2016 season.

Form 2 dealt with all aspects of pesticide usage on the individual crops grown on the holding and harvested in 2016, 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, 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 2016 as recorded in the June Survey of Agriculture and Horticulture for England & Wales (Anon., 2017a, b), Scotland (Anon., 2017c) and Northern Ireland (Anon., 2017d). These, combined with data from the Defra Horticulture Statistics (HS) (Anon., 2017e), allowed estimates of the total area of individual orchard crops grown in the United Kingdom in 2016 to be made. In contrast to previous surveys, information on the area of 'Other culinary apples' were not available from the HS data, and for the purposes of this survey 'Bramley' and 'Other culinary apples' have been combined as 'Culinary apples'.

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 HS 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 HS data make regional estimates of individual orchard crops; these data therefore must 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 was proportional to the sampled area. A comparison of the HS 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 HS estimates for the UK. However, the HS 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 Science Ltd. 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 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 Science Ltd. has implemented the UK Statistics Authority Code of Practice for Official Statistics, published in 2009. Whilst all eight principles apply, we acknowledge, 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

Analysis of pesticide orchard usage survey

The aim of the analysis of the results was to provide an estimate of the pesticide usage associated within each region and nationally.

Estimates are derived from pesticide usage survey data which are stratified by region and holding size. The survey reports the mass of pesticide applied and the area to which it is applied. The survey information is combined with the total cultivated area within each stratum to provide an estimate of the total mass of pesticide used by region and nationally, and of the area sprayed. Each estimate (E) is provided with a standard error (se). In general we expect, with approximately 95% confidence, that the true quantity of pesticide used will lie within the interval:

$$E \pm 1.96 \times se$$

Estimation method

We are provided with information about holdings in J regions. Holdings are assigned one of K size classes. L holdings are surveyed within each stratum (j,k). In addition the total area and number of holdings in each stratum from which samples have been taken is reported. Hence, we are given:

$H_{j,k}$: the total area of the stratum (in holdings of size class k, in region j)

$N_{j,k}$: the total number of holdings in the stratum

$L_{j,k}$: number of holdings surveyed within the stratum

$h_{j,k,l}$: area of each holding surveyed within the stratum

$a_{l,j,k,i}$: area of each holding sprayed within the surveyed stratum

$m_{l,j,k,i}$: mass of pesticide applied to each holding in the surveyed stratum

Then we estimate:

$\bar{a}_{j,k}$: mean area sprayed per area surveyed within the stratum

$\bar{m}_{j,k}$: mean mass applied per area surveyed within the stratum

$s_{a,j,k}$: the between-holding standard deviation of the area sprayed per area surveyed within the stratum

$s_{m,j,k}$: the between holding standard deviation of the mass sprayed per area surveyed within the stratum

A_j : estimated total area sprayed in a region

se_{A_j} : standard error of estimated total area sprayed in a region

M_j : estimated total mass applied in a region

se_{M_j} : standard error of estimated total mass applied in a region

A : estimated total area sprayed nationally

se_A : standard error of estimated total area sprayed nationally

M : estimated total mass applied nationally

se_M : standard error of estimated total mass applied nationally

Estimates are provided using the following formulas

Estimators

$$r_{a_{j,k,l}} = \frac{a_{j,k,l}}{h_{j,k,l}} \quad \text{Equation 1}$$

$$r_{m_{j,k,l}} = \frac{m_{j,k,l}}{h_{j,k,l}} \quad \text{Equation 2}$$

$$r_{a_{j,k}} = \text{mean} (r_{a_{j,k,l}}), l = 1, 2 \dots L_{j,k} \quad \text{Equation 3}$$

$$r_{m_{j,k}} = \text{mean} (r_{m_{j,k,l}}), l = 1, 2 \dots L_{j,k} \quad \text{Equation 4}$$

$$s_{a_{j,k}} = \text{sd} (r_{a_{j,k,l}}), l = 1, 2 \dots L_{j,k} \quad \text{Equation 5}$$

$$s_{m_{j,k}} = \text{sd} (r_{m_{j,k,l}}), l = 1, 2 \dots L_{j,k} \quad \text{Equation 6}$$

$$A_j = \sum_{k=1}^{k=K} H_{j,k} \cdot r_{a_{j,k}} \quad \text{Equation 7}$$

$$M_j = \sum_{k=1}^{k=K} H_{j,k} \cdot r_{m_{j,k}} \quad \text{Equation 8}$$

$$s_{\theta_{A_j}} = \sqrt{\sum_{k=1}^{k=K} H_{j,k}^2 \cdot \frac{s_{a_{j,k}}^2}{L_{j,k}} \cdot \frac{N_{j,k} - L_{j,k}}{N_{j,k} - 1}} \quad \text{Equation 9}$$

$$s_{\theta_{M_j}} = \sqrt{\sum_{k=1}^{k=K} H_{j,k}^2 \cdot \frac{s_{m_{j,k}}^2}{L_{j,k}} \cdot \frac{N_{j,k} - L_{j,k}}{N_{j,k} - 1}} \quad \text{Equation 10}$$

$$A = \sum_{j=1}^{j=J} A_j \quad \text{Equation 11}$$

$$M = \sum_{j=1}^{j=J} M_j \quad \text{Equation 12}$$

$$s_{\theta_A} = \sqrt{\sum_{j=1}^{j=J} s_{\theta_{A_j}}^2} \quad \text{Equation 13}$$

$$se_M = \sqrt{\sum_{j=1}^J se_{M_j}^2}$$

Equation 14

Standard errors se_A , se_M , se_{A_j} and se_{M_j} are estimated by a first order Taylor approximation [1] (Equations 9,10,13,14) with a finite population correction [1] (Equations 9 and 10)

95% confidence intervals for estimates A_j , M_j , A and M as estimated as $mean \pm 1.96 \times \text{standard error}$.

Estimates of use derived from this survey were based on a stratification by region only because of a number of strata (region and size) which contained no holdings or a low number of holdings (less than 5). A number of survey entries were removed because they had an area reported as zero of zero: one each from Eastern, London & South East, North East, North West, South West, Wales, Yorkshire & the Humber, and three from Scotland. This resulted in the following numbers of holdings surveyed within each region.

Table 1: Number of holdings in survey and census

| Region | Number of holdings: | |
|------------------------|---------------------|-----------|
| | in PUS survey | in census |
| East Midlands | 5 | 147 |
| Eastern | 22 | 334 |
| London & South East | 86 | 700 |
| North East | 0 | 39 |
| North West | 3 | 117 |
| Northern Ireland | 53 | 210 |
| Scotland | 8 | 203 |
| South West | 41 | 1082 |
| Wales | 4 | 76 |
| West Midlands | 60 | 671 |
| Yorkshire & the Humber | 1 | 108 |

There were an insufficient number of holdings surveyed to make estimates for a number of regions. Hence, for the purpose of estimating pesticide use, North East, North West, Yorkshire & the Humber were combined into ‘North’. Upper and lower confidence intervals were not reported where the relative standard error was estimated to be larger than 30%

Estimates of area of application and mass applied by region and nationally are provided in Tables 2 and 3.

Assumptions

- 1) The survey is unbiased. This means that there is no correlation between the use of pesticides on the holding and the probability of holdings being included or excluded from a survey. The simplest way of achieving this is to sample holdings at random from the population of holdings within a stratum.
- 2) Samples are not correlated between strata. This means that if by chance the holdings sampled from one stratum have a higher average pesticide use than the population within the stratum, then this provides no information about the relation between samples and populations in other strata.
- 3) The values of number of holdings per strata are correct.
- 4) The size of the potential error in estimates of the total area of holdings [se(H)] within each stratum is small compared with the standard error of the estimates for the ratios “mean area sprayed per area surveyed within the

stratum” and “mean mass applied per area surveyed within the stratum” [se(R)]. For uncorrelated errors “small” might mean $rse(H) < 0.3 \times rse(R)^2$

- 5) The error associated with estimates A_j , M_j , A , and M is assumed to be described by a normal distribution

Table 2: Estimates of area treated

| Region | Total Area (Ha) | Number of holdings | Number of holdings surveyed | Estimate (Ha) | s.e.. (Ha) | RSE (%) | 95% C.I (Ha) | |
|------------------|-----------------|--------------------|-----------------------------|---------------|--------------|------------|---------------|---------------|
| East Midlands | 315 | 147 | 5 | 4652 | 2619 | 56 | NA | NA |
| Eastern | 1754 | 334 | 22 | 41951 | 5337 | 13 | 31491 | 52410 |
| London & S.E. | 9912 | 700 | 86 | 338568 | 16302 | 4.8 | 306617 | 370519 |
| North | 440 | 264 | 4 | 2708 | 2256 | 83 | NA | NA |
| Northern Ireland | 1484 | 210 | 53 | 34915 | 1294 | 3.7 | 32378 | 37451 |
| Scotland | 98 | 203 | 8 | 373 | 159 | 43 | NA | NA |
| South West | 3539 | 1082 | 41 | 21578 | 4232 | 20 | 13284 | 29873 |
| Wales | 356 | 76 | 4 | 2647 | 1370 | 52 | NA | NA |
| West Midlands | 7024 | 671 | 60 | 92952 | 7510 | 8.1 | 78233 | 107672 |
| National | 24923 | 3687 | 283 | 540344 | 19597 | 3.6 | 501933 | 578755 |

Table 3: Estimates of mass of treatment applied

| Region | Total Area (Ha) | Number of holdings | Number of holdings surveyed | Estimate (Kg) | s.e.. (Kg) | RSE (%) | 95% C.I (Kg) | |
|------------------|-----------------|--------------------|-----------------------------|---------------|--------------|------------|---------------|---------------|
| East Midlands | 315 | 147 | 5 | 1968 | 1219 | 62 | NA | NA |
| Eastern | 1754 | 334 | 22 | 27105 | 4100 | 15 | 19068 | 35142 |
| London & S.E. | 9912 | 700 | 86 | 187344 | 10431 | 5.6 | 166899 | 207789 |
| North | 440 | 264 | 4 | 320 | 318 | 99 | NA | NA |
| Northern Ireland | 1484 | 210 | 53 | 22508 | 1336 | 5.9 | 19888 | 25127 |
| Scotland | 98 | 203 | 8 | 111 | 76 | 69 | NA | NA |
| South West | 3539 | 1082 | 41 | 13959 | 3219 | 23 | 7650 | 20269 |
| Wales | 356 | 76 | 4 | 934 | 599 | 64 | NA | NA |
| West Midlands | 7024 | 671 | 60 | 51099 | 6281 | 12 | 38789 | 63409 |
| National | 24923 | 3687 | 283 | 305347 | 13385 | 4.4 | 279111 | 331582 |

¹ BIPM, (2008). Evaluation of measurement data — Guide to the expression of uncertainty in measurement, JCGM 100:2008

¹ Isserlis, L. (1918). "On the value of a mean as calculated from a sample". Journal of the Royal Statistical Society. 81 (1): 75–81.

² If given estimates of relative standard errors (rse) $rse(R)=1$ and $rse(H)=0.3$ then $rse(R.H)=1.04$

APPENDIX 5 – FIRST RAISING FACTORS FOR ORCHARD CROPS - 2016

| <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 | 7.43 | 177 | 23.82 | * |
| | B | 5.93 | 72 | 12.14 | * |
| Eastern | A | 24.75 | 579 | 23.40 | 7 |
| | B | 2.99 | 333 | 111.48 | 8 |
| | C | 3.72 | 186 | 49.99 | * |
| | D | 1.42 | 458 | 321.87 | 6 |
| London & South East | A | 11.20 | 1,326 | 118.37 | 24 |
| | B | 4.37 | 882 | 201.60 | 14 |
| | C | 2.73 | 997 | 365.69 | 15 |
| | D | 2.28 | 2,441 | 1,071.57 | 23 |
| | E | 2.30 | 4,266 | 1,851.47 | 11 |
| North East | A | 110.00 | 44 | 0.40 | * |
| North West | A | 103.57 | 145 | 1.40 | * |
| | B | 1.24 | 33 | 26.71 | * |
| Northern Ireland | A | 2.86 | 457 | 160.06 | 28 |
| | B | 2.37 | 464 | 195.53 | 16 |
| | C | 2.68 | 245 | 91.39 | * |
| | D | 1.49 | 318 | 212.77 | * |
| Scotland | A | 5.25 | 87 | 16.58 | 11 |
| South West | A | 22.53 | 1,741 | 77.26 | 23 |
| | B | 3.64 | 372 | 102.16 | 7 |
| | C | 2.67 | 396 | 148.15 | 6 |
| | D | 3.80 | 673 | 177.30 | * |
| | E | 1.37 | 358 | 260.95 | * |
| Wales | A | 15.92 | 72 | 4.52 | * |
| | D | 0.98 | 76 | 77.90 | * |
| | E | 1.34 | 165 | 123.00 | * |
| West Midlands | A | 18.71 | 1,225 | 65.46 | 13 |
| | B | 4.68 | 769 | 164.21 | 12 |
| | C | 5.29 | 1,070 | 202.41 | 8 |
| | D | 2.59 | 2,374 | 917.29 | 21 |
| | E | 2.41 | 1,587 | 658.19 | 6 |
| Yorkshire & the Humber | A | 50.04 | 86 | 1.72 | * |

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.

ACKNOWLEDGEMENTS

Thanks are due to all the growers who willingly participated in this survey, providing invaluable information upon which this report is based. Many thanks are also due to Jackie Hughes, Stephen Jess, Trudyann Kelly, Michael Lavery, David Matthews, Carol Monie, Gillian Reay, Johan Wardlaw, David Williams and Alan Withers for their role in the collection and provision of data; Yvonne Powell-Wainwright and Josephine Roberts for their role in maintaining the pesticides database; and Jennie Blackburn, Sarah Thompson and John Bleasdale for their help with the cropping areas of orchard crops in England & Wales respectively. Thanks also go to the members of the ECP Working Party on Pesticide Usage Surveys, Sarah Cook, Peter Gladders and Mike Lole, for their invaluable comments.

REFERENCES

Anon. (2016a) *Agricultural Statistics in England 2015*. London: HMSO

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

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

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

Anon. (2017a) *Agricultural Statistics in England 2016*. London: HMSO

Anon. (2017b) *Agricultural Statistics in Wales 2016*. London: HMSO

Anon. (2017c) *Agricultural Statistics in Scotland 2016*. Edinburgh: HMSO

Anon. (2017d) *Agricultural Statistics, Northern Ireland 2016*. Belfast: HMSO

Anon. (2017e) *Horticultural Statistics 2016*, Defra,
<https://www.gov.uk/government/collections/horticultural-statistics>, (last accessed 08.10.2017)

Garthwaite, D.G., Barker, I., Laybourn, R., Huntly, A., Parrish, G., Hudson, S., Thygesen, H., & Macarthur, R. (2015) *Pesticide Usage Survey Report 265 – Orchards 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 11.11.2017)

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