

PESTICIDE USAGE SURVEY REPORT 279

GRASSLAND & FODDER CROPS IN THE UNITED KINGDOM

2017



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A NATIONAL STATISTICS SURVEY

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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 462 410

Alternatively, please contact: Fera Science Ltd. at: science@fera.co.uk

DATA USES

The data are used for a number of purposes including:

- Quantifying pesticide usage and changes in the use of active substances over time;
- 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 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 grassland & fodder crops grown and taken to harvest in 2017. 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

Information is given concerning maize; turnips & swedes; fodder beet & mangolds; kale, cabbage & rape; other crops for stock feeding; and stubble turnips & catch crops as well as different grassland types including newly sown leys (direct sown and undersown crops); grassland less than five years old; permanent pasture; and rough grazing.

Data on pesticide usage on these crops were collected from 9,089 examples (fields) grown on 581 holdings growing fodder crops throughout the United Kingdom and from 1,210 holdings returning either a grassland postal questionnaire (999 holdings) or grassland data collected by personal visit or telephone call (211 holdings). Additional data on grassland was collected alongside the visits to 501 of the fodder holdings. The sample accounted for 7% of the total fodder crop area and for 3% of the area of grassland grown in the United Kingdom in 2017 (excluding rough grazing).

Permanent pasture, including rough grazing, accounted for 88% of the total area of crops grown in the survey, grassland less than five years old for 9% and all fodder crops 3%. Maize was the major fodder crop grown, comprising 63% of the total area of fodder crops, with other crops for stock feeding, fodder beet & mangolds and stubble turnips & catch crops accounting for a further 14%, 7% and 11% respectively. Of the total area of fodder crops grown, 25% of the total area was grown in the South West region, 14% in West Midlands, 14% in London & South East region, 11% in Eastern region, 9% in East Midlands region, 9% in Wales, 6% in North West region, 5% in Scotland, 4% in Yorkshire & the Humber region, 2% in Northern Ireland and 1% percent in North East region.

The usage of pesticides more closely reflected the area of fodder crops alone rather than the area of fodder and grassland crops combined, indicating the minimal use of pesticides on grassland. For example, Scotland, with 38% of the total area of grassland and fodder crops, accounted for only 6% of the total treated area. However, South West region, growing 11% of all grassland and fodder crops, accounted for 19% of the total treated area. Similarly, West Midlands region, with 4% of the total area of fodder crops grown, accounted for 13% of the total treated area. The relatively high usage of herbicides in the West Midlands reflects, in part, the use of repeat low dose herbicides on fodder beet, with 32% of the United Kingdom area of this crop grown in this region.

The use of fungicides on grassland & fodder crops accounted for 3% of the total area treated, with undersown new leys and other crops for stock feeding (which includes cereals grown for whole crop silage) accounting for 65% of all usage. For both crop groups fungicide usage was targeted to control diseases within cereal crops, either those being grown as a nurse crop to an undersown new ley or to those being grown for whole crop silage.

Herbicides accounted for 76% of the total pesticide-treated area of grassland & fodder crops grown in the United Kingdom in 2017, seed treatments 19%, fungicides 3% with insecticides, growth regulators, molluscicides and repellents at 1% each. In terms of weight of active substances applied, herbicides accounted for 95%, seed treatments 2%, fungicides 1%, and insecticides, growth regulators and molluscicides less than 1% each.

The area of fodder crops grown in 2017 increased by 5% compared with 2013, and 16% compared with 2009. There were corresponding increases in the pesticide-treated area of 2% since 2013, and 14% since 2009. The weight of pesticides applied increased by 11% since 2013 and by 30% since 2009. These changes reflect the increased use of herbicides on fodder crops. In 2017, herbicide use had increased by 13% in treated area and 21% by weight applied compared with 2013, and by 47% in treated area and 45% by weight applied compared with 2009. Between 2013 and 2017, the maize area grown has only increased by 2% but the area treated and weight applied of herbicides has increased significantly by 15% and 29% respectively. The area of stubble turnips and catch crops grown has more than doubled since 2013, the area treated and weight applied of herbicides has increased dramatically between 2013 and 2017.

There was a small increase of 0.5% in the area of grassland in the United Kingdom in 2017 compared with 2013, and a 3.5% decrease since 2009. There was a 6% increase in the pesticide-treated area between 2013 and 2017, but 22% less area treated compared with 2009. However, the weight of pesticides applied to grassland decreased by 18% between 2013 and 2017, and by 32% between 2009 and 2017. The removal of chlorpyrifos has resulted in the near cessation of insecticide use on grassland during 2017. The main reduction in weight of pesticide applied to grassland can be attributed to herbicides which despite a small increase of 6% in area treated, showed a reduction of 16% in weight applied between 2013 and 2017. Lower application rates of newer formulations of grassland herbicides have also contributed to the overall reduction in weight of pesticide applied.

INTRODUCTION

The Expert Committee on Pesticides (ECP) advises government on all aspects of pesticide use. 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 grassland & fodder crops in 2016/17 by visiting holdings throughout the United Kingdom during the winter of 2017/18.

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

This is the second survey of pesticide usage on grassland & crops in the United Kingdom. The previous report for the United Kingdom was published in 2014 covering pesticide usage on grassland & fodder crops in 2013 (Garthwaite et. al., 2014). Previous reports, including those in 2005 and 2009, covered Great Britain rather than the UK. For the purposes of this report we have amalgamated Great Britain and Northern Ireland data.

Additional data on crop agronomy are collected for all surveys but are 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 for 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 462 410
Or visit the website: <https://secure.fera.defra.gov.uk/pusstats/surveys/index.cfm>

Alternatively, please contact: Fera Science Ltd. at: science@fera.co.uk

Further data relating specifically to Scotland may be obtained from the Pesticide Usage Survey Team at Science and Advice for Scottish Agriculture, Edinburgh. Also available at:

<http://www.sasa.gov.uk/pesticides/pesticide-usage/pesticide-usage-survey-reports>

Copies of reports on pesticide usage in Northern Ireland may be obtained from Her Majesty's Stationery Offices. Also available at:

<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 – FODDER CROPS

Figure 1 - Changes in the area (ha) of fodder crops grown in the United Kingdom 2005 - 2017

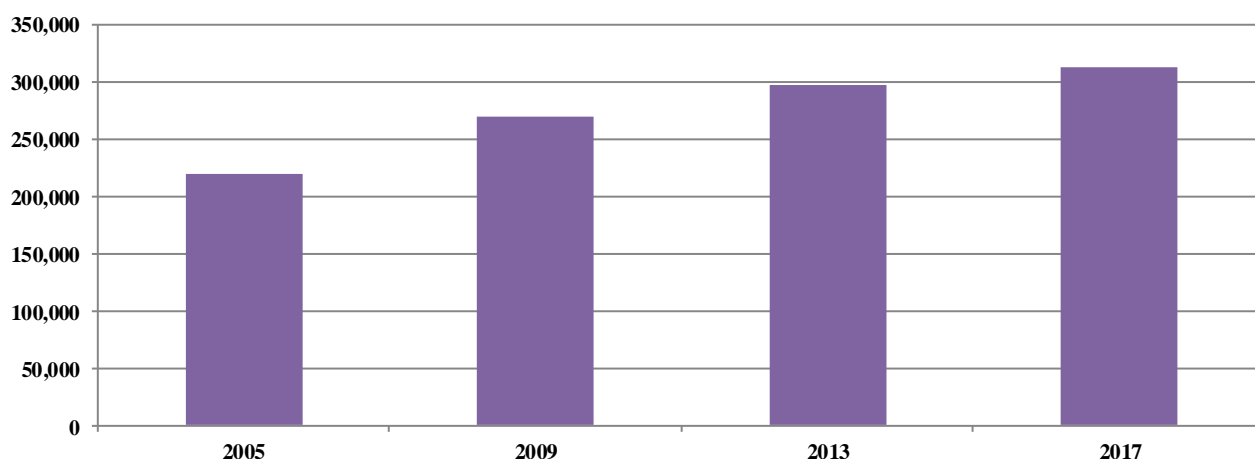


Figure 2 - Changes in the pesticide treated area of fodder crops in the United Kingdom 2005 - 2017 (treated hectares)

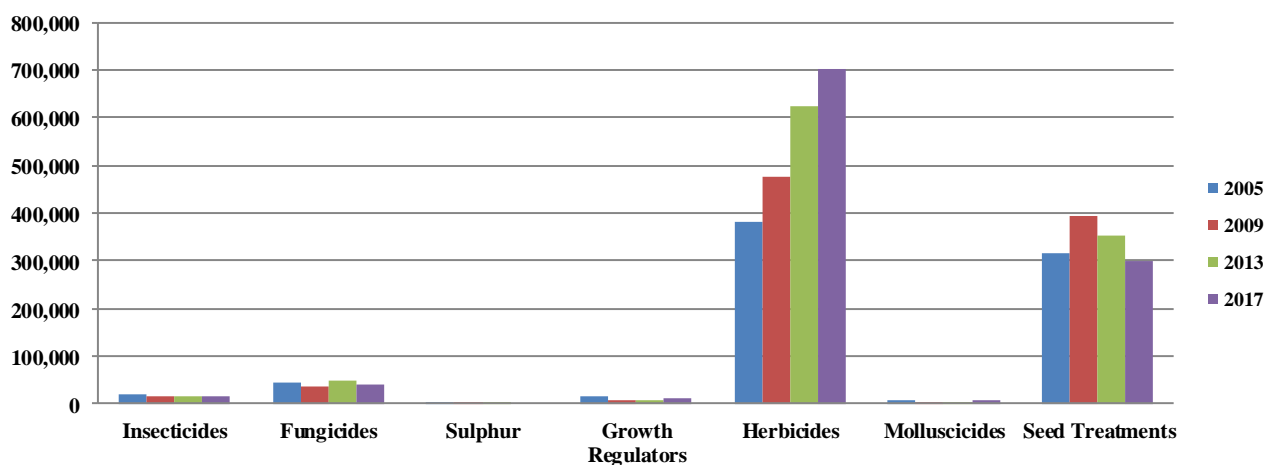
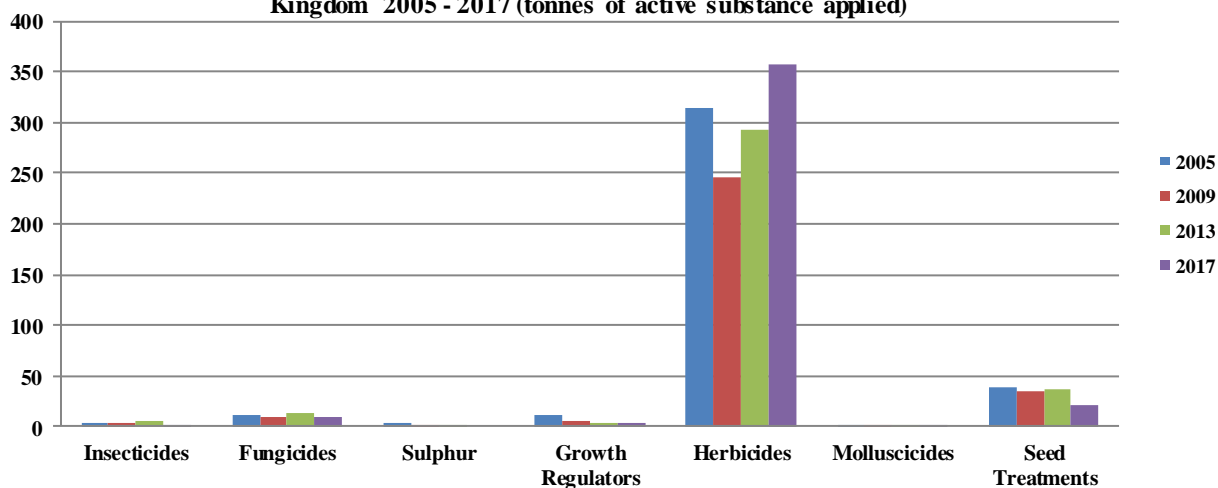


Figure 3 - Changes in the weight of pesticides applied to fodder crops in the United Kingdom 2005 - 2017 (tonnes of active substance applied)



TRENDS – GRASSLAND

Figure 4 - Changes in the area (ha) of grassland grown in the United Kingdom 2005 - 2017

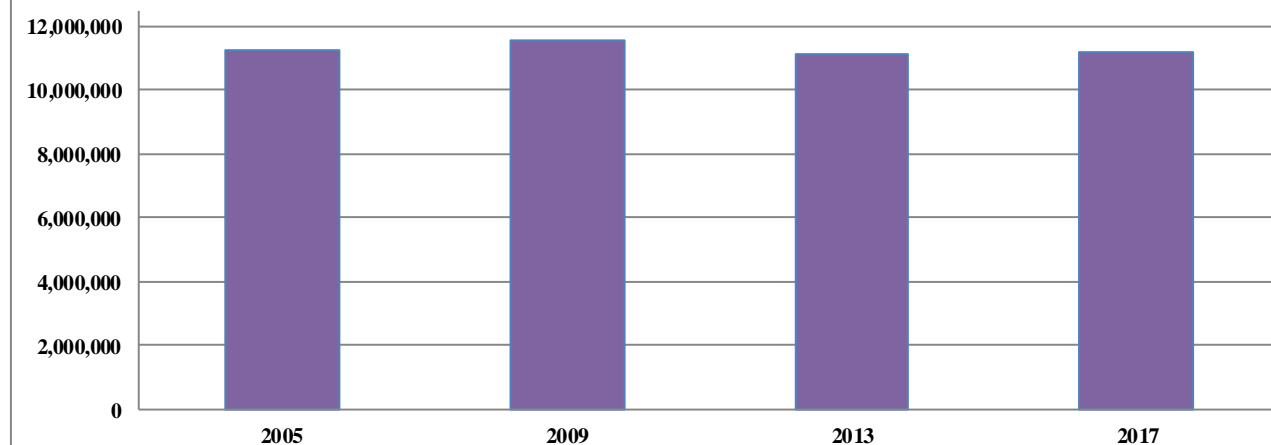


Figure 5 - Changes in the pesticide treated area of grassland in the United Kingdom 2005 - 2017 (treated hectares)

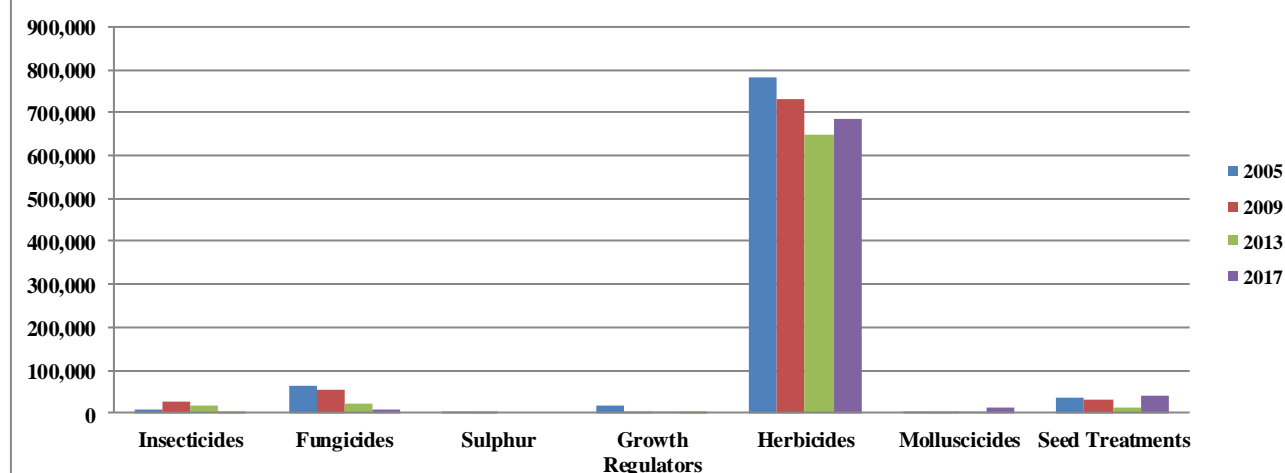
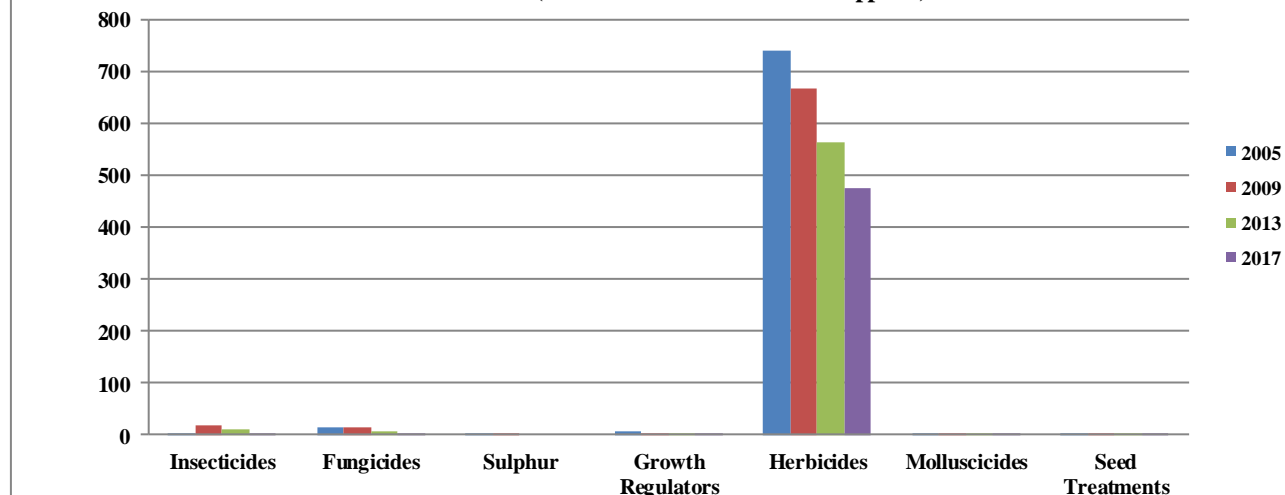


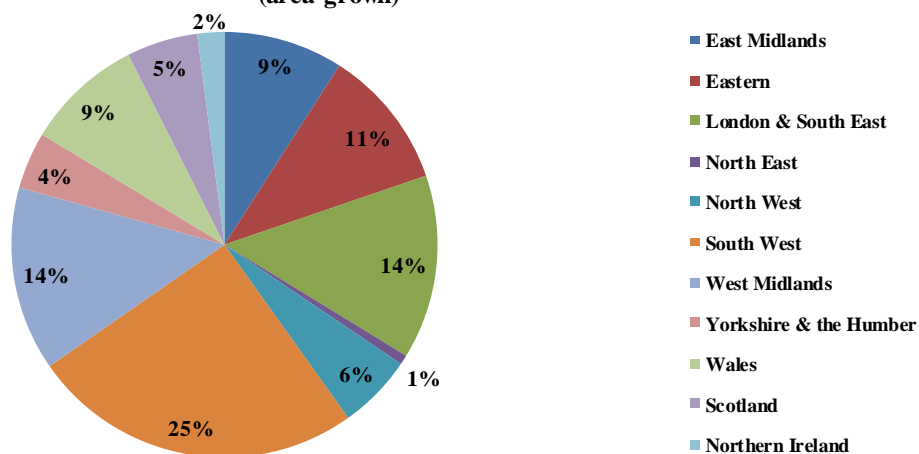
Figure 6 - Changes in the weight of pesticides applied to grassland in the United Kingdom 2005 - 2017 (tonnes of active substance applied)



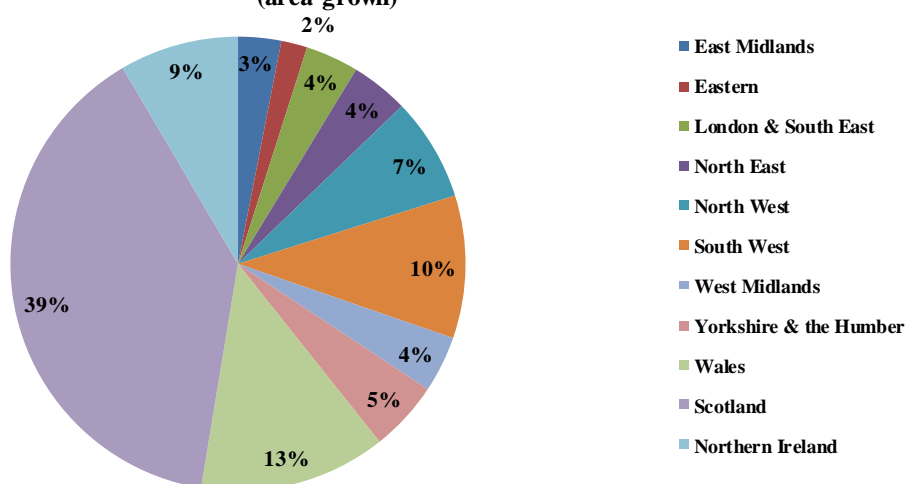
CROPS

Information is given concerning maize; turnips & swedes; fodder beet & mangolds; kale, cabbage & rape; other crops for stock feeding; and stubble turnips & catch crops as well as different grassland types including newly sown leys (direct sown and undersown crops); grassland less than five years old; permanent pasture; and rough grazing. Data on pesticide usage on these were collected from 9,089 examples (fields) grown on 581 holdings growing fodder crops throughout the United Kingdom and from 1,210 holdings returning either a grassland postal questionnaire or grassland data collected by personal visit or by telephone call. The sample accounted for 7% of the total fodder crop area and for 3% of the area of grassland grown in the United Kingdom in 2017 (excluding rough grazing).

**Figure 7 - Regional distribution of fodder crops in the United Kingdom - 2017
(area grown)**

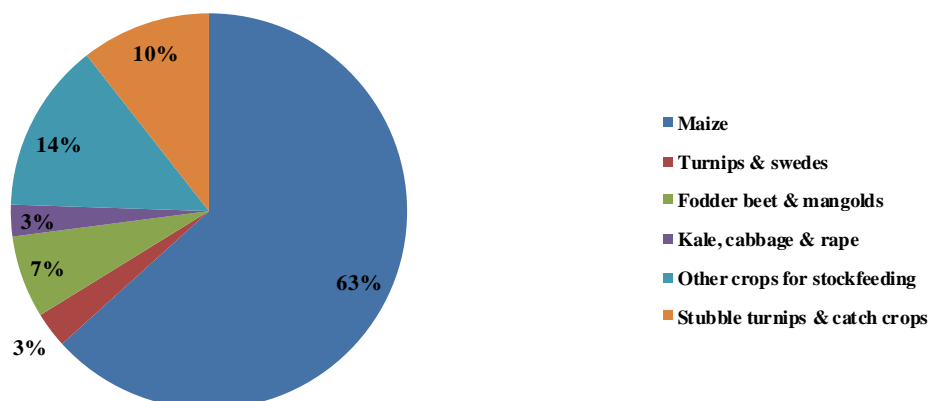


**Figure 8 - Regional distribution of grassland in the United Kingdom - 2017
(area grown)**

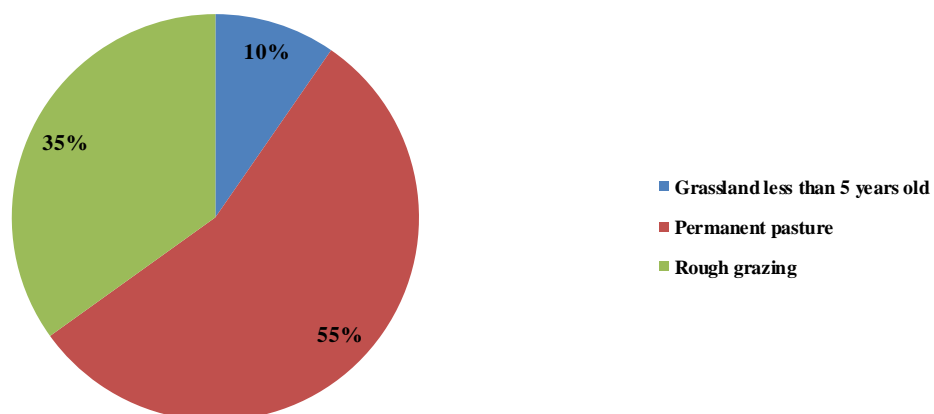


CROPS (continued)

**Figure 9 - Relative importance of fodder crops in the United Kingdom - 2017
(area grown)**



**Figure 10 - Relative importance of grassland crops in the United Kingdom - 2017
(area grown)¹**



¹Grassland less than 5 years old includes established grass leys between 2 and 5 years old and direct and undersown new leys.

PESTICIDE USAGE

Figure 11 - Pesticide usage on all grassland and fodder crops in the United Kingdom - 2017

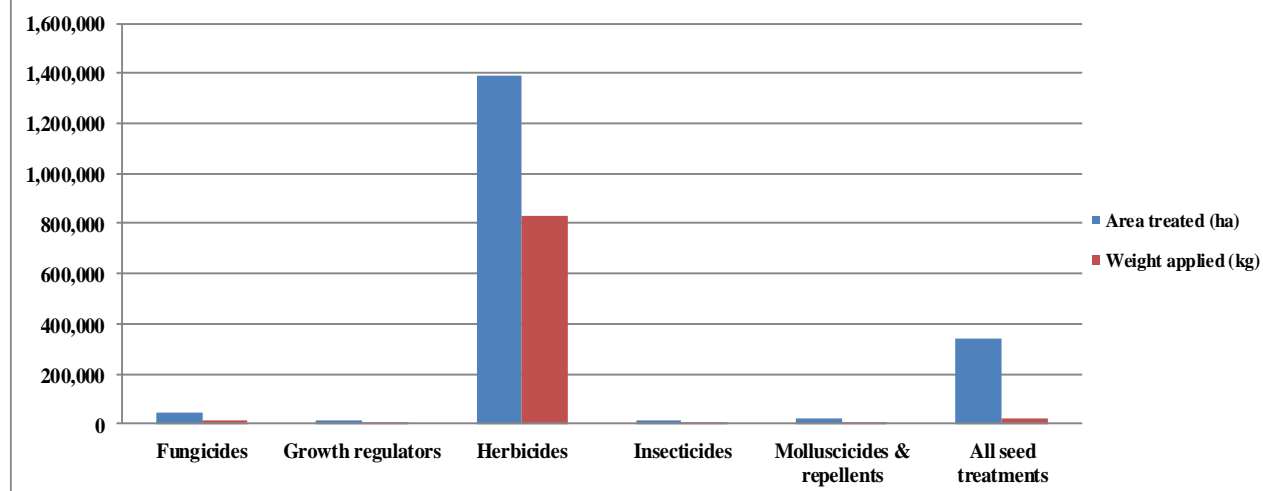


Figure 12 - Regional distribution of pesticide usage on grassland and fodder crops in the United Kingdom - 2017

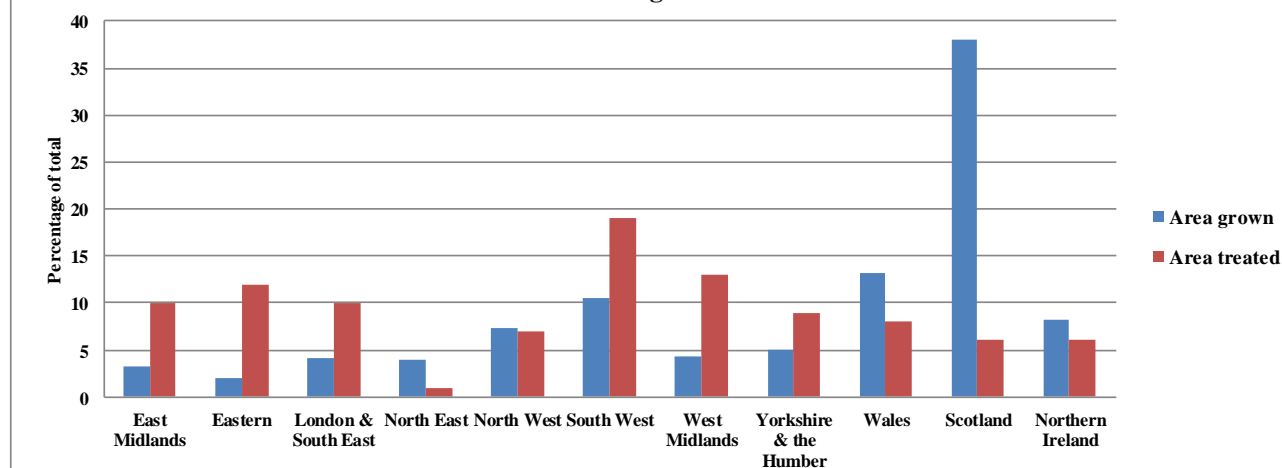
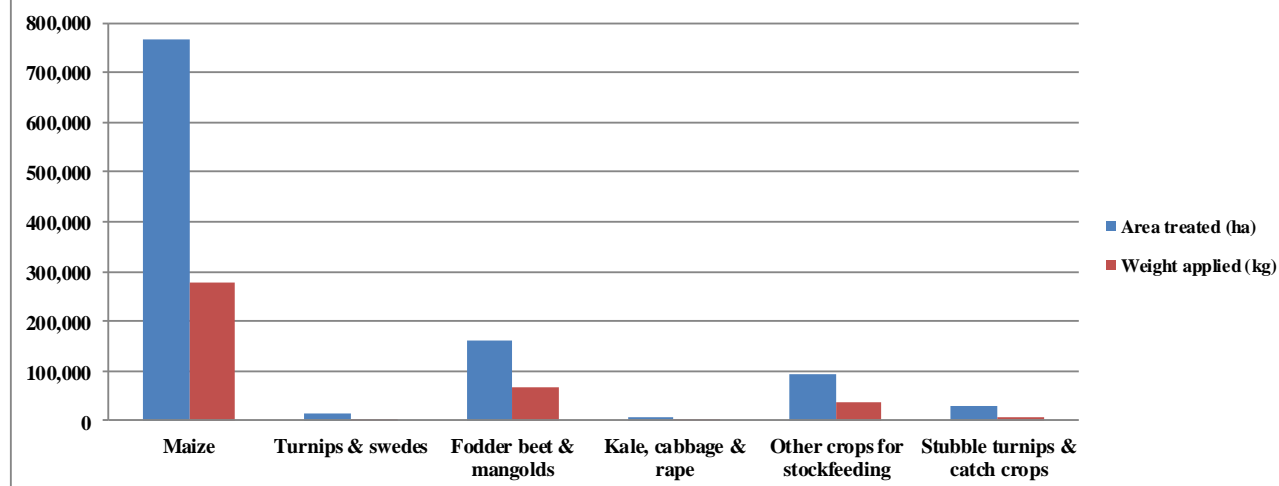


Figure 13 - Pesticide usage on fodder crops in the United Kingdom - 2017



PESTICIDE USAGE (continued)

Figure 14 - Pesticide usage on grassland in the United Kingdom - 2017

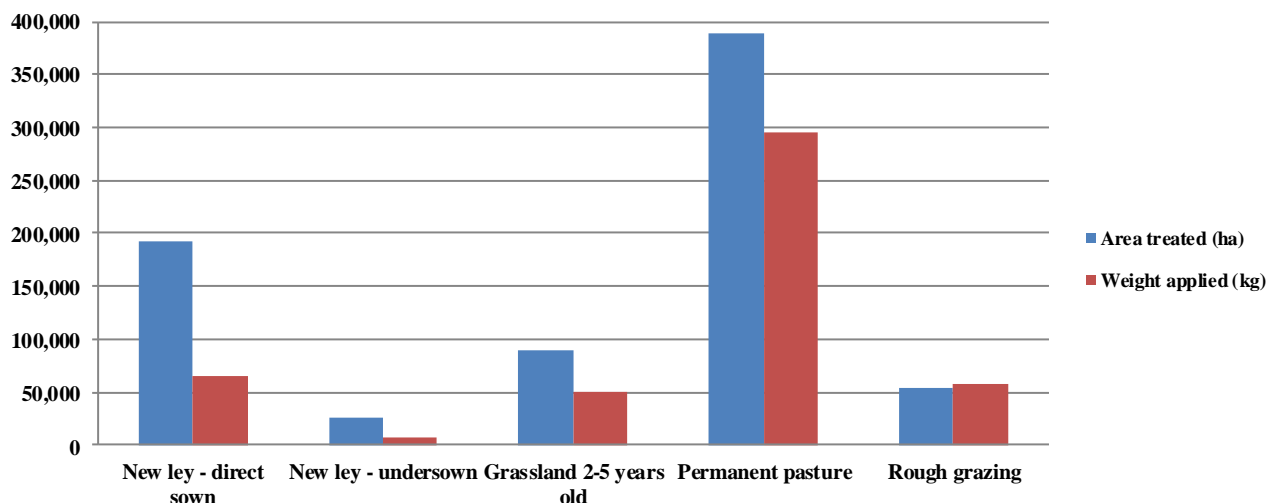


Figure 15 - Average number of applications made to treated fodder crops in the United Kingdom - 2017

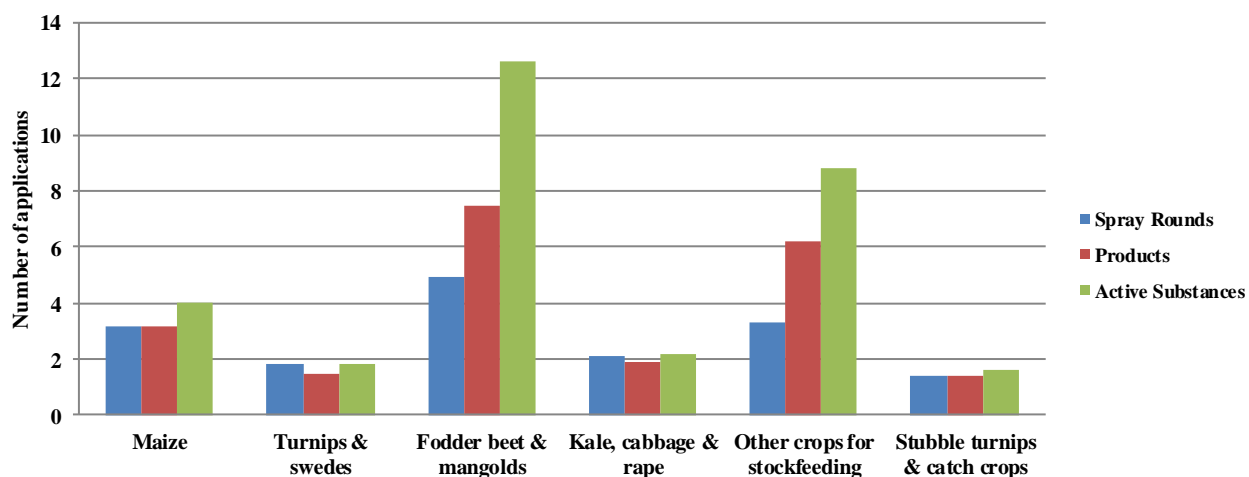
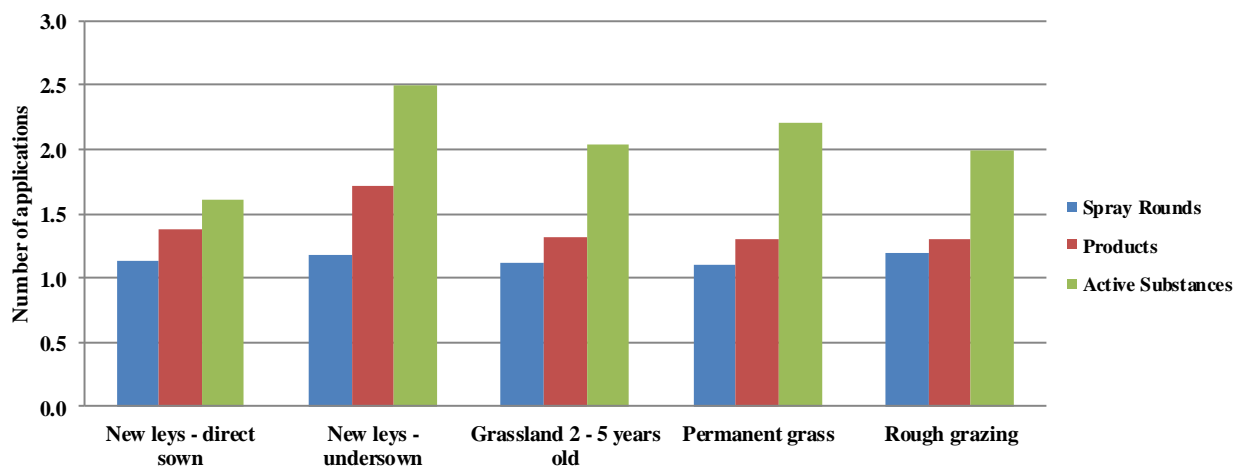


Figure 16 - Average number of applications made to treated grassland in the United Kingdom - 2017



PESTICIDE USAGE ON FODDER CROPS

MAIZE

- 197,477 hectares of maize grown in the United Kingdom
- 767,630 treated hectares
- 277.49 tonnes of active substances applied
- 3.9% of maize received no soil applied or foliar pesticide applications
- No foliar or soil applied insecticide use on maize crops was encountered during the 2017 survey
- Where treated, maize received an average of 3 sprays with 3 products and 4 active substances
- Maize grown for forage accounted for 76% of the total area grown, anaerobic digestion 19%, grain maize 3% and game cover 2%

Figure 17 - Usage of pesticides on maize in the United Kingdom - 2017

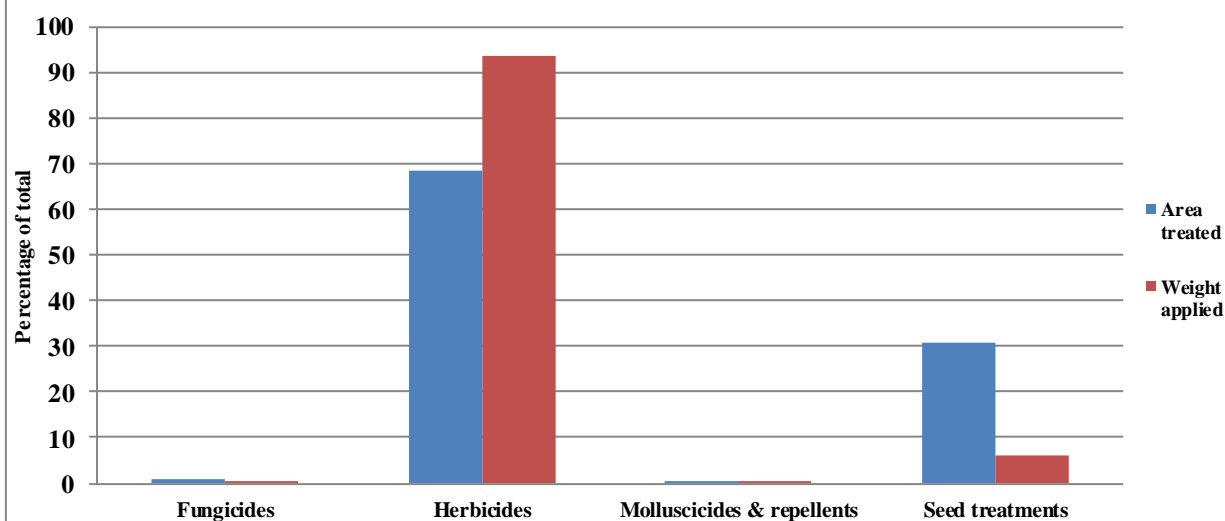
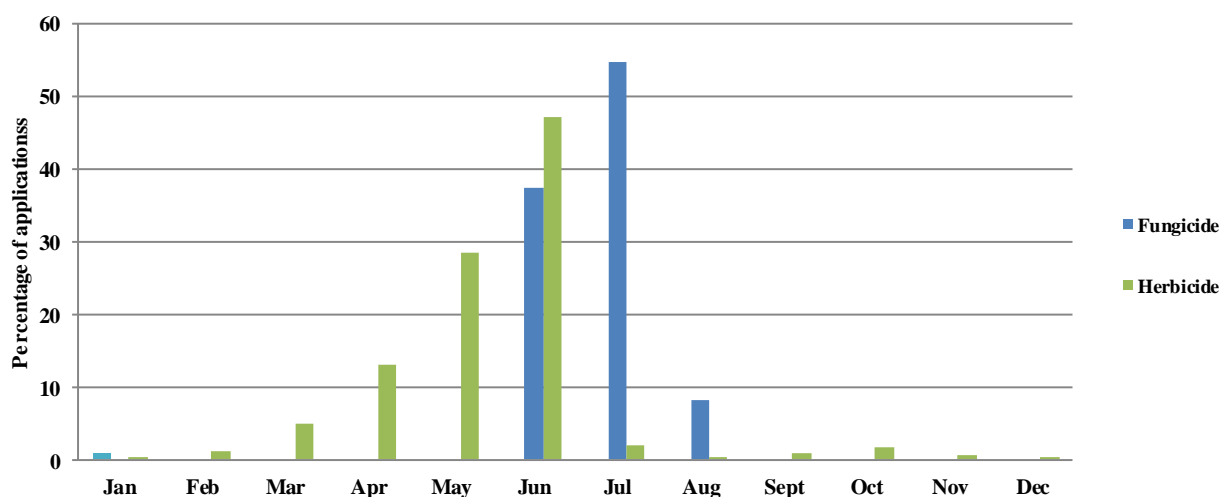


Figure 18 - Timing of pesticide applications on maize in the United Kingdom - 2017

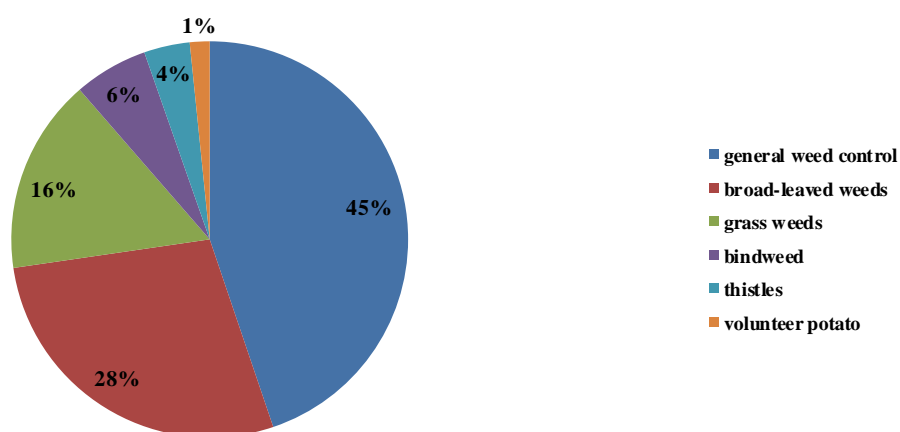


Maize – Herbicides

- **Formulation area treated: 524,097 hectares**
- **Weight of active substances applied: 259.46 tonnes**
- **The five most common formulations by area treated were:**

	Formulation area treated (ha)	Weight of a.s. applied (kg)	Proportion of herbicide – treated area	Proportion of census area treated	Average number of applications (where applied)	Average proportion of full label rate
Nicosulfuron	103,650	3,565	0.20	0.50	1.03	0.81
Glyphosate	82,179	81,285	0.16	0.36	1.15	0.56
Mesotrione/terbuthylazine	81,260	35,042	0.16	0.38	1.05	0.72
Pendimethalin	69,509	82,101	0.13	0.34	1.02	0.79
Mesotrione	55,045	5,141	0.11	0.27	1.00	0.62

Figure 19 - Maize - reasons for use of herbicides (where given)



Maize – Molluscicides

- **Formulation area treated: 1,167 hectares**
- **Weight of active substances applied: 0.16 tonnes**
- **The only formulation encountered was metaldehyde**

Maize – Fungicides

- **Formulation area treated: 7,345 hectares**
- **Weight of active substances applied: 1.35 tonnes**
- **The only formulations encountered were:**

	Formulation area treated (ha)	Weight of a.s. applied (kg)	Proportion of fungicide – treated area	Proportion of census area treated	Average number of applications (where applied)	Average proportion of full label rate
Pyraclostrobin	4,859	880	0.66	0.02	1.00	0.88
Epoxiconazole/pyraclostrobin	2,486	469	0.34	0.01	1.00	0.69

The only reason specified for disease control on maize was eyespot.

Maize – Seed Treatments

- **Formulation area treated: 235,021 hectares**
- **Weight of active substances applied: 16.52 tonnes**
- **2.1 % of the seed remained untreated**
- **Where specified the most common formulations (excluding unspecified treatments) were:**

	Formulation area treated (ha)	Weight of a.s. applied (kg)	Proportion of seed treatment area	Proportion of census area treated
Methiocarb	147,614	16,247	0.77	0.76
Fludioxonil/metalaxyl-M	20,486	21	0.11	0.10
Thiram	17,718	521	0.10	0.09
Thiacloprid	4,139	364	0.02	0.02

TURNIPS & SWEDES

- 9,085 hectares of turnips & swedes grown in the United Kingdom
- 15,021 treated hectares
- 3.39 tonnes applied
- 45.8% of turnips & swedes remained untreated
- Where treated, turnips & swedes received an average of 2 sprays with 2 products and 2 active substances
- There was only limited use of fungicides and no molluscicide use recorded

Figure 20 - Usage of pesticides on turnips & swedes in the United Kingdom - 2017

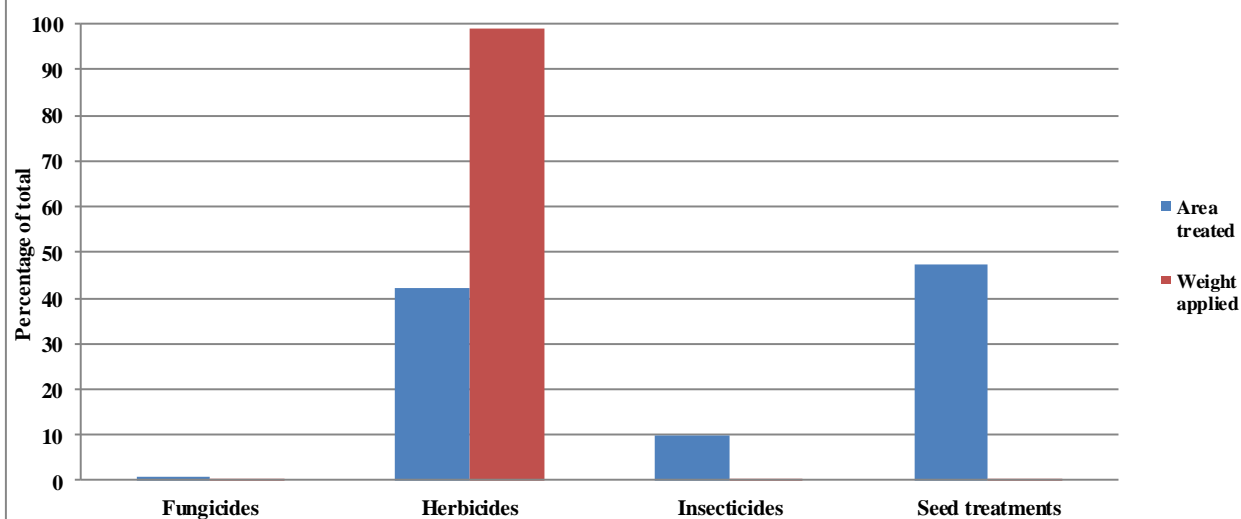
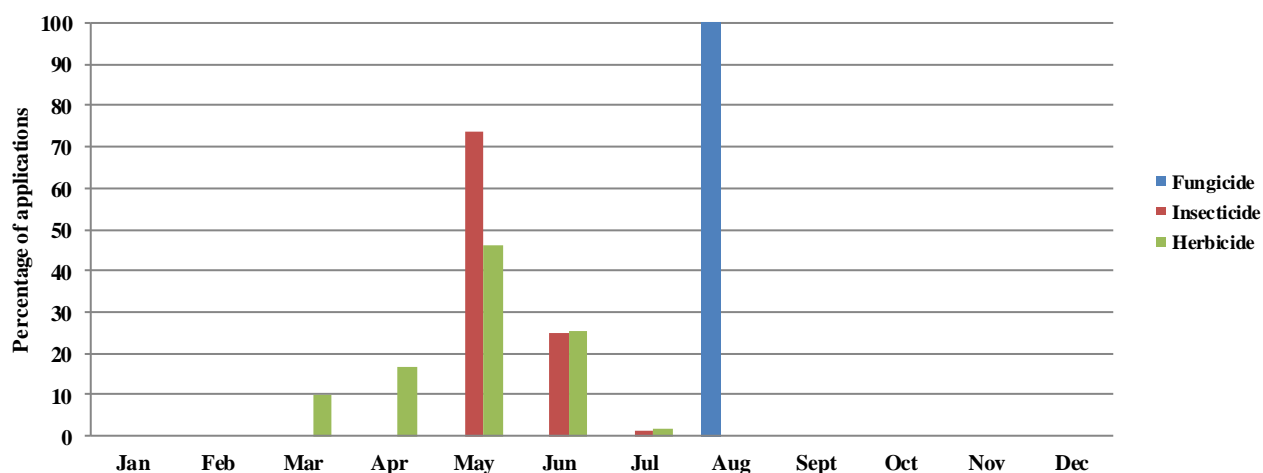


Figure 21 - Timing of pesticide applications on turnip and swede crops in the United Kingdom - 2017

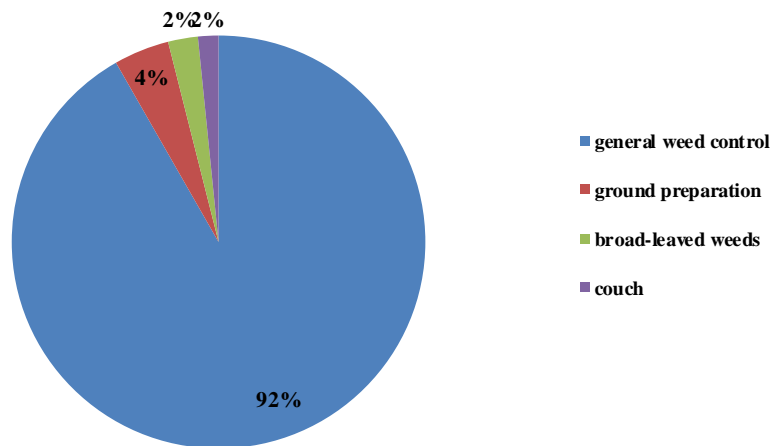


Turnips & swedes– Herbicides

- **Formulation area treated: 6,314 hectares**
- **Weight of active substances applied: 3.35 tonnes**
- **The five most common formulations by area treated were:**

	Formulation area treated (ha)	Weight of a.s. applied (kg)	Proportion of herbicide – treated area	Proportion of census area treated	Average number of applications (where applied)	Average proportion of full label rate
Metazachlor	1,652	971	0.26	0.18	1.00	0.78
Glyphosate	1,550	1,485	0.25	0.17	1.00	0.61
Clomazone	1,277	88	0.20	0.14	1.00	0.77
Dimethenamid-P/metazachlor	923	643	0.15	0.10	1.00	0.70
Clopyralid	427	43	0.07	0.05	1.00	0.50

Figure 22 - Turnips & swedes - reasons for use of herbicides (where given)

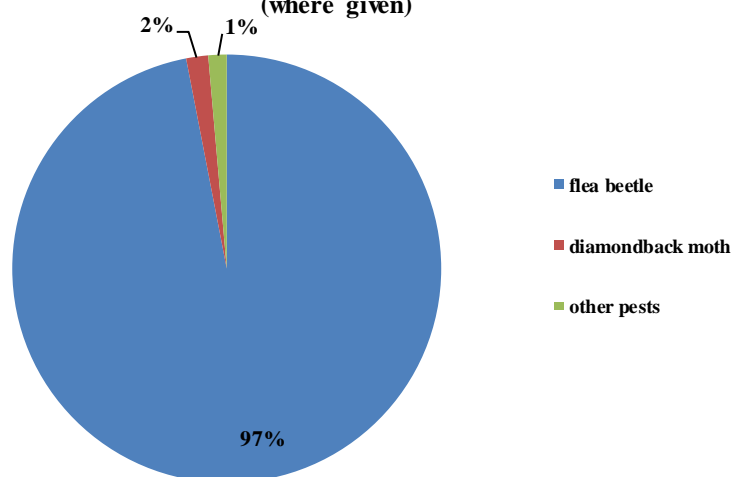


Turnips & swedes – Insecticides

- **Formulation area treated: 1,496 hectares**
- **Weight of active substances applied: <0.01 tonnes**
- **The only formulations encountered were:**

	Formulation area treated (ha)	Weight of a.s. applied (kg)	Proportion of insecticide – treated area	Proportion of census area treated	Average number of applications (where applied)	Average proportion of full label rate
Lambda-cyhalothrin	1,089	4	0.73	0.06	2.00	1.00
Deltamethrin	388	3	0.26	0.04	1.00	0.97

Figure 23 - Turnips & swedes - reasons for use of insecticides (where given)



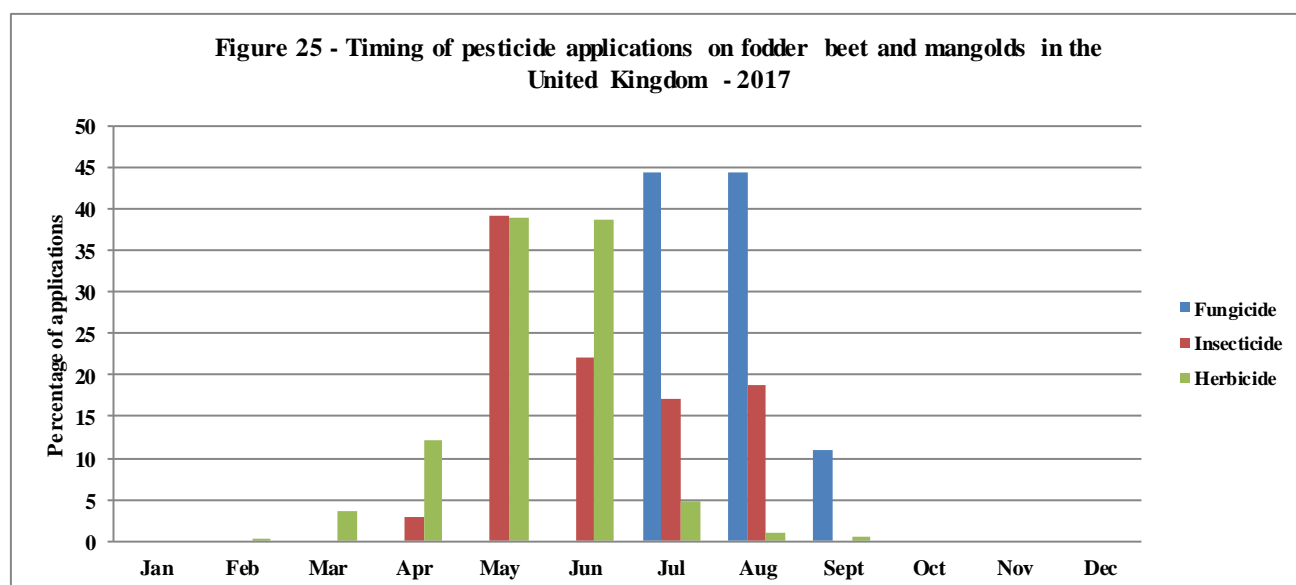
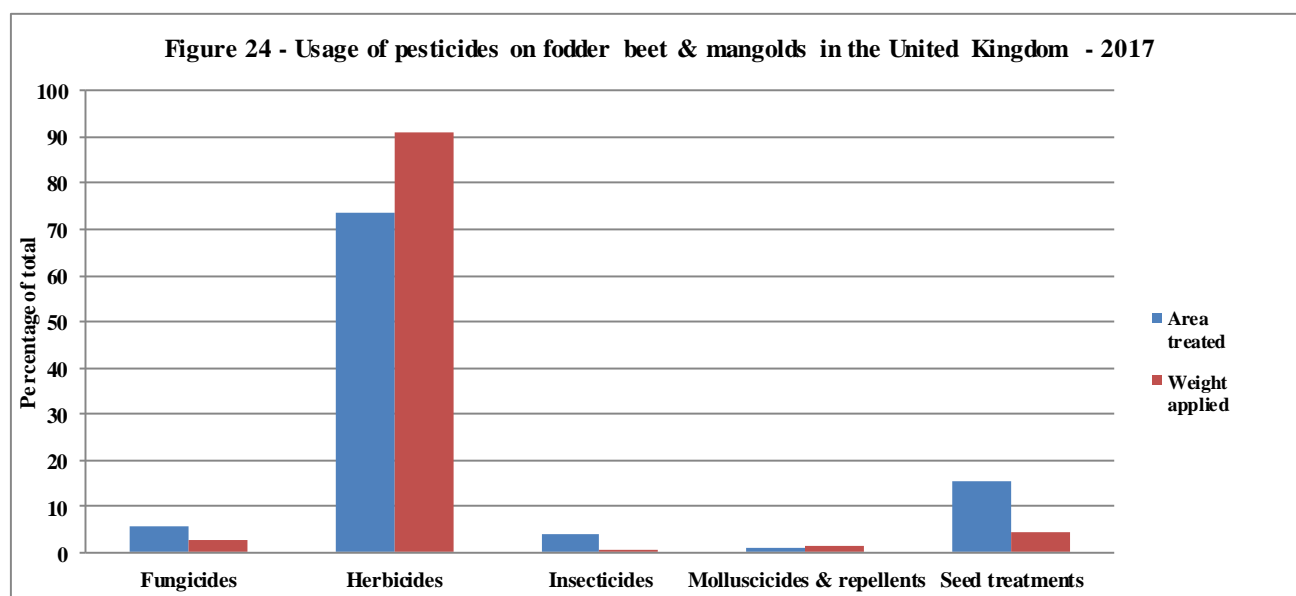
Turnips & swedes – Seed Treatments

- **Formulation area treated: 7,120 hectares**
- **Weight of active substances applied: 0.01 tonnes**
- **41.6% of the seed remained untreated**
- **Where specified, the most common formulations (excluding unspecified treatments) were:**

	Formulation area treated (ha)	Weight of a.s. applied (kg)	Proportion of seed treatment area	Proportion of census area treated
Thiamethoxam	2,526	10	0.54	0.28
Thiram	2,164	3	0.46	0.24

FODDER BEET & MANGOLDS

- 21,049 hectares of fodder beet & mangolds grown in the United Kingdom
- 161,609 treated hectares
- 65.58 tonnes applied
- 6.4% of fodder beet & mangolds remained untreated
- Where treated, fodder beet & mangolds received an average of 5 sprays with 8 products and 13 active substances

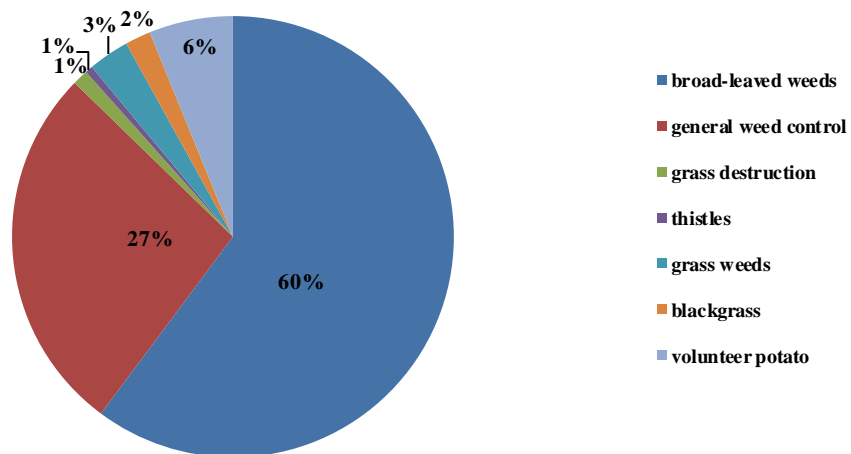


Fodder beet & mangolds – Herbicides

- **Formulation area treated: 119,040 hectares**
- **Weight of active substances applied: 59.62 tonnes**
- **The five most common formulations by area treated were:**

	Formulation area treated (ha)	Weight of a.s. applied (kg)	Proportion of herbicide – treated area	Proportion of census area treated	Average number of applications (where applied)	Average proportion of full label rate
Metamitron	30,193	27,588	0.25	0.80	1.76	0.61
Desmedipham/ethofumesate/lenacil/phenmedipham	19,912	5,363	0.17	0.52	1.81	0.86
Triflurosulfuron-methyl	9,428	115	0.08	0.35	1.28	0.81
Phenmedipham	8,716	2,750	0.07	0.31	1.32	0.69
Clopyralid	8,234	906	0.07	0.32	1.21	0.55

Figure 26 - Fodder beet & mangolds - reasons for use of herbicides (where given)



Fodder beet & mangolds – Molluscicides and repellents

- **Formulation area treated: 1,725 hectares**
- **Weight of active substances applied: 1.01 tonnes**

Metaldehyde was the only molluscicide used accounting for 73% of the area treated with molluscicides and repellents, the remaining 27% was the repellent, aluminium ammonium sulphate.

Fodder beet & mangolds – Fungicides

- **Formulation area treated: 8,949 hectares**
- **Weight of active substances applied: 1.72 tonnes**
- **The only formulations encountered were:**

	Formulation area treated (ha)	Weight of a.s. applied (kg)	Proportion of fungicide-treated area	Proportion of census area treated	Average number of applications (where applied)	Average proportion of full label rate
Cyproconazole/trifloxystrobin	6,260	1,125	0.70	0.24	1.23	0.96
Azoxystrobin/cyproconazole	1,349	336	0.15	0.06	1.00	0.99
Epoxiconazole/pyraclostrobin	918	162	0.10	0.04	1.05	0.96
Cyproconazole/picoxystrobin	422	96	0.05	0.02	1.00	0.81

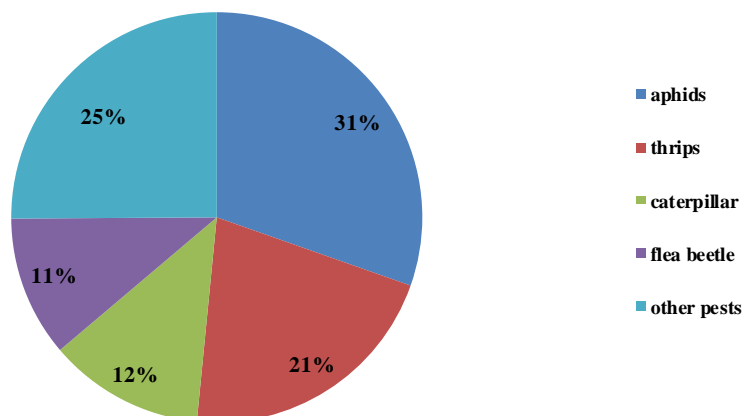
The only reason given for fungicide use on fodder beet and mangolds was unspecified mildew/phoma.

Fodder beet & mangolds – Insecticides

- **Formulation area treated: 6,581 hectares**
- **Weight of active substances applied: 0.20 tonnes**
- **The five most common formulations by area treated were:**

	Formulation area treated (ha)	Weight of a.s. applied (kg)	Proportion of insecticide – treated area	Proportion of census area treated	Average number of applications (where applied)	Average proportion of full label rate
Lambda-cyhalothrin	5,517	39	0.84	0.18	1.44	0.94
Cypermethrin	657	16	0.10	0.03	1.00	1.00
Pirimicarb	214	31	0.03	0.01	1.00	0.68
Oxamyl	192	115	0.03	0.01	1.00	1.00

Figure 27 - Fodder beet & mangold - reasons for use of insecticides (where given)



Fodder beet & mangolds – Seed Treatments

- **Formulation area treated: 25,315 hectares**
- **Weight of active substances applied: 3.03 tonnes**
- **7.1% of the seed remained untreated**
- **Where specified, the most common formulations (excluding unspecified treatments) were:**

	Formulation area treated (ha)	Weight of a.s. applied (kg)	Proportion of seed treatment area	Proportion of census area treated
Hymexazol	4,464	47	0.28	0.21
Thiram	4,070	2,710	0.26	0.19
Thiamethoxam	3,941	236	0.25	0.19
Tefluthrin	3,316	33	0.21	0.16

KALE, CABBAGE & RAPE

- 8,071 hectares of kale, cabbage & rape grown in the United Kingdom
- 8,900 treated hectares
- 3.34 tonnes applied
- 64.4% of kale, cabbage & rape remained untreated
- Where treated, kale, cabbage & rape received an average of 2 sprays with 2 products and 2 active substances
- There was minimal usage of molluscicides recorded

Figure 28 - Usage of pesticides on kale, cabbage & rape in the United Kingdom - 2017

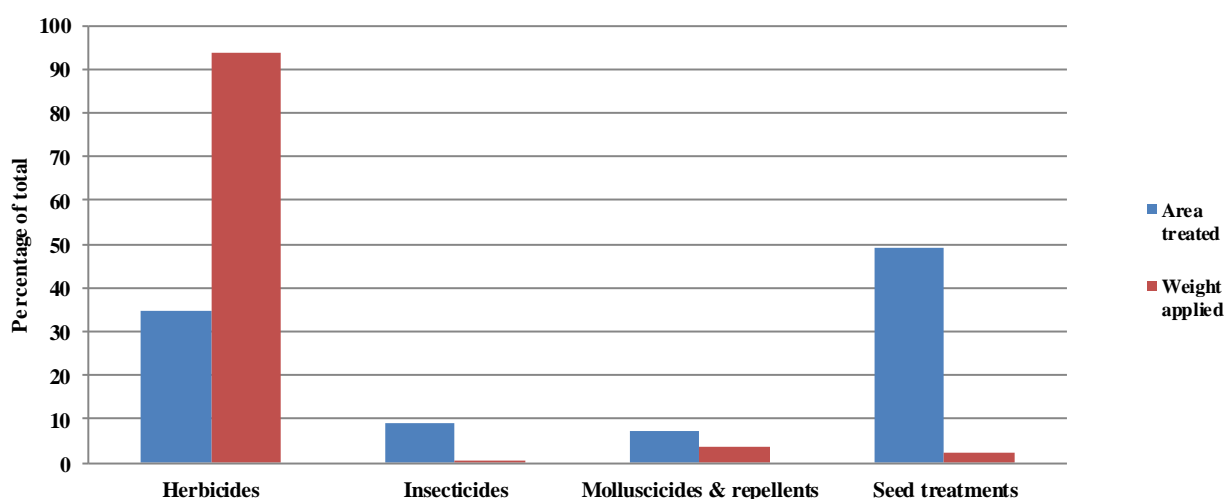
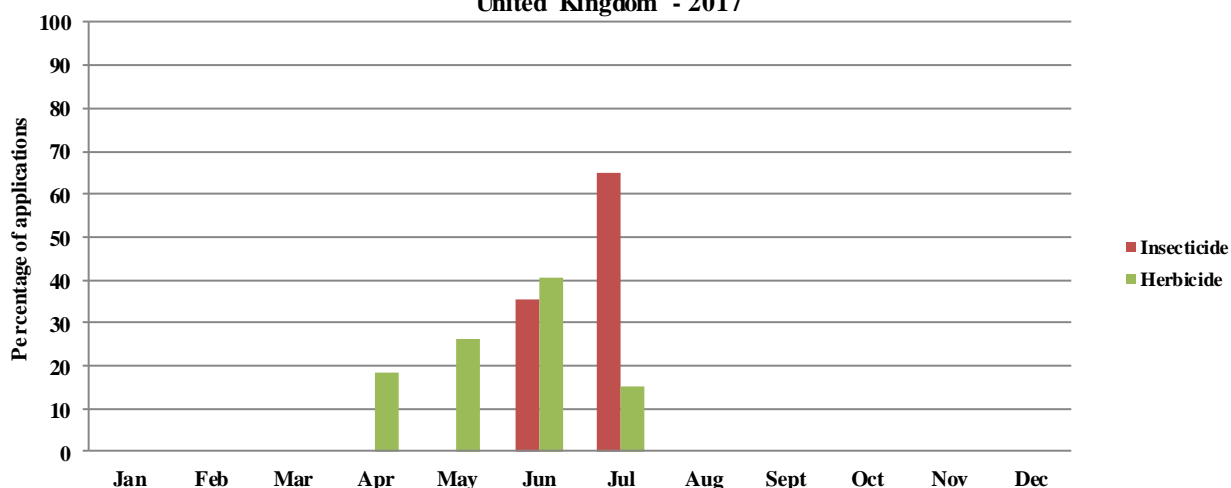


Figure 29 - Timing of pesticide applications on kale, cabbage & rape in the United Kingdom - 2017

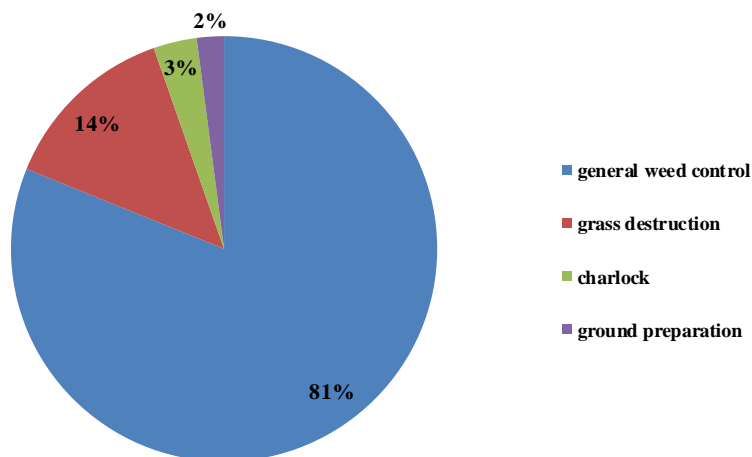


Kale, cabbage & rape – Herbicides

- **Formulation area treated: 3,080 hectares**
- **Weight of active substances applied: 3.14 tonnes**
- **The most common formulations by area treated were:**

	Formulation area treated (ha)	Weight of a.s. applied (kg)	Proportion of herbicide – treated area	Proportion of census area treated	Average number of applications (where applied)	Average proportion of full label rate
Glyphosate	1,668	2,248	0.54	0.21	1.00	0.81
Metazachlor	551	385	0.18	0.07	1.00	0.93
Dimethenamid-P/metazachlor	503	402	0.16	0.06	1.00	0.80
Diquat	154	41	0.05	0.02	1.00	1.00
Clopyralid	62	12	0.02	0.01	1.00	0.99

Figure 30 - Kale, cabbage & rape - reasons of use of herbicides (where given)

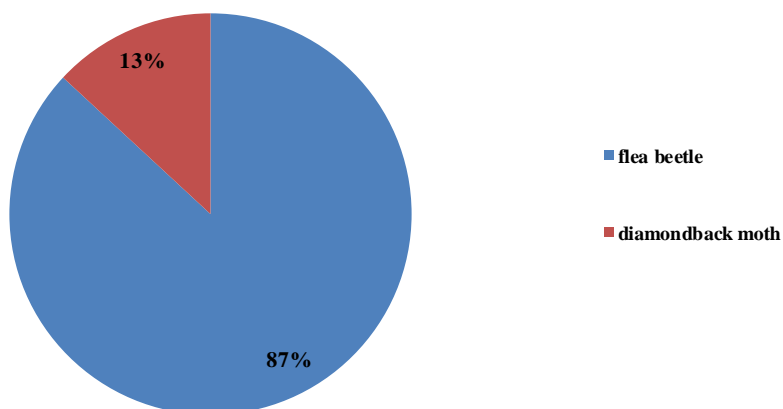


Kale, cabbage & rape – Insecticides

- **Formulation area treated: 812 hectares**
- **Weight of active substances applied: <0.01 tonnes**
- **The only formulations encountered were:**

	Formulation area treated (ha)	Weight of a.s. applied (kg)	Proportion of herbicide – treated area	Proportion of census area treated	Average number of applications (where applied)	Average proportion of full label rate
Lambda-cyhalothrin	423	6	0.52	0.05	1.00	1.32
Deltamethrin	218	1	0.27	0.02	1.20	0.89

Figure 31 - Kale, cabbage & rape - reasons for use of insecticides (where given)



Kale, cabbage & rape – Seed Treatments

- **Formulation area treated: 4,363 hectares**
- **Weight of active substances applied: 0.07 tonnes**
- **62.3% of the seed remained untreated**
- **Where specified the most common formulations (excluding unspecified treatments) were:**

	Formulation area treated (ha)	Weight of a.s. applied (kg)	Proportion of seed treatment area	Proportion of census area treated
Thiamethoxam	2,575	55	0.30	0.32
Thiram	1,097	15	0.70	0.14

OTHER CROPS FOR STOCKFEEDING

- Other crops for stockfeeding included arable silage mixes or whole-cropped fields of the following crops: lucerne, rye, wheat, red clover, barley, peas, oats, triticale, beans, sainfoin, trefoil, vetches, soya, lupins and chicory.
- 43,377 hectares of other crops for stockfeeding grown in the United Kingdom
- 94,106 treated hectares
- 35.96 tonnes applied
- 55.4% of other crops for stockfeeding remained untreated
- Where treated, other crops for stockfeeding received an average of 3 sprays with 6 products and 9 active substances

Figure 32 - Usage of pesticides on other crops for stockfeeding in the United Kingdom - 2017

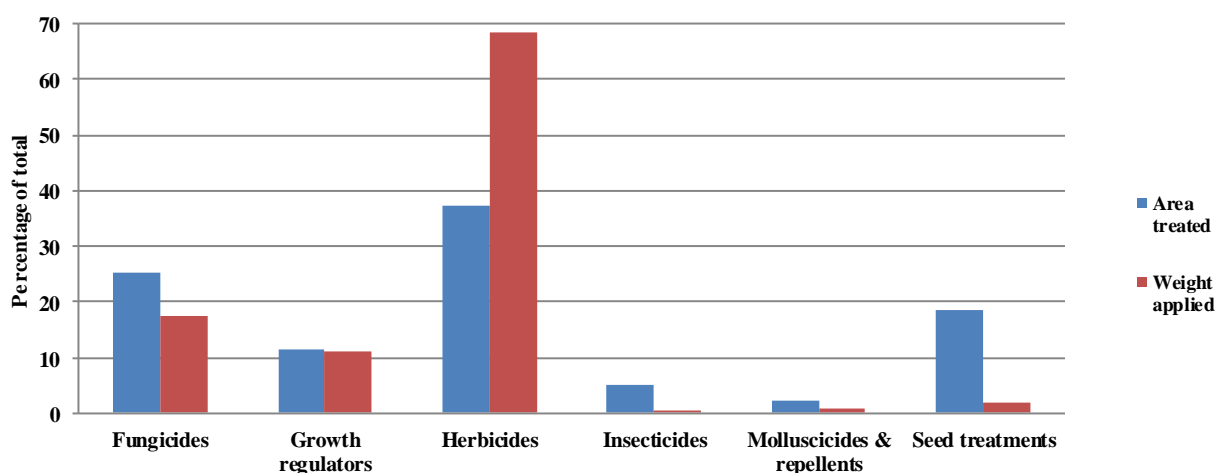
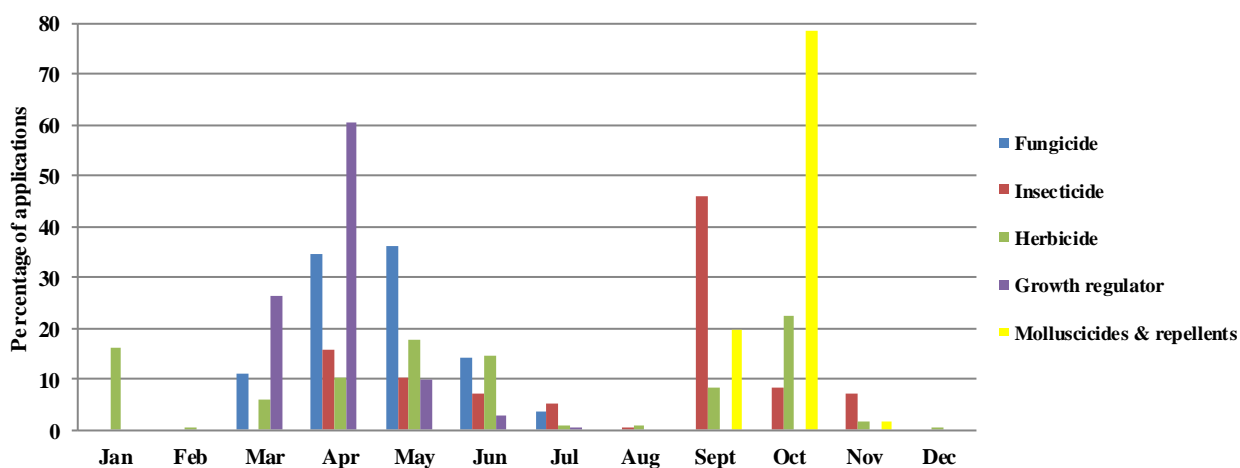


Figure 33 - Timing of pesticide applications on other crops for stockfeeding in the United Kingdom - 2017

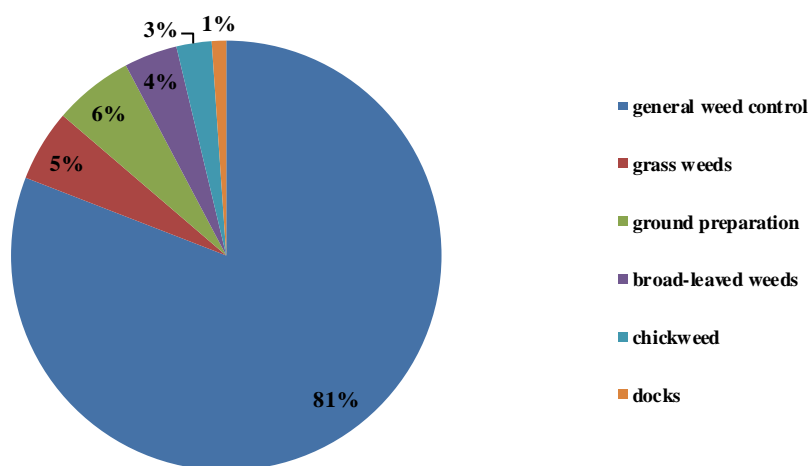


Other crops for stockfeeding– Herbicides

- **Formulation area treated: 35,141 hectares**
- **Weight of active substances applied: 24.67 tonnes**
- **The five most common formulations by area treated were:**

	Formulation area treated (ha)	Weight of a.s. applied (kg)	Proportion of herbicide – treated area	Proportion of census area treated	Average number of applications (where applied)	Average proportion of full label rate
Glyphosate	5,950	6,526	0.17	0.12	1.08	0.67
2,4-DB	3,804	6,106	0.11	0.09	1.00	0.89
Propyzamide	2,539	1,805	0.07	0.06	1.00	1.01
Diflufenican/flufofenacet	2,482	645	0.07	0.06	1.04	1.01
Pendimethalin	2,330	2,297	0.07	0.05	1.00	0.75

Figure 34 - Other crops for stock feeding - reasons for use of herbicides (where given)



Other crops for stockfeeding – Molluscicides

- **Formulation area treated: 2,134 hectares**
- **Weight of active substances applied: 0.33 tonnes**

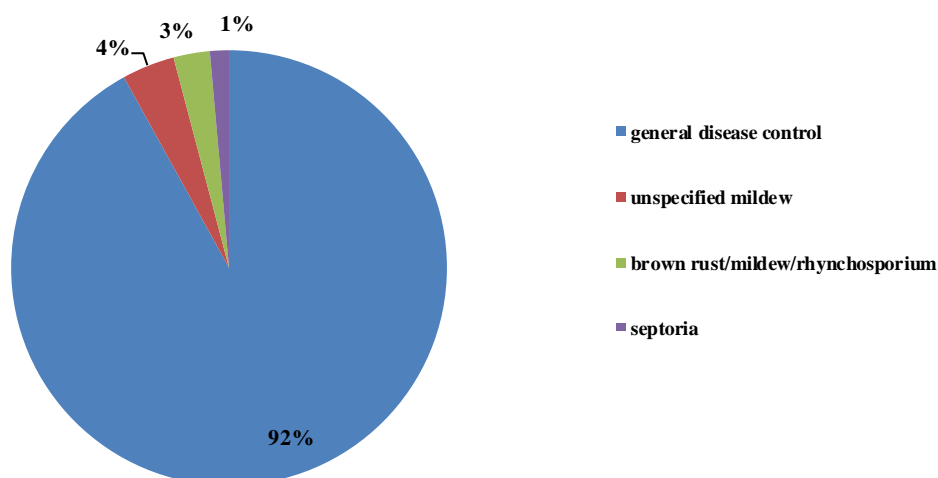
Metaldehyde accounted for 76% of the area treated, ferric phosphate the remaining 24%.

Other crops for stockfeeding– Fungicides

- **Formulation area treated: 23,705 hectares**
- **Weight of active substances applied: 6.29 tonnes**
- **Fungicide usage was primarily directed at cereals grown for whole crop silage**
- **The five most common formulations by area treated were:**

	Formulation area treated (ha)	Weight of a.s. applied (kg)	Proportion of fungicide – treated area	Proportion of census area treated	Average number of applications (where applied)	Average proportion of full label rate
Fluoxastrobin/prothioconazole/trifloxystrobin	3,148	478	0.13	0.07	1.00	0.51
Epoxiconazole/fenpropimorph	2,223	673	0.09	0.03	1.57	0.60
Chlorothalonil	1,743	958	0.07	0.03	1.29	0.47
Pyraclostrobin	1,295	192	0.05	0.03	1.07	0.59
Chlorothalonil/penthiopyrad	1,213	876	0.05	0.02	1.60	0.82

Figure 35 - Other crops for stock feeding - reasons for use of fungicides (where given)



Other crops for stockfeeding- growth regulators

- **Formulation area treated: 10,926 hectares**
- **Weight of active substances applied: 4.00 tonnes**
- **The five most common formulations by area treated were:**

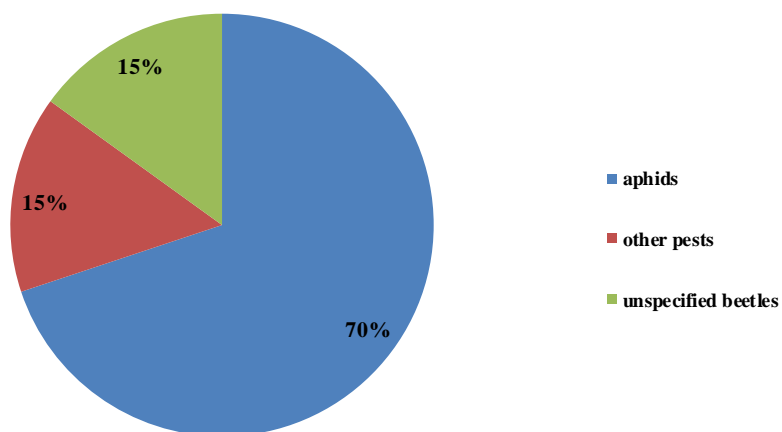
	Formulation area treated (ha)	Weight of a.s. applied (kg)	Proportion of insecticide – treated area	Proportion of census area treated	Average number of applications (where applied)	Average proportion of full label rate
Chlormequat	4,360	3,330	0.40	0.07	1.43	0.54
Trinexapac-ethyl	3,752	184	0.34	0.08	1.12	0.49
Prohexadione-calcium/trinexapac-ethyl	1,769	91	0.16	0.03	1.44	0.41
Mepiquat chloride/prohexadione-calcium	664	131	0.06	0.01	1.13	0.38
Chlormequat/imazaquin	284	210	0.03	0.01	1.00	0.80

Other crops for stockfeeding- insecticides

- **Formulation area treated: 4,675 hectares**
- **Weight of active substances applied: 0.04 tonnes**
- **The five most common formulations by area treated were:**

	Formulation area treated (ha)	Weight of a.s. applied (kg)	Proportion of insecticide – treated area	Proportion of census area treated	Average number of applications (where applied)	Average proportion of full label rate
Lambda-cyhalothrin	2,575	13	0.55	0.06	1.02	1.00
Zeta-cypermethrin	1,058	13	0.23	0.02	1.00	0.84
Esfenvalerate	760	3	0.16	0.02	1.08	0.96
Tau-fluvalinate	184	9	0.04	<0.01	1.00	1.00
Deltamethrin	95	<0.01	0.02	<0.01	1.00	0.63

Figure 36 - Other crops for stock feeding - reasons for use of insecticides (where given)



Other crops for stockfeeding- seed treatments

- **Formulation area treated: 17,526 hectares**
- **Weight of active substances applied: 0.62 tonnes**
- **47% of the seed remained untreated**
- **Where specified the most common formulations (excluding unspecified treatments) were:**

	Formulation area treated (ha)	Weight of a.s. applied (kg)	Proportion of seed treatment area	Proportion of census area treated
Fludioxonil	2,329	15	0.23	0.05
Clothianidin/prothioconazole	2,050	214	0.20	0.05
Prothioconazole	988	24	0.11	0.02
Rhizobial inoculum	860	12	0.10	0.02
Prochloraz/triticonazole	853	8	0.10	0.02

STUBBLE TURNIPS & CATCH CROPS

- 32,999 hectares of stubble turnips & catch crops grown in the United Kingdom
- 31,079 treated hectares
- 6.77 tonnes applied
- 50% of stubble turnips & catch crops remained untreated
- Stubble turnips & catch crops included combinations of kale, rape, swedes and turnips sown as catch crops in early July or later
- Where treated, stubble turnips & catch crops received an average of 1 spray with a single product and 2 active substances
- No foliar applied fungicides were encountered

Figure 37 - Usage of pesticides on stubble turnips & catch crops in the United Kingdom - 2017

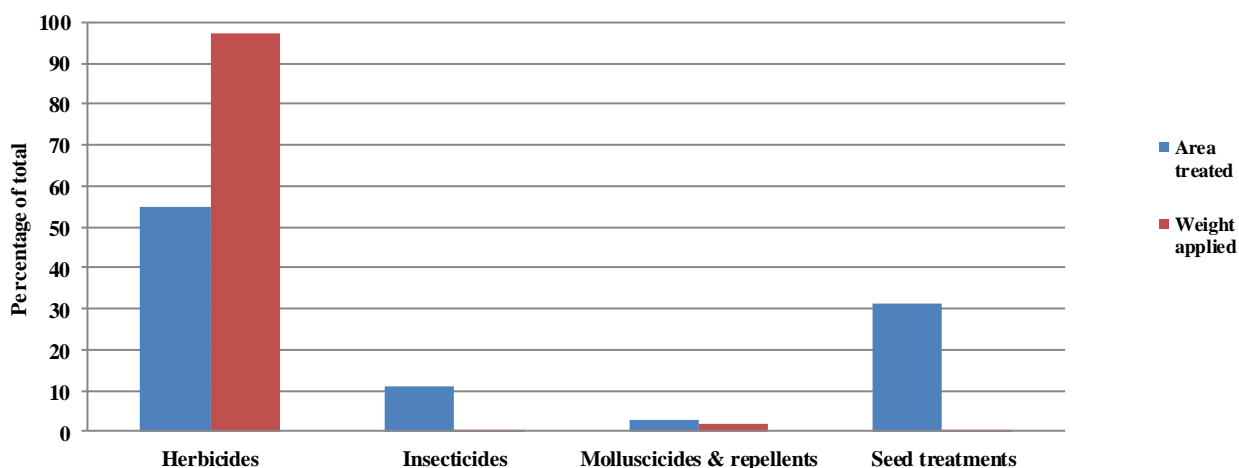
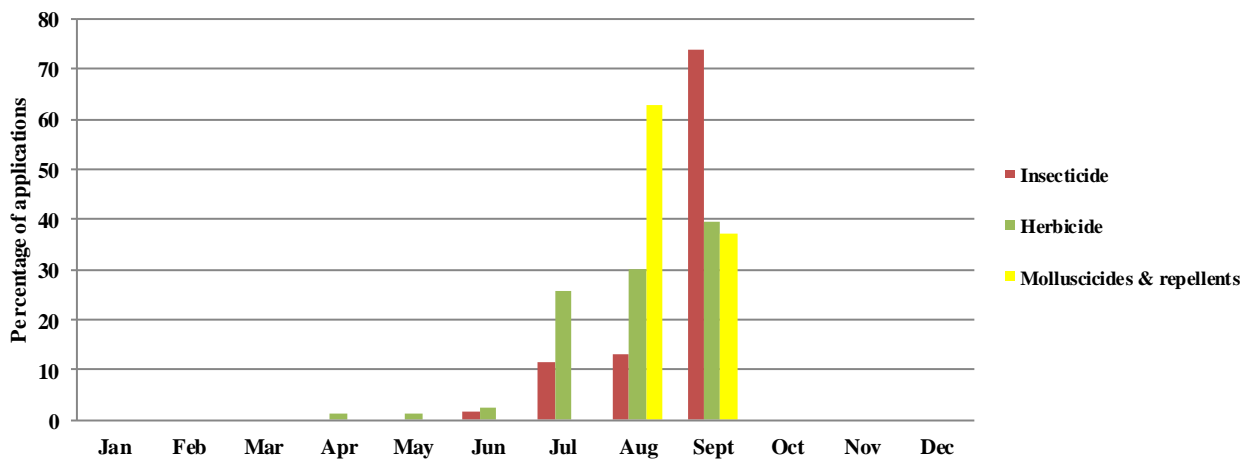


Figure 38 - Timing of pesticide applications on stubble turnips & catch crops in the United Kingdom - 2017

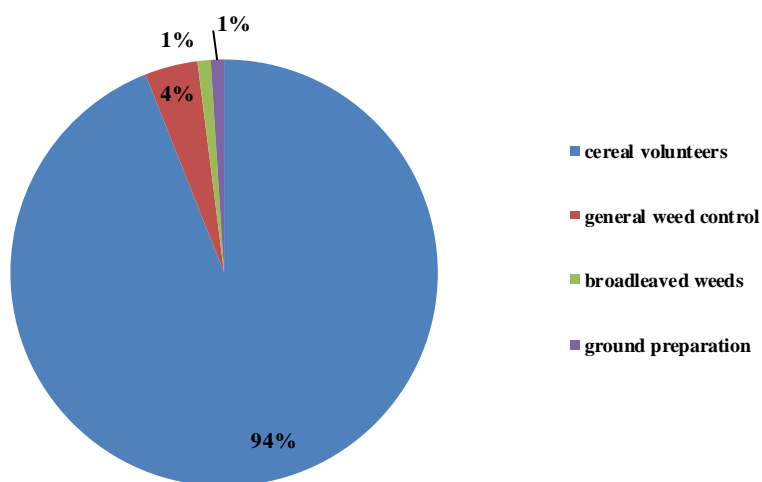


Stubble turnips & catch crops – Herbicides

- **Formulation area treated: 17,030 hectares**
- **Weight of active substances applied: 6.59 tonnes**
- **The five most common formulations by area treated were:**

	Formulation area treated (ha)	Weight of a.s. applied (kg)	Proportion of herbicide – treated area	Proportion of census area treated	Average number of applications (where applied)	Average proportion of full label rate
Propaquizafop	7,586	587	0.45	0.23	1.00	0.52
Glyphosate	6,263	5,423	0.37	0.19	1.02	0.58
Fluazifop-P-butyl	2,007	127	0.12	0.06	1.00	0.17
Quizalofop-P-ethyl	479	24	0.03	0.01	1.00	0.40
Dimethenamid-P/metazachlor	346	319	0.02	0.01	1.00	0.92

Figure 39 - Stubble turnips & catch crops - reasons for use of herbicides (where given)



Stubble turnips & catch crops – Molluscicides

- **Formulation area treated: 875 hectares**
- **Weight of active substances applied: 0.13 tonnes**

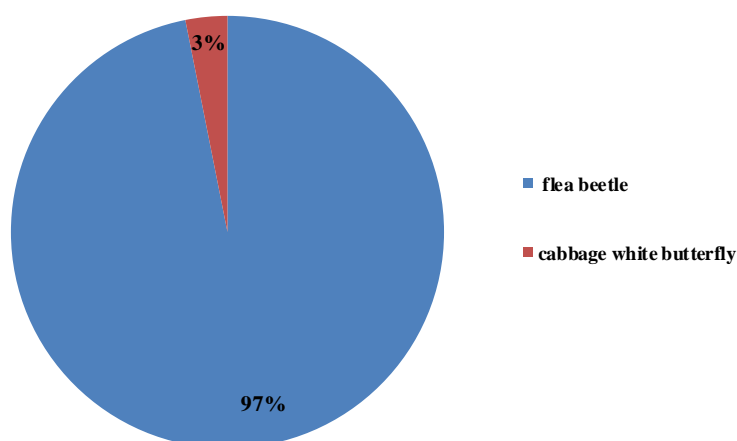
Metaldehyde was the only active substance encountered.

Stubble turnips & catch crops – Insecticides

- **Formulation area treated: 3,466 hectares**
- **Weight of active substances applied: 0.04 tonnes**
- **The only formulations encountered were:**

	Formulation area treated (ha)	Weight of a.s. applied (kg)	Proportion of insecticide – treated area	Proportion of census area treated	Average number of applications (where applied)	Average proportion of full label rate
Lambda-cyhalothrin	3,016	27	0.87	0.09	1.00	0.92
Cypermethrin	425	11	0.12	0.01	1.00	0.99
Alpha-cypermethrin	25	<0.01	0.01	<0.01	1.00	1.50

Figure 40 - Stubble turnips & catch crops - reasons for use of insecticides (where given)



Stubble turnips & catch crops – Seed Treatments

- **Formulation area treated: 9,708 hectares**
- **Weight of active substances applied: 0.01 tonnes**
- **70.8% of the seed remained untreated**
- **Where specified the most common formulations (excluding unspecified treatments) were:**

	Formulation area treated (ha)	Weight of a.s. applied (kg)	Proportion of seed treatment area	Proportion of census area treated
Thiram	734	10	0.92	0.02
Thiamethoxam	68	1	0.08	<0.01

PESTICIDE USAGE ON GRASSLAND

NEW LEYS - DIRECT SOWN

- 200,912 hectares of new leys – direct sown grown in the United Kingdom
- 193,020 treated hectares
- 65.56 tonnes applied
- 64% of new leys - direct sown remained untreated
- Where treated, new leys – direct sown received an average of 1 spray with 1 product and 2 active substances
- There was minimal usage of fungicides and no insecticide use was encountered

Figure 41 - Usage of pesticides on direct sown new leys in the United Kingdom - 2017

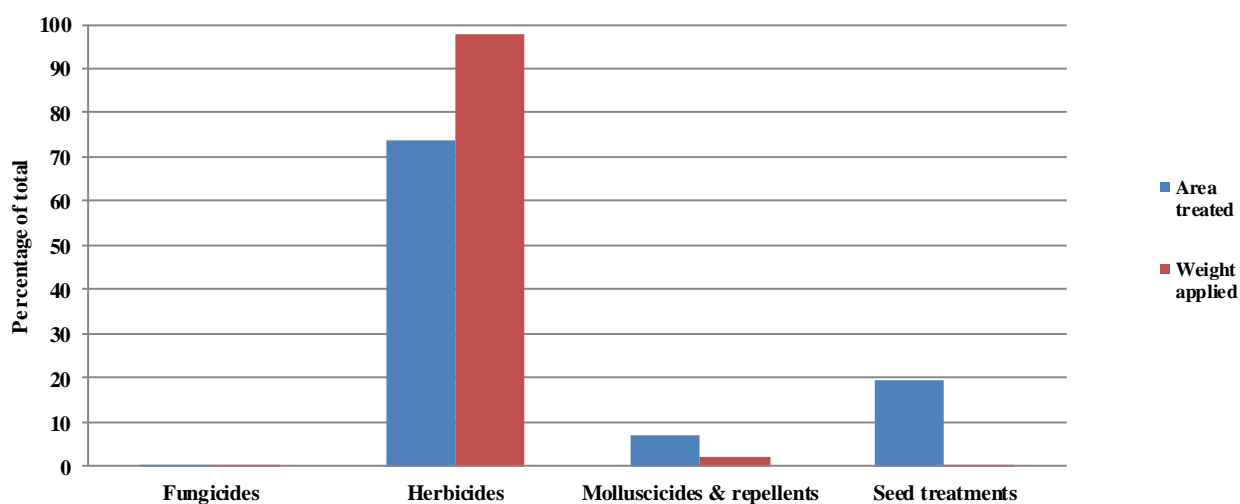
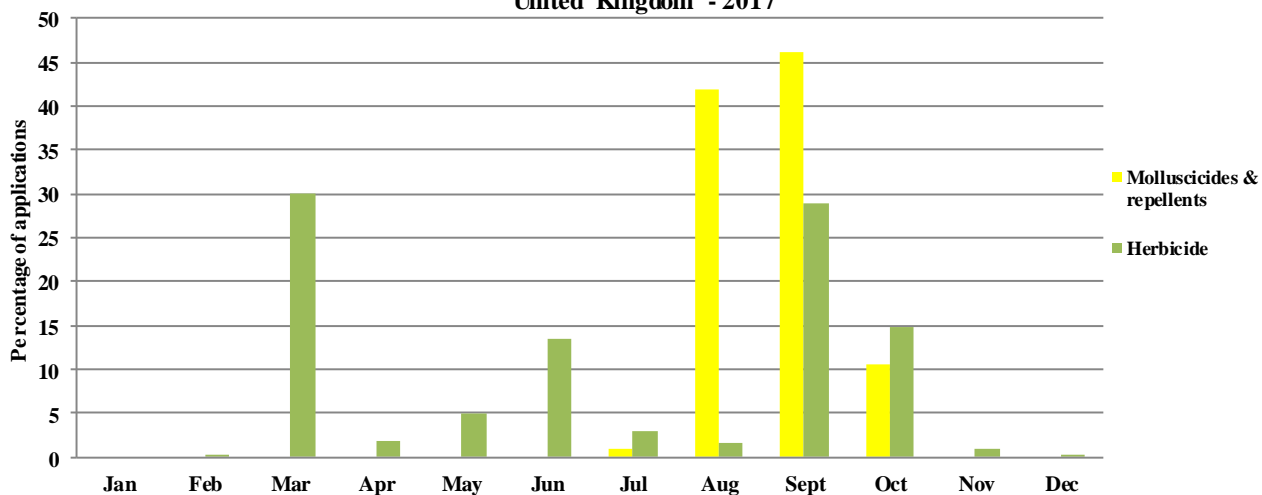


Figure 42 - Timing of pesticide applications on direct sown new leys in the United Kingdom - 2017

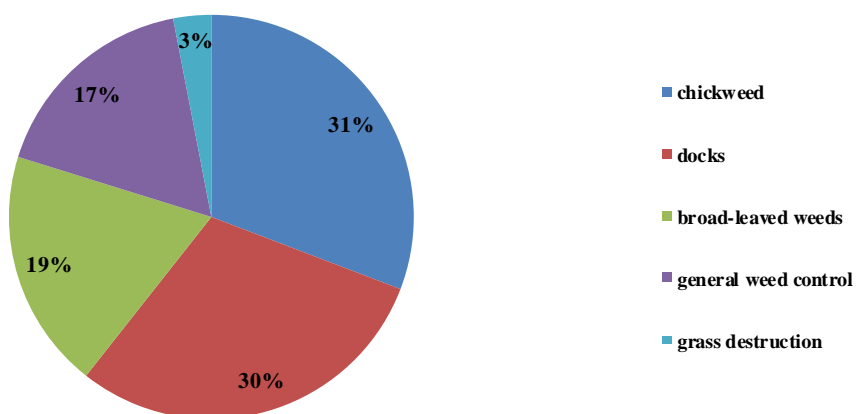


New leys - direct sown –Herbicides

- **Formulation area treated: 142,395 hectares**
- **Weight of active substances applied: 64.09 tonnes**
- **The five most common formulations by area treated were:**

	Formulation area treated (ha)	Weight of a.s. applied (kg)	Proportion of herbicide – treated area	Proportion of census area treated	Average number of applications (where applied)	Average proportion of full label rate
2,4-DB	41,476	16,766	0.29	0.02	1.81	0.22
Tribenuron-methyl	41,128	204	0.29	0.02	1.81	0.99
Fluroxypyr	10,007	1,501	0.07	0.01	1.00	0.40
Glyphosate	9,871	11,830	0.07	0.01	1.01	0.62
Mecoprop-P	9,800	3,470	0.07	0.01	1.00	0.24

Figure 43 - new ley - direct sown - reasons for use of herbicides (where given)



New leys - direct sown – Molluscicides

- **Formulation area treated: 13,365 hectares**
- **Weight of active substances applied: 1.41 tonnes**

Ferric phosphate accounted for 52% of the area treated, metaldehyde 30% and unspecified molluscicides the remaining 18%.

New leys – direct sown – Seed Treatments

- **Formulation area treated: 37,066 hectares**
- **Weight of active substances applied: 0.05 tonnes**
- **82% of the seed remained untreated**
- **The only active substance encountered (excluding unspecified treatments) was:**

	Formulation area treated (ha)	Weight of a.s. applied (kg)	Proportion of seed treatment area	Proportion of census area treated
Thiram	683	51	1.00	<0.01

NEW LEYS - UNDERSOWN

- 26,347 hectares of new leys – undersown grown in the United Kingdom
- 25,281 treated hectares
- 7.80 tonnes applied
- 70.6% of new leys - undersown remained untreated
- Where treated, new leys - undersown received an average of 1 spray with 1 product and 2 active substances
- Fungicide and growth regulator usage was directed at the nurse cereal crop
- Usage on this crop is also reported in pesticide usage surveys on arable crops – beware of potential duplication
- Spring barley was the principal nurse crop used in combination with undersown leys

Figure 44- Usage of pesticides on undersown new leys in the United Kingdom - 2017

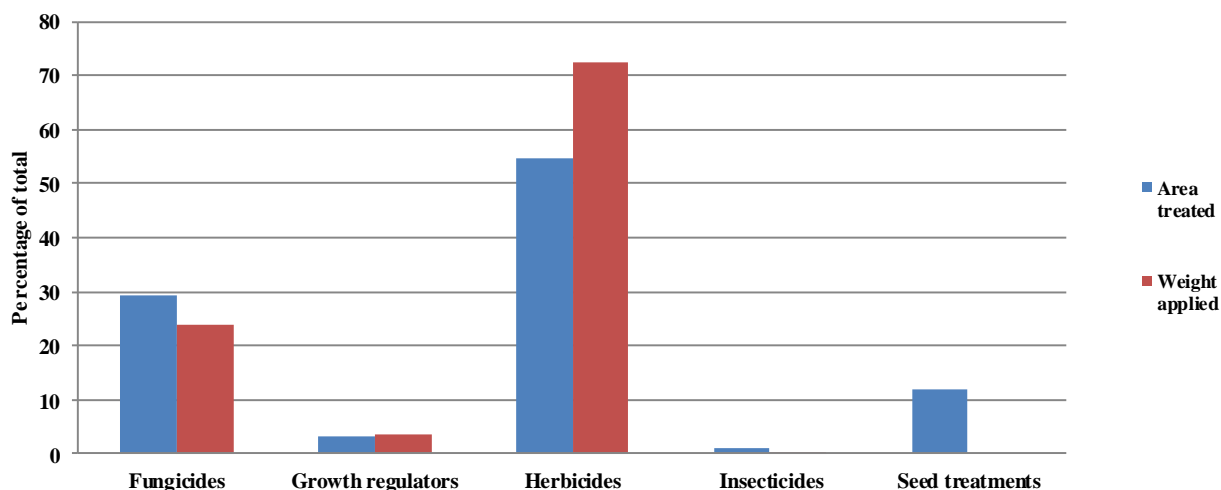
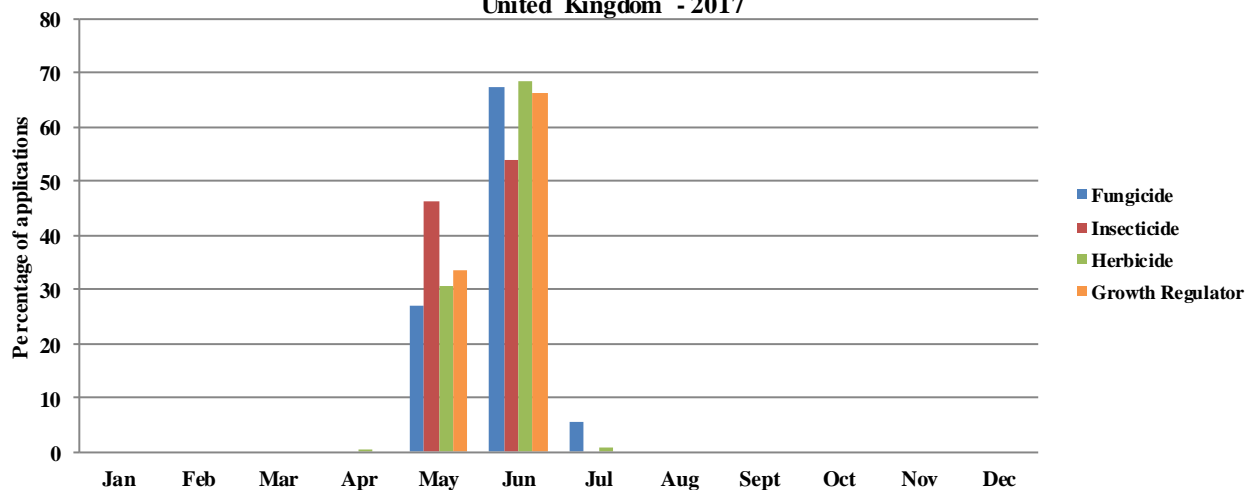


Figure 45- Timing of pesticide applications on undersown new leys in the United Kingdom - 2017

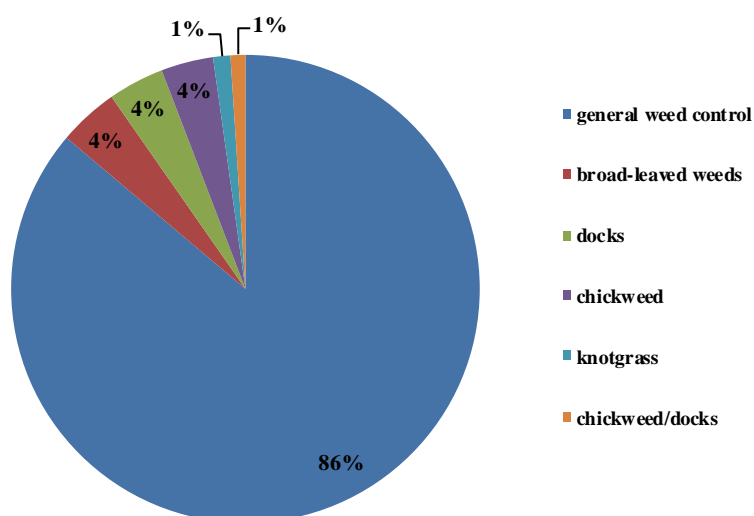


New leys – undersown – Herbicides

- **Formulation area treated: 13,845 hectares**
- **Weight of active substances applied: 5.64 tonnes**
- **The five most common formulations by area treated were:**

	Formulation area treated (ha)	Weight of a.s. applied (kg)	Proportion of herbicide – treated area	Proportion of census area treated	Average number of applications (where applied)	Average proportion of full label rate
Tribenuron-methyl	5,400	28	0.39	0.01	1.00	0.93
2,4-DB	5,311	3,562	0.38	<0.01	1.00	0.37
MCPA	543	293	0.04	<0.01	1.00	0.35
Florasulam/fluroxypyr	520	59	0.04	<0.01	1.00	0.77
Fluroxypyr	512	62	0.04	<0.01	1.00	0.64

Figure 46 - New leys - undersown - reasons for use of herbicides (where given)



New leys – undersown – Growth regulators

- **Formulation area treated: 810 hectares**
- **Weight of active substances applied: 0.29 tonnes**
- **The three formulations encountered were:**

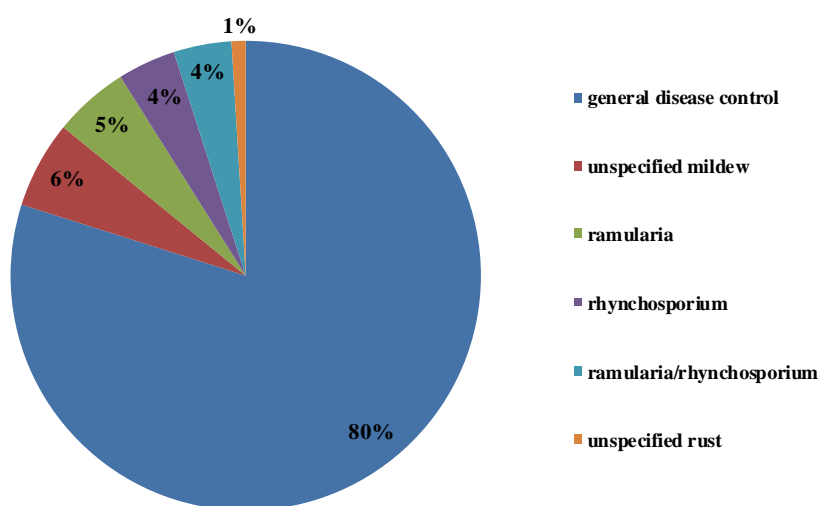
	Formulation area treated (ha)	Weight of a.s. applied (kg)	Proportion of growth regulator – treated area	Proportion of census area treated	Average number of applications (where applied)	Average proportion of full label rate
2-chloroethylphosphonic acid	287	47	0.36	<0.01	1.00	0.56
Chlormequat	272	204	0.34	<0.01	1.00	0.67
Mepiquat chloride/prohexadione-calcium	250	40	0.31	<0.01	1.00	0.31

New leys – undersown – Fungicides

- **Formulation area treated: 7,375 hectares**
- **Weight of active substances applied: 1.87 tonnes**
- **The five most common formulations by area treated were:**

	Formulation area treated (ha)	Weight of a.s. applied (kg)	Proportion of fungicide – treated area	Proportion of census area treated	Average number of applications (where applied)	Average proportion of full label rate
Chlorothalonil	1,494	781	0.20	<0.01	1.00	0.52
Prothioconazole/trifloxystrobin	1,204	172	0.16	<0.01	1.20	0.56
Prothioconazole/tebuconazole	807	103	0.11	<0.01	1.00	0.52
Epoxiconazole/fenpropimorph/metrafenone	666	227	0.09	<0.01	1.00	0.50
Fluoxastrobin/prothioconazole/trifloxystrobin	652	84	0.09	<0.01	1.22	0.43

Figure 47 - New leys - undersown - reasons for use of fungicides (where given)

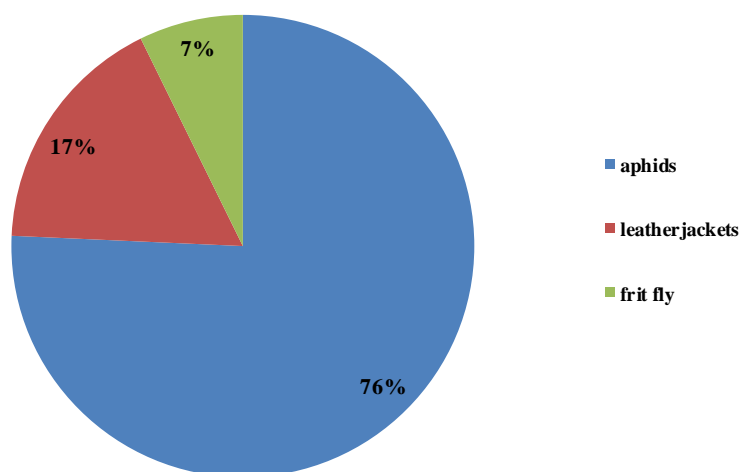


New leys – undersown – Insecticides

- **Formulation area treated: 216 hectares**
- **Weight of active substances applied: <0.01 tonnes**
- **The two formulations encountered were:**

	Formulation area treated (ha)	Weight of a.s. applied (kg)	Proportion of insecticide – treated area	Proportion of census area treated	Average number of applications (where applied)	Average proportion of full label rate
Lambda-cyhalothrin	116	1	0.54	<0.01	1.00	1.00
Esfenvalerate	100	<0.01	0.46	<0.01	1.00	1.21

Figure 48 - New ley undersown - reasons for use of insecticides (where given)



New leys – undersown – Grass Seed Treatments

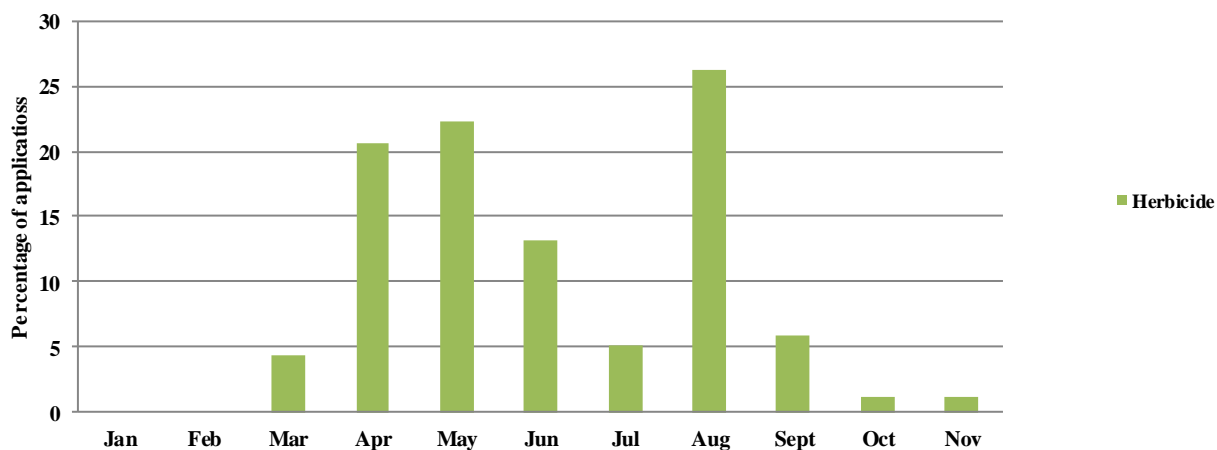
- **Formulation area treated: 3,036 hectares**
- **Weight of active substances applied: <0.01 tonnes**
- **89% of the undersown grass seed remained untreated**
- **Where seed treatments were recorded, no information was provided on the formulations used**

GRASSLAND TWO TO FIVE YEARS OLD

- 849,569 hectares of grassland 2 – 5 years old grown in the United Kingdom
- 89,077 treated hectares
- 49.48 tonnes applied
- 92% of grassland 2 – 5 years old remained untreated
- Where treated, grassland 2 – 5 years old received an average of 1 spray with 1 product and 2 active substances
- No insecticide use was encountered

Almost all pesticide applications made to permanent grass were herbicides (99.96%) with minimal (0.4%) usage of molluscicides.

Figure 49 - Timing of pesticide applications on grassland 2 - 5 years old in the United Kingdom - 2017

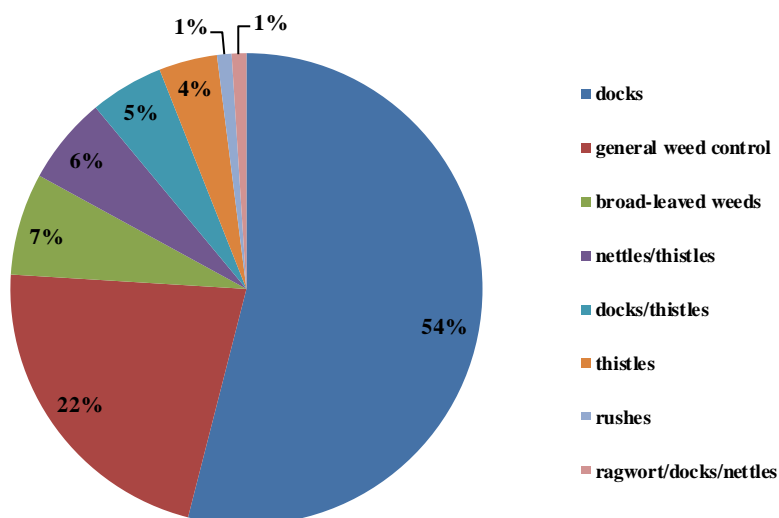


Grassland 2 -5 years old – Herbicides

- **Formulation area treated: 89,039 hectares**
- **Weight of active substances applied: 49.48 tonnes**
- **The five most common formulations by area treated were:**

	Formulation area treated (ha)	Weight of a.s. applied (kg)	Proportion of herbicide – treated area	Proportion of census area treated	Average number of applications (where applied)	Average proportion of full label rate
Fluroxypyr/triclopyr	24,026	10,897	0.27	0.02	1.04	0.76
Fluroxypyr	10,341	3,557	0.12	0.01	1.07	0.86
Clopyralid/fluroxypyr/triclopyr	9,881	6,956	0.11	0.01	1.00	0.78
Clopyralid/triclopyr	6,019	2,224	0.07	0.01	1.09	0.95
Amidosulfuron	5,873	259	0.07	0.01	1.05	0.98

Figure 50 - Grassland 2 - 5 years old - reasons for use of herbicides (where given)



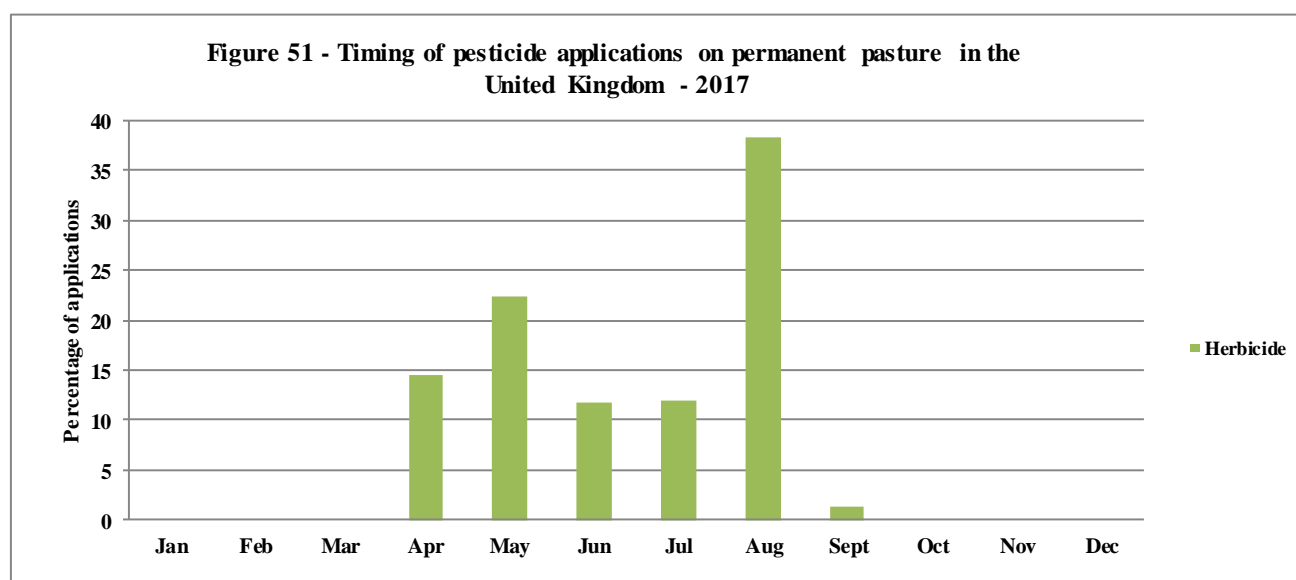
Grassland 2 -5 years old – Molluscicides

- **Formulation area treated: 37 hectares**
- **Weight of active substances applied: <0.01 tonnes**

Metaldehyde was the only molluscicide encountered.

PERMANENT PASTURE

- 6,202,980 hectares of permanent pasture grown in the United Kingdom
- 388,446 treated hectares
- 295.92 tonnes applied
- The only usage recorded on permanent pasture was herbicide application
- 94.6% of permanent pasture remained untreated
- Where treated, permanent pasture received an average of 1 spray with 1 product and 2 active substances

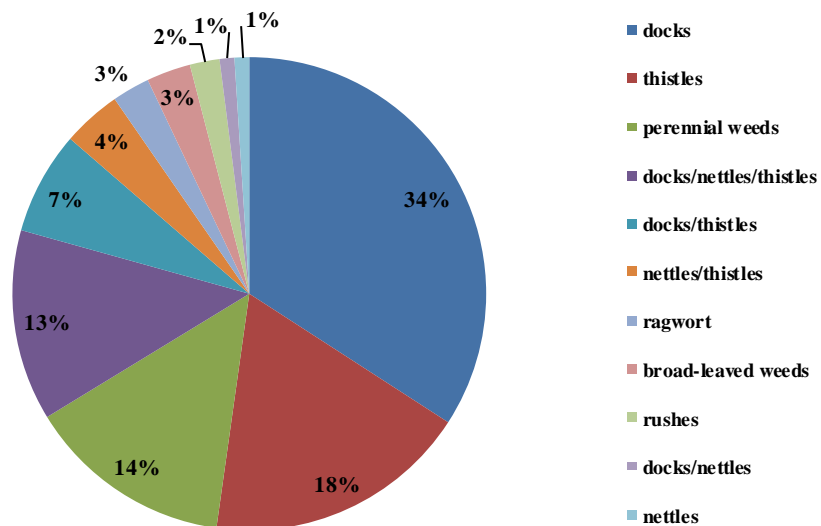


Permanent Pasture – Herbicides

- Formulation area treated: 388,446 hectares
- Weight of active substances applied: 295.92 tonnes
- The five most common formulations by area treated were:

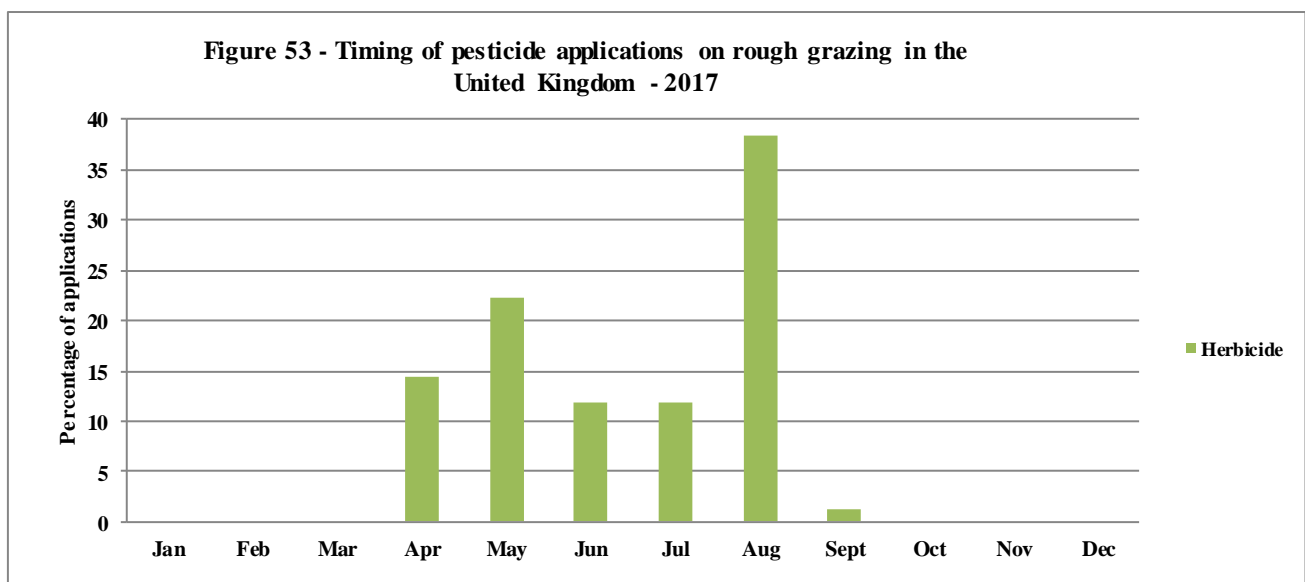
	Formulation area treated (ha)	Weight of a.s. applied (kg)	Proportion of herbicide – treated area	Proportion of census area treated	Average number of applications (where applied)	Average proportion of full label rate
Fluroxypyr/triclopyr	85,989	43,138	0.22	0.01	1.07	0.84
MCPA	67,306	91,605	0.17	0.01	1.01	0.83
Clopyralid/fluroxypyr/triclopyr	52,728	31,026	0.14	0.01	1.05	0.65
Clopyralid/triclopyr	45,181	16,658	0.12	0.01	1.04	0.95
Fluroxypyr	35,065	10,276	0.09	0.01	1.00	0.80

Figure 52 - Permanent pasture - reasons for use of herbicides (where given)



ROUGH GRAZING

- 3,939,855 hectares of rough grazing in the United Kingdom
- 53,332 treated hectares
- 57.48 tonnes applied
- Almost 100% of rough grazing remained untreated, herbicide application was the only usage encountered
- Where treated, rough grazing received an average of 1 spray with a single product and 2 active substances



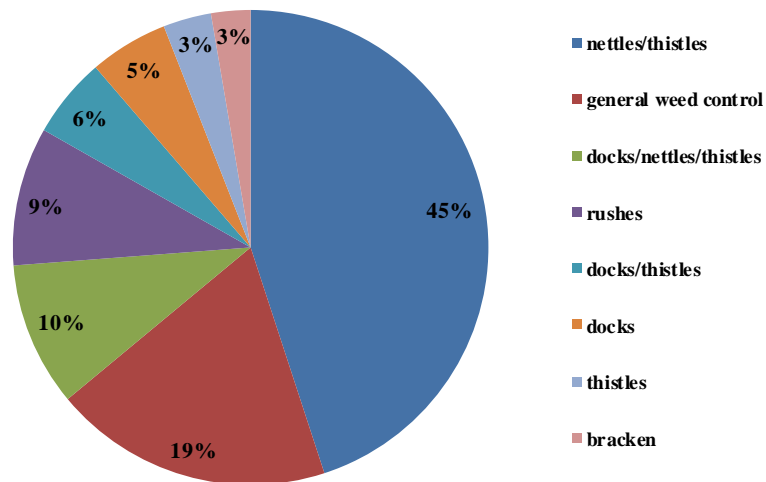
Rough Grazing – Herbicides

- **Formulation area treated: 53,332 hectares**
- **Weight of active substances applied: 57.48 tonnes**
- **The five most common formulations by area treated were:**

	Formulation area treated (ha)	Weight of a.s. applied (kg)	Proportion of herbicide – treated area	Proportion of census area treated	Average number of applications (where applied)	Average proportion of full label rate
MCPA	18,159	24,695	0.34	<0.01	1.00	0.83
Fluroxypyr/triclopyr	13,394	5,011	0.25	<0.01	1.00	0.62
Clopyralid/triclopyr	12,173	4,571	0.23	<0.01	1.00	0.99
Asulam	3,951	16,628	0.07	<0.01	1.00	0.96
Clopyralid/fluroxypyr/triclopyr	2,592	2,333	0.05	<0.01	1.00	1.00

The application of asulam, primarily for bracken control, is made at a relatively high rate compared to other herbicides, resulting in an overall high weight to area treated ratio.

Figure 54 - Rough grazing - reasons for use of herbicides (where given)



APPENDIX 1 – APPLICATION TABLES

Table 1 *Area of grassland & fodder crops grown by region in the United Kingdom 2017 (ha)*

	East Midlands	Eastern	London & South East	North East	North West	South West	West Midlands	Yorkshire & the Humber	Wales	Scotland	Northern Ireland	United Kingdom
Maize	24,805	23,936	27,228	446	12,548	58,833	26,821	8,665	12,022	792	1,381	197,477
Turnips & swedes	.	.	754	145	427	219	430	.	2,926	3,806	378	9,085
Fodder beet & mangolds	1,185	1,767	1,370	197	1,352	2,817	6,704	2,801	1,603	611	642	21,049
Kale, cabbage & rape	.	.	106	303	632	1,109	553	662	728	3,922	56	8,071
Other crops for stockfeeding	1,789	5,328	4,985	916	1,530	6,263	1,409	719	9,788	6,834	3,816	43,377
Stubble turnips & catch crops	532	2,270	9,243	256	1,214	9,336	7,819	643	680	886	120	32,999
Grassland less than 5 years old ¹	54,167	41,818	74,502	32,343	75,548	218,565	90,609	52,548	153,723	206,254	76,751	1,076,828
Permanent pasture	258,133	151,712	326,557	308,290	629,897	849,726	344,187	410,138	1,083,587	1,112,553	728,200	6,202,980
Rough grazing	30,223	13,455	21,342	117,916	116,503	68,095	13,769	97,470	248,678	3,037,615	140,400	3,905,466
All fodder crops & grassland	370,834	240,286	466,087	460,812	839,651	1,214,963	492,301	573,646	1,513,735	4,373,273	951,744	11,497,332

¹ Includes new leys – direct sown, new leys – undersown and grassland 2-5 years old
For the current and subsequent appendix 1 tables ‘.’ has been used to indicate no occurrence.

Table 2 *Treated area of grassland & fodder crops in the United Kingdom 2017 - crop group (spray hectares)*

	Maize	Turnips & swedes	Fodder beet & mangolds	Kale, cabbage, rape etc.	Other crops for stock feeding	Stubble turnips & catch crops	New ley direct sown	New ley undersown	Grassland 2-5 years old	Permanent pasture	Rough grazing	All crops
Insecticides	.	1,496	6,581	812	4,675	3,466	.	216	.	.	.	17,246
Fungicides	7,345	90	8,949	.	23,705	.	194	7,375	.	.	.	47,658
Herbicides	524,097	6,314	119,040	3,080	35,141	17,030	142,395	13,845	89,039	388,446	53,332	1,391,761
Growth regulators	.	.	.	.	10,926	.	.	810	.	.	.	11,735
Molluscicides & repellents	1,167	.	1,725	644	2,134	875	13,365	.	37	.	.	19,947
All seed treatments	235,021	7,120	25,315	4,363	17,526	9,708	37,066	3,036	.	.	.	339,154
All pesticides	767,630	15,021	161,609	8,900	94,106	31,079	193,020	25,281	89,077	388,446	53,332	1,827,501

Table 2a *Usage of pesticides on grassland & fodder crops in the United Kingdom 2017 - crop group (kg of active substances applied)*

	Maize	Turnips & swedes	Fodder beet & mangolds	Kale, cabbage, rape etc.	Other crops for stock feeding	Stubble turnips & catch crops	New ley direct sown	New ley undersown	Grassland 2-5 years old	Permanent pasture	Rough Grazing	All crops
Insecticides & nematocides	.	7	202	7	38	38	.	1	.	.	.	293
Fungicides	1,349	17	1,719	.	6,293	.	42	1,870	.	.	.	11,291
Herbicides	259,460	3,351	59,624	3,137	24,670	6,585	64,088	5,640	49,479	295,920	57,476	829,430
Growth regulators	.	.	.	.	4,004	.	.	291	.	.	.	4,296
Molluscicides & repellents	163	.	1,012	124	327	131	1,405	.	5	.	.	3,167
All seed treatments	16,517	12	3,026	70	623	11	51	.	.	.	.	20,310
All pesticides	277,489	3,388	65,583	3,338	35,956	6,766	65,586	7,801	49,484	295,920	57,476	868,788

Table 3 *Usage of pesticides on grassland & fodder crops in the United Kingdom 2017 - percentage area of crops treated with pesticides*

	Insecticides	Fungicides	Herbicides	Growth regulators	Molluscicides & repellents	Seed treatments	Not treated ¹
Maize	.	3.9	95.8	.	0.6	97.9	3.9
Turnips & swedes	10.5	1	52.6	.	.	58.4	45.8
Fodder beet & mangolds	23.7	35.2	93.5	.	8.3	92.9	6.4
Kale, cabbage and rape	9.6	.	30.6	.	8	37.7	64.4
Other crops for stockfeeding	9.3	24.9	42.9	11.3	2.7	52.8	55.4
Stubble turnips & catch crops	10.5	.	49	.	2.7	29.2	50.0
New ley - direct sown	.	0.1	30.2	.	6.4	18.4	64.0
New ley - undersown	0.8	13.5	29.4	3.1	.	11.5	70.6
Grassland 2 - 5 years old	.	.	7.0	.	<0.1	.	92.0
Permanent pasture	.	.	4.9	.	.	.	94.6
Rough grazing	.	.	1.2	.	.	.	98.8
All crops	0.1	0.3	6.3	<0.1	0.2	54.5	93.2

¹ Area not treated excludes consideration of seed treatments.

Table 4a *Usage of pesticides on grassland & fodder crops in the United Kingdom 2017 - number of applications made to crops when treated with individual pesticide groups (excluding seed treatments)*

	Insecticides	Fungicides	Herbicides	Growth regulators	Molluscicides & repellents	All Pesticides
Maize	.	1.0	2.1	.	1.0	3.2
Turnips & swedes	1.1	1.0	1.1	.	.	1.8
Fodder beet & mangolds	1.5	1.4	3.3	.	1.0	4.9
Kale, cabbage, rape etc.	1.1	.	1.5	.	1.0	2.1
Other crops for stockfeeding	1.1	1.9	1.7	1.7	1.4	3.3
Stubble turnips & catch crops	1.0	.	1.1	.	1.0	1.4
New leys - direct-sown	.	1.0	1.1	.	1.1	1.1
New leys - undersown	1.0	1.4	1.0	1.0	.	1.2
Grassland 2 - 5 years old	.	.	1.1	.	1.0	1.1
Permanent grass	.	.	1.1	.	.	1.1
Rough grazing	.	.	1.2	.	.	1.2
All crops	1.1	1.5	1.6	1.6	1.2	1.8

For tables 4a, 4b and 4c the 1.0 indicates number of passes/spray rounds of application machinery as some herbicides may be applied using weed wipers and some insecticides/molluscicides as granules or pellets. Parts of fields may be treated more than once or one field may have several different parts visited on different occasions. The number of applications relates only to those crops receiving a treatment with an individual pesticide group. Please refer to this table in conjunction with Table 3 which indicates the proportion of each crop treated with each pesticide group.

For tables 4a, 4b and 4c each pass/round may contain a single or multiple products from more than one pesticide group and each product may contain single or multiple active substances. For example, on average farmers with fodder beet applied herbicides on 3 separate occasions, using an average of 7 herbicide products and 11 herbicide active substances during the life of the crop.

Table 4b *Usage of pesticides on grassland & fodder crops in the United Kingdom 2017 - number of products applied to crops when treated with individual pesticide groups (excluding seed treatments)*

	Insecticides	Fungicides	Herbicides	Growth regulators	Molluscicides & repellents	All pesticides
Maize	.	1.0	3.1	.	1.0	3.2
Turnips & swedes	1.1	1.0	1.3	.	.	1.5
Fodder beet & mangolds	1.5	1.4	6.6	.	1.0	7.5
Kale, cabbage and rape	1.1	.	1.5	.	1.0	1.9
Other crops for stockfeeding	1.1	2.7	2.4	2.4	1.4	6.2
Stubble turnips & catch crops	1.0	.	1.2	.	1.0	1.4
New leys - direct-sown	1.1	1.0	.	1.4	.	1.4
New leys - undersown		1.9	1.0	1.7	1.0	1.7
Grassland 2 - 5 years old	1.0	.	.	1.3	.	1.3
Permanent grass	.	.	1.3	.	.	1.3
Rough grazing	.	.	1.3	.	.	1.3
All crops	1.1	2.0	2.2	2.4	1.2	2.6

Table 4c *Usage of pesticides on grassland & fodder crops in the United Kingdom 2017 - number of active substances applied to crops when treated with individual pesticide groups (excluding seed treatments).*

	Insecticides	Fungicides	Herbicides	Growth regulators	Molluscicides & repellents	All Pesticides
Maize	.	1.4	3.8	.	1.0	4.0
Turnips & swedes	1.1	1.0	1.6	.	.	1.8
Fodder beet & mangolds	1.5	2.7	11.2	.	1.0	12.6
Kale, cabbage and rape	1.1	.	1.8	.	1.0	2.2
Other crops for stockfeeding	1.1	4.7	3.3	3.1	1.4	8.8
Stubble turnips & catch crops	1.0	.	1.3	.	1.0	1.6
New leys - direct-sown	1.1	2.0	.	1.7	.	1.6
New leys - undersown	.	3.4	1.3	2.1	1.0	2.5
Grassland 2 - 5 years old	1.0	.	.	2.0	.	2.0
Permanent grass	.	.	2.2	.	.	2.2
Rough grazing	.	.	2.0	.	.	2.0
All crops	1.1	3.4	3.1	3.0	1.2	3.7

Table 5 *Usage of pesticides on grassland & fodder crops grown in the United Kingdom 2017 (spray hectares)*

	Maize	Turnips & swedes	Fodder beet & mangolds	Kale, cabbage, rape etc.	Other crops for stock feeding	Stubble turnips & catch crops	New ley direct sown	New ley undersown	Grassland 2-5 years old	Permanent pasture	Rough grazing	All crops
Fungicides												
Azoxystrobin/cyproconazole	.	.	1,349	.	608	.	.	.	.	.	.	1,957
Chlorothalonil	.	.	.	.	1,743	.	.	1,494	.	.	.	3,237
Cyproconazole/trifloxystrobin	.	.	6,260	.	.	.	.	60	.	.	.	6,260
Epoxiconazole/fenpropimorph	.	.	.	.	2,223	.	194	.	.	.	.	2,477
Epoxiconazole/pyraclostrobin	2,486	.	918	.	.	.	.	.	.	.	.	3,404
Fluoxastrobin/prothioconazole/Trifloxystrobin	.	.	.	.	3,148	.	.	652	.	.	.	3,801
Pyraclostrobin	4,859	.	.	.	1,295	.	.	.	.	.	.	6,155
Other fungicides ¹	.	90	422	.	14,686	.	.	5,169	.	.	.	20,367
All fungicides	7,345	90	8,949	.	23,705	.	194	7,375	.	.	.	47,658

¹Other fungicides include azoxystrobin, azoxystrobin/chlorothalonil, benzovindiflupyr, bixafen/fluoxastrobin/prothioconazole, bixafen/prothioconazole, bixafen/prothioconazole/tebuconazole, boscalid/epoxiconazole, boscalid/epoxiconazole/pyraclostrobin, chlorothalonil/cyproconazole, chlorothalonil/cyproconazole/propiconazole, chlorothalonil/penthiopyrad, chlorothalonil/proquinazid, copper oxychloride, cyproconazole/picoxystrobin, cyprodinil, cyprodinil/isopyrazam, epoxiconazole, epoxiconazole/fenpropimorph/kresoxim-methyl, epoxiconazole/fenpropimorph/metrafenone, epoxiconazole/fluxapyroxad, epoxiconazole/fluxapyroxad/pyraclostrobin, epoxiconazole/folpet, epoxiconazole/isopyrazam, epoxiconazole/metconazole, epoxiconazole/metrafenone, epoxiconazole/prochloraz, fenpropimorph, fenpropimorph/pyraclostrobin, fluoxastrobin/prothioconazole, fluxapyroxad, fluxapyroxad/metconazole, fluxapyroxad/pyraclostrobin, folpet, penthiopyrad, prochloraz/proquinazid/tebuconazole, prochloraz/tebuconazole, propiconazole, proquinazid, prothioconazole, prothioconazole/spiroxamine, prothioconazole/tebuconazole, prothioconazole/trifloxystrobin, tebuconazole and unspecified fungicides.

Table 5 (cont) *Usage of pesticides on grassland & fodder crops grown in the United Kingdom 2017 (spray hectares)*

	Maize	Turnips & swedes	Fodder beet & mangolds	Kale, cabbage, rape etc.	Other crops for stock feeding	Stubble turnips & catch crops	New ley direct sown	New ley undersown	Grassland 2-5 years old	Permanent pasture	Rough grazing	All crops
Herbicides												
2, 4-D	.	.	.	.	.	.	8,885	.	3,864	22,307	1,181	36,237
2, 4-D/dicamba	.	.	.	.	.	.	.	.	804	2,277	.	3,081
2, 4-D/MCPA	.	.	.	.	301	.	9,226	394	2,796	17,404	161	30,283
2, 4-DB	.	.	.	.	3,804	.	41,476	5,311	3,058	2,098	.	55,748
Amidosulfuron	.	.	.	.	.	.	610	.	5,873	3,781	.	10,264
Aminopyralid/triclopyr	.	.	.	.	96	.	24	.	2,639	15,728	.	18,487
Asulam	.	.	.	.	.	.	.	.	.	417	3,951	4,368
Bromoxynil	25,649	.	.	.	.	.	.	.	.	.	.	25,649
Bromoxynil/terbuthylazine	2,001	.	.	.	.	.	.	.	.	.	.	2,001
Chloridazon	.	.	5,342	.	.	.	.	.	.	.	.	5,342
Chloridazon/metamitron	.	.	1,957	.	.	.	.	.	.	.	.	1,957
Clopyralid	8,657	427	8,235	62	.	19	.	.	40	50	.	17,488
Clopyralid/florasulam/fluroxypyr	33	.	.	.	74	.	1,042	79	1,102	.	.	2,330
Clopyralid/fluroxypyr/triclopyr	.	.	.	.	.	.	604	.	9,881	52,728	2,592	65,804
Clopyralid/triclopyr	.	.	.	.	.	23	1,210	.	6,019	45,181	12,173	64,606
Desmedipham/ethofumesate/lenacil/phenmedipham	.	.	19,912	.	.	.	.	.	.	.	.	19,912
Desmedipham/ethofumesate/phenmedipham	.	.	7,298	.	.	.	.	.	.	.	.	7,298
Dicamba	3,776	.	.	.	.	.	.	.	.	.	.	3,776
Dicamba/MCPA/mecoprop-P	.	.	.	.	120	.	27	320	72	5,887	52	6,477
Dicamba/mecoprop-P	.	.	.	.	313	.	2,275	116	.	15,046	.	17,751
Dicamba/prosulfuron	2,806	.	.	.	.	.	.	.	.	.	.	2,806
Diflufenican/flufenacet	.	.	.	.	2,482	.	.	.	.	.	.	2,482
Dimethenamid-P/pendimethalin	17,020	.	.	.	.	.	.	.	.	.	.	17,020
Diquat	519	.	.	154	2,293	.	.	.	.	.	.	2,966
Ethofumesate	.	.	5,875	.	.	.	.	.	.	.	.	5,875
Ethofumesate/phenmedipham	.	.	3,128	.	.	.	.	.	.	.	.	3,128
Florasulam/fluroxypyr	.	118	.	.	607	.	1,101	520	1,099	7,062	.	10,506
Fluazifop-P-butyl	.	.	125	.	372	2,007	.	.	.	.	.	2,505
Fluroxypyr	17,271	.	.	.	1,242	.	10,007	512	10,341	35,065	131	74,569
Fluroxypyr/triclopyr	.	.	.	.	.	.	2,064	.	24,026	85,989	13,394	125,473

Table 5 (cont) *Usage of pesticides on grassland & fodder crops grown in the United Kingdom 2017 (spray hectares)*

	Maize	Turnips & swedes	Fodder beet & mangolds	Kale, cabbage, rape etc.	Other crops for stock feeding	Stubble turnips & catch crops	New ley direct sown	New ley undersown	Grassland 2-5 years old	Permanent pasture	Rough grazing	All crops
Herbicides (cont)												
Foramsulfuron/iodosulfuron-methyl-sodium	25,500	.	.	.	.	.	.	.	.	.	.	25,500
Glyphosate	82,179	1,550	4,290	1,668	5,950	6,263	9,871	427	3,192	2,308	1,538	119,235
Lenacil	.	.	3,914	.	.	.	.	.	.	.	.	3,914
Lenacil/triflusalufuron-methyl	.	.	6,305	.	.	.	.	.	.	.	.	6,305
MCPA	.	.	.	.	440	.	1,339	543	4,754	67,306	18,159	92,540
Mecoprop-P	.	.	.	.	1,225	.	9,800	.	.	.	.	11,026
Mesotrione	55,045	.	.	.	.	.	.	.	.	.	.	55,045
Mesotrione/nicosulfuron	3,861	.	.	.	.	.	.	.	.	.	.	3,861
Mesotrione/terbuthylazine	81,260	.	.	.	.	.	.	.	.	.	.	81,260
Metamitron	.	.	30,193	.	.	.	.	.	.	.	.	30,193
Metazachlor	.	1,652	.	551	.	51	.	.	.	.	.	2,254
Metsulfuron-methyl	.	.	.	.	308	.	266	.	5,219	3,214	.	9,007
Nicosulfuron	103,650	.	.	.	.	.	.	.	.	.	.	103,650
Pendimethalin	69,509	.	.	.	2,330	.	377	.	.	.	.	72,217
Phenmedipham	.	.	8,716	.	.	.	.	.	.	.	.	8,716
Propaquizafop	.	.	2,245	.	.	7,586	.	.	.	.	.	9,831
Propyzamide	.	.	.	.	2,539	.	.	.	.	.	.	2,539
Prosulfuron	5,764	.	.	.	.	.	.	.	.	.	.	5,764
Pyridate	6,179	.	.	55	.	.	.	.	.	.	.	6,233
S-metolachlor	7,938	82	.	.	.	.	.	.	.	.	.	8,019
Thifensulfuron-methyl	.	.	.	.	285	.	167	.	1,790	478	.	2,719
Tribenuron-methyl	.	.	.	.	721	.	41,128	5,400	2,333	2,392	.	51,973
Triflusalufuron-methyl	.	.	9,428	.	.	.	.	.	.	.	.	9,428
Unspecified herbicides	2,164	286	.	88	216	40	90	.	8	72	.	2,964
Other herbicides ²	3,318	2,200	2,077	503	9,423	1,041	807	224	130	1,659	.	21,383
All herbicides	524,097	6,314	119,040	3,080	35,141	17,030	142,395	13,845	89,039	388,446	53,332	1,391,761

²Other Herbicides include 2, 4-D/dicamba/triclopyr, 2, 4-D/glyphosate, 2, 4-DB/MCPA, aminopyralid/fluroxypyr, carfentrazone-ethyl, carfentrazone-ethyl/mecoprop-P, chlorotoluron/diflufenican/pendimethalin, clethodim, clodinafop-propargyl, clomazone, cycloxydim, desmedipham/phenmedipham, diflufenican, diflufenican/flupyrasulfuron-methyl, diflufenican/flurtamone, diflufenican/iodosulfuron-methyl-sodium/mesosulfuron-methyl, dimethenamid-P/metazachlor, ethofumesate/metamitron, ethofumesate/metamitron/phenmedipham, florasulam, florasulam/halauxifen-methyl, florasulam/pyroxsulam, flufenacet, flufenacet/isoxaflutole, flufenacet/pendimethalin, flufenacet/picolinafen, flupyrasulfuron-methyl, imazamox/pendimethalin, iodosulfuron-methyl-sodium, iodosulfuron-methyl-sodium/mesosulfuron-methyl, mesotrione/s-metolachlor, metsulfuron-methyl/thifensulfuron-methyl, metsulfuron-methyl/tribenuron-methyl, pendimethalin/picolinafen, pinoxaden, prosulfocarb, quizalofop-P-ethyl, quizalofop-P-tefuryl and thifensulfuron-methyl/tribenuron-methyl.

Table 5 (cont) Usage of pesticides on grassland & fodder crops grown in the United Kingdom 2017 (spray hectares)

	Maize	Turnips & swedes	Fodder beet & mangolds	Kale, cabbage, rape etc.	Other crops for stock feeding	Stubble turnips & catch crops	New ley direct sown	New ley undersown	Grassland 2-5 years old	Permanent pasture	Rough grazing	All crops
Growth regulators												
Chlormequat	.	.	.	.	4,361	.	.	272	.	.	.	4,633
Trinexapac-ethyl	.	.	.	.	3,752	.	.	.	.	.	.	3,752
Other growth regulators ³	.	.	.	.	2,813	.	.	537	.	.	.	3,350
All growth regulators	.	.	.	.	10,926	.	.	810	.	.	.	11,735
Insecticides												
Lambda-cyhalothrin	.	1,089	5,517	423	2,575	3,016	.	116	.	.	.	12,737
Other insecticides ⁴	.	407	1,063	389	2,100	450	.	100	.	.	.	4,510
All insecticides	.	1,496	6,581	812	4,675	3,466	.	216	.	.	.	17,246
											.	
Molluscicides & repellents											.	
Ferric phosphate	.	.	.	.	520	.	6,920	.	.	.	.	7,440
Metaldehyde	1,167	.	1,256	337	1,614	875	3,990	.	37	.	.	9,276
Unspecified molluscicides	.	.	.	.	.	.	2,455	.	.	.	.	2,455
Other molluscicides & repellents ⁵	.	.	469	307	.	.	.	.	.	.	.	777
All molluscicides & repellents	1,167	.	1,725	644	2,134	875	13,365	.	37	.	.	19,947

³Other growth regulators include 2-chloroethylphosphonic acid, 2-chloroethylphosphonic acid/mepiquat, chlormequat/imazaquin, mepiquat chloride/prohexadione-calcium and prohexadione-calcium/trinexapac-ethyl.

⁴Other Insecticides & nematicides include alpha-cypermethrin, cypermethrin, deltamethrin, esfenvalerate, oxamyl, pirimicarb, tau-fluvalinate, unspecified insecticides and zeta-cypermethrin.

⁵Other molluscicides & repellents include aluminium ammonium sulphate and calcium chloride.

Table 5 (cont) *Usage of pesticides on grassland & fodder crops grown in the United Kingdom 2017 (spray hectares)*

	Maize	Turnips & swedes	Fodder beet & mangolds	Kale, cabbage, rape etc.	Other crops for stock feeding	Stubble turnips & catch crops	New ley direct sown	New ley undersown	Grassland 2-5 years old	Permanent pasture	Rough grazing	All crops
<i>Fungicide seed treatments</i>												
Chitosan hydrochloride ⁶	134	.	.	.	.	.	.	.	.	.	.	134
Fludioxonil	.	.	.	.	2,329	.	.	.	.	.	.	2,329
Fludioxonil/metalaxyl-M	20,486	.	.	.	.	.	.	.	.	.	.	20,486
Fluopyram/prothioconazole/tebuconazole	.	.	.	.	860	.	.	.	.	.	.	860
Hymexazol	.	.	4,464	.	.	.	.	.	.	.	.	4,464
Imazalil/ipconazole	.	.	.	.	853	.	.	.	.	.	.	853
Prochloraz/triticonazole	.	.	.	.	988	.	.	.	.	.	.	988
Prothioconazole	.	.	.	.	1,122	.	.	.	.	.	.	1,122
Prothioconazole/tebuconazole	.	.	.	.	59	.	.	.	.	.	.	59
Silthiofam	.	.	.	.	435	.	.	.	.	.	.	435
Thiram	17,718	2,164	4,070	1,097	491	734	683	.	.	.	.	26,957
All fungicide seed treatments	38,338	2,164	8,534	1,097	7,137	734	683	.	.	.	.	58,687
<i>Fungicide/insecticide seed treatments</i>									.	.	.	
Clothianidin/prothioconazole	.	.	.	.	2,050	.	.	.	.	.	.	2,050
All fungicide/insecticide seed treatments	.	.	.	.	2,050	.	.	.	.	.	.	2,050
		
<i>Insecticide seed treatments</i>		.				.	.	.	.	.	.
Clothianidin	.	.	.	.	57	.	.	.	.	.	.	57
Methiocarb	141,642	.	.	.	.	.	.	.	.	.	.	141,642
Tefluthrin	.	.	3,316	.	.	.	.	.	.	.	.	3,316
Thiacloprid	4,139	.	.	.	.	.	.	.	.	.	.	4,139
Thiamethoxam	.	2,526	3,941	2,575	.	68	.	.	.	.	.	9,111
All insecticide seed treatments	145,781	2,526	7,257	2,575	57	68	.	.	.	.	.	158,265

⁶ Although not a pesticide, Chitosan hydrochloride is used as a plant elicitor, plant resistance against pathogenic fungi and bacteria.

Table 5 (cont) *Usage of pesticides on grassland & fodder crops grown in the United Kingdom 2017 (spray hectares)*

	Maize	Turnips & swedes	Fodder beet & mangolds	Kale, cabbage, rape etc.	Other crops for stock feeding	Stubble turnips & catch crops	New ley direct sown	New ley undersown	Grassland 2-5 years old	Permanent pasture	Rough grazing	All crops
<i>Other seed treatments</i>												
Rhizobial inoculum	.	.	.	.	1,080	.	.	.	.	.	.	1,080
Unspecified seed treatments	50,902	2,430	9,523	690	7,202	8,905	36,383	3,036	.	.	.	119,072
All other seed treatments	50,902	2,430	9,523	690	8,283	8,905	36,383	3,036	.	.	.	120,152
All seed treatments	235,021	7,120	25,315	4,363	17,526	9,708	37,066	3,036	.	.	.	339,154
Untreated	4,083	3,783	1,493	5,026	20,483	23,360	163,846	23,311	.	.	.	245,385

Table 6 Usage of pesticides on grassland & fodder crops grown in the United Kingdom 2017 (kg of active substances)

	Maize	Turnips & swedes	Fodder beet & mangolds	Kale, cabbage, rape etc.	Other crops for stock feeding	Stubble turnips & catch crops	New ley direct sown	New ley undersown	Grassland 2-5 years old	Permanent pasture	Rough grazing	All crops
Fungicides												
Azoxystrobin/cyproconazole	.	.	336	.	136	.	.	.	.	.	.	472
Chlorothalonil	.	.	.	.	958	.	.	781	.	.	.	1,739
Cyproconazole/trifloxystrobin	.	.	1,125	.	.	.	.	.	.	.	.	1,125
Epoxiconazole/fenpropimorph	.	.	.	.	673	.	42	12	.	.	.	727
Epoxiconazole/pyraclostrobin	469	.	162	.	.	.	.	.	.	.	.	631
Fluoxastrobin/prothioconazole/trifloxystrobin	.	.	.	.	478	.	.	84	.	.	.	562
Pyraclostrobin	880	.	.	.	192	.	.	.	.	.	.	1,073
Other fungicides ¹	.	17	96	.	3,857	.	.	994	.	.	.	4,964
All fungicides	1,349	17	1,719	.	6,293	.	42	1,870	.	.	.	11,291

¹Other Fungicides include azoxystrobin, azoxystrobin/chlorothalonil, benzovindiflupyr, bixafen/fluoxastrobin/prothioconazole, bixafen/prothioconazole, bixafen/prothioconazole/tebuconazole, boscalid/epoxiconazole, boscalid/epoxiconazole/pyraclostrobin, chlorothalonil/cyproconazole, chlorothalonil/cyproconazole/propiconazole, chlorothalonil/penthiopyrad, chlorothalonil/proquinazid, copper oxychloride, cyproconazole/picoxystrobin, cyprodinil, cyprodinil/isopyrazam, epoxiconazole, epoxiconazole/fenpropimorph/kresoxim-methyl, epoxiconazole/fenpropimorph/metrafenone, epoxiconazole/fluxapyroxad, epoxiconazole/fluxapyroxad/pyraclostrobin, epoxiconazole/folpet, epoxiconazole/isopyrazam, epoxiconazole/metconazole, epoxiconazole/metrafenone, epoxiconazole/prochloraz, fenpropimorph, fenpropimorph/pyraclostrobin, fluoxastrobin/prothioconazole, fluxapyroxad, fluxapyroxad/metconazole, fluxapyroxad/pyraclostrobin, folpet, penthiopyrad, prochloraz/proquinazid/tebuconazole, prochloraz/tebuconazole, propiconazole, proquinazid, prothioconazole, prothioconazole/spiroxamine, prothioconazole/tebuconazole, prothioconazole/trifloxystrobin, tebuconazole and unspecified fungicides.

Table 6 *Usage of pesticides on grassland & fodder crops grown in the United Kingdom 2017 (kg of active substances)*

	Maize	Turnips & swedes	Fodder beet & mangolds	Kale, cabbage, rape etc.	Other crops for stock feeding	Stubble turnips & catch crops	New ley direct sown	New ley undersown	Grassland 2-5 years old	Permanent pasture	Rough grazing	All crops
Herbicides												
2,4-D	.	.	.	.	.	.	6,241	.	5,065	27,951	1,560	40,816
2,4-D/dicamba	.	.	.	.	.	.	.	.	1,306	2,281	.	3,587
2,4-D/MCPA	.	.	.	.	509	.	15,888	642	4,723	32,983	282	55,026
2,4-DB	.	.	.	.	6,106	.	16,766	3,562	3,510	3,214	.	33,158
Amidosulfuron	.	.	.	.	.	.	27	.	259	170	.	457
Aminopyralid/triclopyr	.	.	.	.	52	.	13	.	1,122	7,724	.	8,910
Asulam	.	.	.	.	.	.	.	.	.	1,833	16,628	18,461
Bromoxynil	5,875	.	.	.	.	.	.	.	.	.	.	5,875
Bromoxynil/terbuthylazine	1,464	.	.	.	.	.	.	.	.	.	.	1,464
Chloridazon	.	.	7,191	.	.	.	.	.	.	.	.	7,191
Chloridazon/metamitron	.	.	3,347	.	.	.	.	.	.	.	.	3,347
Clopyralid	843	43	906	12	.	3	.	.	8	10	.	1,825
Clopyralid/florasulam/fluroxypyr	6	.	.	.	7	.	230	7	201	.	.	451
Clopyralid/fluroxypyr/triclopyr	.	.	.	.	.	.	272	.	6,956	31,026	2,333	40,587
Clopyralid/triclopyr	.	.	.	.	.	9	431	.	2,224	16,658	4,571	23,894
Desmedipham/ethofumesate/lenacil/phenmedipham	.	.	5,363	.	.	.	.	.	.	.	.	5,363
Desmedipham/ethofumesate/phenmedipham	.	.	2,464	.	.	.	.	.	.	.	.	2,464
Dicamba	1,043	.	.	.	.	.	.	.	.	.	.	1,043
Dicamba/MCPA/mecoprop-P	.	.	.	.	155	.	46	461	110	8,526	40	9,338
Dicamba/mecoprop-P	.	.	.	.	188	.	2,614	68	.	15,517	.	18,387
Dicamba/prosulfuron	361	.	.	.	.	.	.	.	.	.	.	361
Di flufenican/ flufenacet	.	.	.	.	645	.	.	.	.	.	.	645
Dimethenamid-P/pendimethalin	24,343	.	.	.	.	.	.	.	.	.	.	24,343
Diquat	104	.	.	41	853	.	.	.	.	.	.	997
Ethofumesate	.	.	1,563	.	.	.	.	.	.	.	.	1,563
Ethofumesate/phenmedipham	.	.	963	.	.	.	.	.	.	.	.	963
Florasulam/fluroxypyr	.	12	.	.	54	.	211	59	225	839	.	1,400
Fluazifop-P-butyl	.	.	10	.	34	127	.	.	.	.	.	171
Fluroxypyr	2,502	.	.	.	199	.	1,501	62	3,557	10,276	26	18,123
Fluroxypyr/triclopyr	.	.	.	.	.	.	1,064	.	10,897	43,138	5,011	60,110
Foramsulfuron/iodosulfuron-methyl-sodium	1,135	.	.	.	.	.	.	.	.	.	.	1,135
Glyphosate	81,285	1,485	4,716	2,248	6,526	5,424	11,830	454	4,066	1,877	2,330	122,240

Table 6 (cont) Usage of pesticides on grassland & fodder crops grown in the United Kingdom 2017 (kg of active substances)

	Maize	Turnips & swedes	Fodder beet & mangolds	Kale, cabbage, rape etc.	Other crops for stock feeding	Stubble turnips & catch crops	New ley direct sown	New ley undersown	Grassland 2-5 years old	Permanent pasture	Rough grazing	All crops
Herbicides (cont)												
Lenacil	.	.	577	.	.	.	.	.	.	.	.	577
Lenacil/triflurosulfuron-methyl	.	.	1,220	.	.	.	.	.	.	.	.	1,220
MCPA	.	.	.	.	516	.	1,622	293	5,186	91,605	24,695	123,918
Mecoprop-P	.	.	.	.	812	.	3,470	.	.	.	.	4,282
Mesotrione	5,141	.	.	.	.	.	.	.	.	.	.	5,141
Mesotrione/nicosulfuron	452	.	.	.	.	.	.	.	.	.	.	452
Mesotrione/terbuthylazine	35,042	.	.	.	.	.	.	.	.	.	.	35,042
Metamitron	.	.	27,588	.	.	.	.	.	.	.	.	27,588
Metazachlor	.	971	.	385	.	30	.	.	.	.	.	1,386
Metsulfuron-methyl	.	.	.	.	1	.	<1	.	8	5	.	14
Nicosulfuron	3,565	.	.	.	.	.	.	.	.	.	.	3,565
Pendimethalin	82,101	.	.	.	2,297	.	438	.	.	.	.	84,836
Phenmedipham	.	.	2,750	.	.	.	.	.	.	.	.	2,750
Propaquizafop	.	.	196	.	.	587	.	.	.	.	.	783
Propyzamide	.	.	.	.	1,805	.	.	.	.	.	.	1,805
Prosulfuron	66	.	.	.	.	.	.	.	.	.	.	66
Pyridate	2,245	.	.	49	.	.	.	.	.	.	.	2,294
S-metolachlor	9,427	110	.	.	.	.	.	.	.	.	.	9,537
Thifensulfuron-methyl	.	.	.	.	11	.	1	.	19	4	.	34
Tribenuron-methyl	.	.	.	.	3	.	204	28	12	14	.	262
Triflurosulfuron-methyl	.	.	115	.	.	.	.	.	.	.	.	115
Other herbicides ²	2,461	731	657	402	3,897	405	1,218	5	25	270	.	10,071
All herbicides	259,460	3,351	59,624	3,137	24,668	6,585	64,087	5,640	49,479	295,920	57,476	829,428

²Other Herbicides include 2,4-D/dicamba/triclopyr, 2,4-D/glyphosate, 2,4-DB/MCPA, aminopyralid/fluroxypyr, carfentrazone-ethyl, carfentrazone-ethyl/mecoprop-P, chlorotoluron/diflufenican/pendimethalin, clethodim, clodinafop-propargyl, clomazone, cycloxydim, desmedipham/phenmedipham, diflufenican, diflufenican/flupyrasulfuron-methyl, diflufenican/flurtamone, diflufenican/iodosulfuron-methyl-sodium/mesosulfuron-methyl, dimethenamid-P/metazachlor, ethofumesate/metamitron, ethofumesate/metamitron/phenmedipham, florasulam, florasulam/haloxifen-methyl, florasulam/pyroxulam, flufenacet, flufenacet/isoxaflutole, flufenacet/pendimethalin, flufenacet/picolinafen, flupyrasulfuron-methyl, imazamox/pendimethalin, iodosulfuron-methyl-sodium, iodosulfuron-methyl-sodium/mesosulfuron-methyl, mesotrione/s-metolachlor, metsulfuron-methyl/thifensulfuron-methyl, metsulfuron-methyl/tribenuron-methyl, pendimethalin/picolinafen, pinoxaden, prosulfocarb, quizalofop-P-ethyl, quizalofop-P-tefuryl and thifensulfuron-methyl/tribenuron-methyl.

Table 6 (cont) Usage of pesticides on grassland & fodder crops grown in the United Kingdom 2017 (kg of active substances)

	Maize	Turnips & swedes	Fodder beet & mangolds	Kale, cabbage, rape etc.	Other crops for stock feeding	Stubble turnips & catch crops	New ley direct sown	New ley undersown	Grassland 2-5 years old	Permanent pasture	Rough grazing	All crops
<i>Growth regulators</i>												
Chlormequat	.	.	.	.	3,330	.	.	204	.	.	.	3,535
Trinexapac-ethyl	.	.	.	.	184	.	.	.	.	.	.	184
Other growth regulators ³	.	.	.	.	490	.	.	87	.	.	.	577
All growth regulators	.	.	.	.	4,004	.	.	291	.	.	.	4,296
<i>Insecticides</i>												
Lambda-cyhalothrin	.	4	39	6	13	27	.	1	.	.	.	89
Other Insecticides & nematicides ⁴	.	3	163	2	25	11	.	<1	.	.	.	204
All insecticides & nematicides	.	7	202	7	38	38	.	1	.	.	.	293
<i>Molluscicides & repellents</i>												
Ferric phosphate	.	.	.	.	77	.	948	.	.	.	.	1,025
Metaldehyde	163	.	187	116	249	132	456	.	5	.	.	1,309
Other molluscicides & repellents ⁵	.	.	826	7	.	.	.	.	.	.	.	833
All molluscicides & repellents	163	.	1,012	124	327	132	1,405	.	5	.	.	3,167

³Other Growth regulators include 2-chloroethylphosphonic acid, 2-chloroethylphosphonic acid/mepiquat, chlormequat/imazaquin, mepiquat chloride/prohexadione-calcium and prohexadione-calcium/trinexapac-ethyl.

⁴Other Insecticides & nematicides include alpha-cypermethrin, cypermethrin, deltamethrin, esfenvalerate, oxamyl, pirimicarb, tau-fluvalinate, unspecified insecticides and zeta-cypermethrin.

⁵Other Molluscicides & repellents include aluminium ammonium sulphate and calcium chloride.

Table 6 (cont) Usage of pesticides on grassland & fodder crops grown in the United Kingdom 2017 (kg of active substances)

	Maize	Turnips & swedes	Fodder beet & mangolds	Kale, cabbage, rape etc.	Other crops for stock feeding	Stubble turnips & catch crops	New ley direct sown	New ley undersown	Grassland 2-5 years old	Permanent pasture	Rough grazing	All crops
<i>Fungicide seed treatments</i>												
Chitosan hydrochloride ⁶	58	.	.	.	.	.	.	.	.	.	.	58
Fludioxonil	.	.	.	.	15	.	.	.	.	.	.	15
Fludioxonil/metalaxyl-M	21	.	.	.	.	.	.	.	.	.	.	21
Fluopyram/prothioconazole/tebuconazole	.	.	.	.	12	.	.	.	.	.	.	12
Hymexazol	.	.	47	.	.	.	.	.	.	.	.	47
Imazalil/ipconazole	.	.	.	.	8	.	.	.	.	.	.	8
Prochloraz/triticonazole	.	.	.	.	24	.	.	.	.	.	.	24
Prothioconazole	.	.	.	.	20	.	.	.	.	.	.	20
Prothioconazole/tebuconazole	.	.	.	.	<1	.	.	.	.	.	.	<1
Silthiofam	.	.	.	.	19	.	.	.	.	.	.	19
Thiram	521	3	2,710	15	68	10	51	.	.	.	.	3,378
All fungicide seed treatments	601	3	2,757	15	166	10	51	.	.	.	.	3,602
<i>Fungicide/insecticide seed treatments</i>												
Clothianidin/prothioconazole	.	.	.	.	214	.	.	.	.	.	.	214
All fungicide/insecticide seed treatments	.	.	.	.	214	.	.	.	.	.	.	214
<i>Insecticide seed treatments</i>												
Clothianidin	.	.	.	.	5	.	.	.	.	.	.	5
Methiocarb	15,553	.	.	.	.	.	.	.	.	.	.	15,553
Tefluthrin	.	.	33	.	.	.	.	.	.	.	.	33
Thiacloprid	364	.	.	.	.	.	.	.	.	.	.	364
Thiamethoxam	.	10	237	55	.	<1	.	.	.	.	.	302
All insecticide seed treatments	15,916	10	269	55	5	<1	.	.	.	.	.	16,256
<i>Other seed treatments</i>												
Rhizobial inoculum	.	.	.	.	237	.	.	.	.	.	.	237
All other seed treatments	.	.	.	.	237	.	.	.	.	.	.	237
All seed treatments	16,517	13	3,027	70	622	10	51	.	.	.	.	20,310

⁶ Although not a pesticide, Chitosan hydrochloride is used as a plant elicitor, plant resistance against pathogenic fungi and bacteria.

Table 7 *Estimated area (ha) of application of the fifty most extensively used active substances on all grassland & fodder crops surveyed in 2017 in the United Kingdom excluding seed treatments*

	Active substance	Area treated 2017 (ha)	Area treated 2013 (ha)	% change on 2013	Movement	
1	Fluroxypyr	280,048	201,765	39	↑	
2	Triclopyr	274,560	258,997	6	↑	
3	Clopyralid	150,228	201,968	-26		↓
4	Mesotrione	140,946	147,188	-4		↓
5	MCPA	130,340	179,045	-27		↓
6	Glyphosate	120,753	110,584	9	↑	
7	Nicosulfuron	107,510	115,787	-7		↓
8	Pendimethalin	90,062	65,509	37	↑	
9	Terbuthylazine	83,261	98,951	-16		↓
10	2,4-D	71,307	47,879	49	↑	
11	2,4-DB	56,788	16,457	245	↑	
12	Tribenuron-methyl	53,189	18,107	194	↑	
13	Phenmedipham	39,532	37,710	5	↑	
14	Ethofumesate	36,755	34,378	7	↑	
15	Mecoprop-P	35,268	74,602	-53		↓
16	Dicamba	34,080	57,430	-41		↓
17	Metamitron	32,691	35,639	-8		↓
18	Lenacil	30,131	20,514	47	↑	
19	Bromoxynil	27,650	39,971	-31		↓
20	Desmedipham	27,545	23,563	17	↑	
21	Iodosulfuron-methyl-sodium	26,531	2,167	1,124	↑	
22	Foramsulfuron	25,500	35	72,984	↑	
23	Aminopyralid	19,853	22,210	-11		↓
24	Dimethenamid-P	18,792	5,753	227	↑	
25	Triflurosulfuron-methyl	15,733	14,296	10	↑	
26	Florasulam	13,652	1,614	746	↑	
27	Lambda-cyhalothrin	12,737	3,903	226	↑	
28	Epoxiconazole	12,471	11,026	13	↑	
29	Trifloxystrobin	11,707	5,202	125	↑	
30	Metsulfuron-methyl	10,889	14,952	-27		↓
31	Amidosulfuron	10,264	10,083	2	↑	
32	Pyraclostrobin	10,196	7,692	33	↑	
33	Propaquizafop	9,831	2,519	290	↑	
34	Metaldehyde	9,276	6,772	37	↑	
35	Prothioconazole	9,201	19,949	-54		↓
36	Cyproconazole	9,029	2,914	210	↑	
37	S-metolachlor	8,800	3,102	184	↑	
38	Prosulfuron	8,570	10,487	-18		↓
39	Ferric phosphate	7,440	1,500	396	↑	
40	Chloridazon	7,299	9,274	-21		↓
41	Pyridate	6,233	286	2,080	↑	
42	Trinexapac-ethyl	5,521	3,093	78	↑	
43	Fenpropimorph	5,494	6,382	-14		↓
44	Chlorothalonil	5,101	10,327	-51		↓
45	Diflufenican	4,924	4,119	20	↑	
46	Chlormequat	4,917	6,821	-28		↓
47	Asulam	4,368	4,994	-13		↓
48	Fluoxastrobin	4,362	3,479	25	↑	
49	Metazachlor	4,026	5,874	-31		↓
50	Thifensulfuron-methyl	4,015	6,165	-35		↓

Table 8 *Estimated amount (kg) of the fifty most extensively used active substances on all grassland & fodder crops surveyed in 2017 in the United Kingdom excluding seed treatments*

	Active substance	Amount used 2017 (kg)	Amount used 2013 (kg)	% change on 2013	Movement	
1	MCPA	154,639	219,024	-29		↓
2	Glyphosate	123,608	130,642	-5		↓
3	Pendimethalin	98,700	70,484	40	↑	
4	2,4-D	73,738	54,251	36	↑	
5	Triclopyr	69,899	75,835	-8		↓
6	Fluroxypyr	63,536	40,077	59	↑	
7	2,4-DB	34,510	19,098	81	↑	
8	Terbuthylazine	29,788	39,203	-24		↓
9	Metamitron	29,479	35,496	-17		↓
10	Mecoprop-P	24,388	52,184	-53		↓
11	Clopyralid	21,053	26,302	-20		↓
12	Asulam	18,461	15,767	17	↑	
13	Dimethenamid-P	11,867	3,997	197	↑	
14	Mesotrione	11,638	11,509	1	↑	
15	S-metolachlor	9,883	3,734	165	↑	
16	Chloridazon	8,922	7,754	15	↑	
17	Bromoxynil	6,460	12,592	-49		↓
18	Phenmedipham	5,669	5,454	4	↑	
19	Ethofumesate	5,506	6,828	-19		↓
20	Dicamba	5,111	6,128	-17		↓
21	Chlormequat	3,744	4,674	-20		↓
22	Nicosulfuron	3,694	3,849	-4		↓
23	Chlorothalonil	2,650	5,165	-49		↓
24	Lenacil	2,404	977	146	↑	
25	Pyridate	2,294	257	791	↑	
26	Metazachlor	2,067	3,918	-47		↓
27	Prosulfocarb	1,987	.	.	↑	
28	Propyzamide	1,805	857	111	↑	
29	Pyraclostrobin	1,592	1,333	19	↑	
30	Desmedipham	1,421	1,091	30	↑	
31	Metaldehyde	1,308	1,254	4	↑	
32	Fenpropimorph	1,178	1,379	-15		↓
33	Foramsulfuron	1,098	2	69,833	↑	
34	Aminopyralid	1,056	1,313	-20		↓
35	Trifloxystrobin	1,038	287	261	↑	
36	Ferric phosphate	1,025	210	389	↑	
37	Diquat	997	814	22	↑	
38	Epoxiconazole	830	784	6	↑	
39	Aluminium ammonium sulphate	826	.	.	↑	
40	Flufenacet	810	1,243	-35		↓
41	Propaquizafop	783	245	220	↑	
42	Prothioconazole	778	1,790	-57		↓
43	Cyproconazole	523	166	215	↑	
44	Azoxystrobin	467	572	-18		↓
45	Amidosulfuron	457	430	6	↑	
46	Prochloraz	406	258	57	↑	
47	Tebuconazole	345	751	-54		↓
48	Diflufenican	284	217	31	↑	
49	Tribenuron-methyl	270	102	165	↑	
50	Penthiopyrad	263	148	77	↑	

Table 9 New or newly encountered compounds encountered on all grassland & fodder crops in the United Kingdom between 2013 & 2017

	Active substance	Area treated 2017 (ha)	Amount used 2017 (kg)
1	Prosulfocarb	1,041	1,987
2	Halauxifen-methyl	538	3
3	Quizalofop-P-ethyl	479	24
4	Aluminium ammonium sulphate	469	826
5	Clethodim	423	51
6	Clodinafop-propargyl	411	12
7	Copper oxychloride	372	35
8	Calcium chloride	307	7
9	Quizalofop-P-tefuryl	218	17
10	Benzovindiflupyr	190	12
11	Tau-fluvalinate	184	9

Table 10 Major increases in the use of individual active substances on all grassland & fodder crops in the United Kingdom since 2013 (area treated)

	Active substance	Area treated 2017 (ha)	Area treated 2013 (ha)	% change on 2013
1	Foramsulfuron	25,500	35	72,984
2	Carfentrazone-ethyl	1,146	21	5,336
3	Pyridate	6,233	286	2,080
4	Prohexadione-calcium	2,682	170	1,479
5	Iodosulfuron-methyl-sodium	26,531	2,167	1,124
6	Florasulam	13,652	1,614	746
7	Ferric phosphate	7,440	1,500	396
8	Fluxapyroxad	1,694	410	314
9	Propaquizafop	9,831	2,519	290
10	2,4-DB	56,788	16,457	245
11	Imazamox	372	113	228
12	Dimethenamid-P	18,792	5,753	227
13	Lambda-cyhalothrin	12,737	3,903	226
14	Cyproconazole	9,029	2,914	210
15	Mepiquat chloride	914	298	206
16	Tribenuron-methyl	53,189	18,107	194
17	S-metolachlor	8,800	3,102	184
18	Fluazifop-P-butyl	2,504	1,013	147
19	Trifloxystrobin	11,707	5,202	125
20	Cycloxydim	688	316	118

Table 11 Major decreases in the use of individual active substances on all grassland & fodder crops in the United Kingdom since 2013 (area treated)

	Active substance	Area treated 2017 (ha)	Area treated 2013 (ha)	% change on 2013
1	Isoxaflutole	35	4,385	-99
2	Alpha-cypermethrin	25	518	-95
3	Pinoxaden	125	1,637	-92
4	Chlorotoluron	52	604	-91
5	Spiroxamine	457	3,911	-88
6	Folpet	329	2,028	-84
7	Pirimicarb	214	1,221	-82
8	Pyroxsulam	120	571	-79
9	Boscalid	329	1,378	-76
10	Metconazole	681	2,488	-73
11	Cyprodinil	451	1,550	-71
12	Mepiquat	97	326	-70
13	2-chloroethylphosphonic acid	384	1,244	-69
14	Deltamethrin	702	2,223	-68
15	Tebuconazole	3,190	9,290	-66
16	Propiconazole	362	1,054	-66
17	Oxamyl	192	508	-62
18	Mesosulfuron-methyl	703	1,813	-61
19	Bixafen	678	1,737	-61
20	Imazaquin	284	656	-57

Table 12 Comparison of pesticide usage on fodder crops other than grassland in the United Kingdom from 2009 to 2017 - area treated (ha) and amount used tonnes (t)

Chemical group	2009		2013		2017	
	ha	t	ha	t	ha	t
<i>Insecticides</i>	17,723	3.68	16,873	5.08	17,030	0.29
<i>Fungicides</i>	36,121	9.25	50,173	12.56	40,089	9.38
<i>Sulphur</i>	429	1.03	195	0.56	.	.
<i>Growth regulators</i>	8,968	5.11	9,320	4.12	10,926	4.00
<i>Herbicides</i>	478,354	246.17	623,656	293.82	704,702	356.83
<i>Molluscicides</i>	3,840	1.07	4,750	0.83	6,545	1.76
<i>Seed treatments</i>	395,815	35.48	353,001	37.06	299,052	20.26
Total – all registered pesticides	941,250	301.78	1,057,968	354.03	1,078,344	392.52
Area grown	269,306		296,620		312,058	

Table 13 Comparison of pesticide usage on grassland in the United Kingdom from 2009 to 2017 - area treated (ha) and amount used in tonnes (t)

Chemical group	2009		2013		2017	
	ha	t	ha	t	ha	t
<i>Insecticides</i>	28,648	16.60	16,081	10.77	216	.
<i>Fungicides</i>	54,171	12.70	20,445	5.40	7,569	1.91
<i>Sulphur</i>	51	0.36	.	.	.	.
<i>Growth regulators</i>	6,173	1.26	1,998	1.08	810	0.29
<i>Herbicides</i>	730,579	664.01	648,556	562.72	687,059	472.60
<i>Molluscicides</i>	3,347	1.21	3,816	0.66	13,403	1.41
<i>Seed treatments</i>	33,745	0.31	12,804	0.38	40,102	0.05
Total - all registered pesticides	856,714	696.44	703,700	581.01	749,157	476.27
Area grown	11,587,679		11,131,267		11,185,274	

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 single or multiple active substances.

c) 'Reason for application' indicated in the text is the grower's stated reason for use of that 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 or adjuvants also contained within a product that contribute to its efficacy.

f) For the purposes of this survey the total area of fodder crops was taken as the sum of the areas of the following crops: maize; turnips & swedes; fodder beet & mangolds; kale, cabbage & rape; other crops for stockfeeding including whole-cropped cereals, peas and beans, lucerne, sainfoin and clover. Samples were selected on the basis of these crops. Stubble turnips & catch crops were not included in the sampling process as these crops are unlikely to have been recorded on the June Survey form.

g) For the purposes of this survey the total area of grassland was taken as the sum of the areas of the following crops: permanent pasture; grassland less than five years old, including established leys 2 to 5 years old, and both direct sown new leys and those undersown cereals crops. Samples were selected on the basis of these crops. Rough grazing was not included in the sampling process as pesticide usage on this crop is minimal and could be considered atypical of normal grassland pesticide usage.

h) Pesticide applications included 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.

i) 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.

j) Within the seed treatment tables at the end of each crop section, unspecified or unknown seed treatments have been excluded from the last column to express the known seed treatment areas as a proportion of the total area of each crop grown.

k) Untreated crops are those that have received no foliar applications of insecticides, fungicides, herbicides, growth regulators, molluscicides and sulphur. They may have been grown from treated seed.

l) Undersown grass leys are those that are drilled at the same time, or after the drilling of a cereal crop, primarily spring barley, leaving an established grass ley after the cereal crop has been harvested. Most of the pesticide applications applied to undersown new leys are targeted at the nurse crop rather than the grass. It is likely that this usage is duplicated in pesticide usage survey reports on arable crops.

m) Unspecified fungicides and herbicides have been recorded where the farmer was unsure of the product used. Within Table 5 the area treated is reported but as they are not associated with a weight or rate of application they are therefore not included in Table 6.

n) Throughout all tables, "Other" refers to chemicals grouped together because they were applied to less than 0.1% of the total area treated with pesticides.

o) 'Spray round' refers to a single pass/spray round of application machinery; some herbicides may be applied using weed wipers and some insecticides/molluscicides as granules or pellets. Each spray round may contain single or multiple products from more than one pesticide group and each product may contain single or multiple active substances.

APPENDIX 3 - METHODOLOGY

METHODS

The samples of holdings to be surveyed were selected using data from the Agricultural Census Returns, June 2016 for England & Wales (Anon., 2016a and 2016b).

The samples were drawn from the June Survey returns to represent the area of all grassland and fodder crops grown throughout England, Scotland, Northern Ireland and Wales. For England the sample was selected within each of the eight Government Office Regions (GORs). The Welsh Government provided a further sample, which represented the area grown in Wales. For Scotland and Northern Ireland, the sample represented the regions in each country.

Two separate samples were taken, one for fodder crops and one for grassland crops. The grassland sample was intended to supplement grassland data collected as part of the fodder survey. The samples were stratified according to the total area of all grassland or fodder crops grown in each region and by size group based on the total area of grassland or fodder crops grown on each holding. The area of grassland or fodder crops sampled in each size group and each region was proportional to the total area of grassland or fodder 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.

For the fodder sample, the size groups, based on the total fodder area are as follows: <12.5ha; >12.5-<=30 ha; >30-<=50 ha; >50-<=90 ha; and >90 ha; for the grassland sample the size groups, based on the total grassland area are as follows: <30ha; >30-<=60 ha; >60-<=90 ha; >90-<=150 ha; and >150 ha.

For the purposes of this survey the total area of fodder crops was taken as the sum of the areas of the following crops: maize; turnips & swedes; fodder beet & mangolds; kale, cabbage & rape; other crops for stockfeeding including whole-cropped cereals, peas and beans, lucerne, sainfoin and clover. Stubble turnips & catch crops were not included in the sampling process as these crops are unlikely to have been recorded on the June Survey form.

For the grassland sample the total area was taken as the sum of the areas of the following crops: permanent pasture; grassland less than five years old, including established leys 2 to 5 years old, and both direct sown new leys and those undersown cereals crops. Rough grazing was not included in the sampling process as pesticide usage on this crop is minimal and could be considered atypical of normal grassland pesticide usage. In England, Wales and Scotland the supplementary grassland data were collected as part of postal surveys. In Northern Ireland grassland data were collected by interview or by telephone.

An introductory letter was sent to the occupiers of the selected holdings explaining the purpose of the survey. A total of 581 fodder crop holdings (356 in England and Wales, 153 in Scotland and 72 in Northern Ireland) were visited or provided data during the winter of 2016/17. Data were collected either during a personal interview with the grower conducted by an experienced pesticide usage surveyor, by email or by post. Where a holding listed in the original sample was not able to provide data it was replaced, where possible, with another from the same size group and region, held on a reserve list.

A number of holdings, that were part of the original fodder sample, grew catch crops only during the period of the survey and were not recorded as fodder crop holdings. However, the data collected from these holdings were used and contributed to the estimates of pesticide use on stubble turnips & catch crops.

Within England and Wales a total of 575 farms were contacted, of which 73 (13%) were not growing fodder crops during 2017. Of the 502 farms growing fodder crops, 73 (15%) were unwilling to help with the survey, a further 56 (11%) either provided data after the deadline or were willing to help at a later date. Other growers contacted had either retired or were in ill health and not contacted further.

Commercial farm management software and in-house electronic record keeping systems are now used extensively, these combined with spray books and agronomists' recommendation sheets provide the main sources of data used by surveyors on farm. Where information was available (356 fodder crop holdings in England & Wales), electronic record keeping was used by 36% of the holdings contacted in England & Wales for fodder crops grown, with these records accounting for 60% of the total pesticide-treated area.

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 87% of the fodder crop holdings in England & Wales were collected using non-visit methodologies, which together accounted for 86% of the fodder crop 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 424 holdings in the United Kingdom from which information was available, 92% were members of one or more crop assurance schemes with 7% of the holdings being registered organic on all or part of their farm. In terms of area grown, membership of a crop assurance scheme accounted for 95% 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 grassland & fodder crops grown on the designated holding during the 2016/2017 season.

Form 2 dealt with all aspects of pesticide usage on the individual crops grown on the holding and harvested in 2017, 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 drilling and harvest times, seed rates, intended use, 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, 2000).

The raising factors were based on the areas of grassland & fodder crops grown and harvested in 2017 as recorded in the June Survey of Agriculture and Horticulture for England & Wales (Anon., 2017a, b).

The first raising factors from the principal survey, fodder crops, are presented in Table 14 (see Appendix 5). It is the first raising factor which does most of the work and gives an indication of the robustness of the sample with smaller numbers indicating a larger area sampled within each size group and region. The first raising factor is often largest in the smaller size groups where there is generally a much larger population. The first raising factors are not presented for the grassland sample as this was a supplementary sample to the main fodder sample.

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 are much more limited. Where possible the survey team has used data collected as part of the June Survey to make estimates of national and 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 combinations of June Survey data and our own observations have been used and these data may therefore be associated with a higher standard error.

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 authorisation and 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 Government release calendar and the Fera website in line with the Code of Practice for Statistics.

Data limitations and use of data

Our experience (Fera, SASA and AFBI) has shown that the 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 Statistics. Drawing a fresh stratified random sample each year is clearly an appropriate survey methodology.

As part of this survey Fera has implemented the UK Statistics Authority Code of Practice for Statistics, published in 2009 and revised in 2018. Whilst all three pillars and 14 principles apply, we acknowledge the following:

- Honesty and integrity: people in organisations that release statistics should be truthful, impartial and independent, and meet consistent standards of behaviour that reflect the wider public good.
- Data governance: organisations should look after people’s information securely and manage data in ways that are consistent with relevant legislation and serve the public good.
- Efficiency and proportionality: statistics and data should be published in forms that enable their reuse. Producers should use existing data wherever possible and only ask for more where justified.
- Accessibility: statistics and data should be equally available to all, not given to some people before others. They should be published at a sufficient level of detail and remain publicly available.

In accordance with UKSA Code of Practice for 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 is a broad spectrum of users and stakeholders across policy, research, agricultural supply industry (including consultancies), farming and horticultural businesses, civil society organisations 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 – ESTIMATES OF STANDARD ERRORS FROM PESTICIDE USAGE DATA (2017 DATA)

Roy Macarthur, Statistician, FERA

ANALYSIS OF GRASSLAND & FODDER CROPS PESTICIDE USAGE SURVEY

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

Estimates are derived from pesticide usage survey data which are stratified by region and holding size within each crop type. 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 on that crop type 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

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

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

Then we estimate:

$r_{a_{j,k}}$: mean area sprayed per area surveyed within the stratum

$r_{m_{j,k}}$: 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

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

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

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

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

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

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

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

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

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

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

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

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

$$se_A = \sqrt{\sum_{j=1}^J se_{A_j}^2} \quad \text{Equation 13}$$

$$se_M = \sqrt{\sum_{j=1}^J se_{M_j}^2} \quad \text{Equation 14}$$

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 [²] (Equations 9 and 10)

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

Estimates of use derived from this survey were based on a stratification by region and size.

Some adjustments were made for each of the three reports:

Fodder

Some size strata within regions were combined to maintain at least five survey observations per stratum (Tables A1, A2). In one instance (North East) a stratum contained four observations.

Maize

No survey returns were provided for Wales or the North East. Hence, Wales and the West Midlands were combined to form “Wales and WM”, and the North East and North West were combined to form

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

² Isserlis, L. (1918). "On the value of a mean as calculated from a sample". Journal of the Royal Statistical Society. 81 (1): 75–81.

the “North”. Subsequently, some size strata within regions were combined to maintain at least five survey observations per stratum (Tables A5, A6).

Grassland

Some size strata within regions were combined to maintain at least five survey observations per stratum. (Tables A9, A10).

Estimates of area of application and mass applied by region and size group are provided in Tables A1 and A2 (Fodder); A5, A6 (Maize) and A9, A10 (Grassland). Estimates of the total area of application and mass applied, by region and nationally are given in Tables A3 and A4 (Fodder); A7, A8 (Maize) and A11, A12 (Grassland).

Upper and lower confidence intervals were not reported where the relative standard error was estimated to be larger than 30% (marked as NA in Tables A1 to A12).

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 $rse(H) < 0.3 \times rse(R)$ ³
- 5) The error associated with estimates A_i , M_i , A , and M is assumed to be described by a normal distribution

Effect of a reduced number of observations in some regions

The number of observations gained showed some particular combinations of crop and region were smaller than the target number. This meant that some within-stratum uncertainties (expressed as relative standard errors were large (>30%)) and that National estimates were sometimes based on fewer strata (planned strata were combined). The effect of this was to slightly reduce the *power* of the survey: standard errors associated with National estimates were probably slightly larger than they would have been had the target number of observations been gained. However, the reduced survey size was not judged to significantly effect the *robustness* of the national estimates: the expected coverage of the 95% confidence intervals for national estimates remains at 95%.

³ If given estimates of relative standard errors (rse) $rse(R)=1$ and $rse(H)=0.3$ then $rse(R.H)=1.04$

Table A.1: Estimates of area of application by region and size group- Fodder

Region	Size group	Total Area (Ha)	Number of holdings	Number surveyed	Estimate (Ha)	s.e (Ha)	RSE (%)	95% Confidence Interval (Ha)	
East Midlands	A	3101	609	14	20345	5353	26	9853	30837
East Midlands	B	5350	274	14	30236	4553	15	21313	39160
East Midlands	CD	9537	195	6	40964	5165	13	30842	51087
East Midlands	E	12162	43	10	72358	8120	11	56442	88274
Eastern	A	3271	767	13	10579	2852	27	4989	16168
Eastern	B	6381	318	14	26144	3793	15	18709	33579
Eastern	C	5365	137	6	18722	4566	24	9773	27671
Eastern	D	6837	105	11	24210	4600	19	15193	33227
Eastern	E	9702	60	12	42133	5690	14	30981	53285
London & SE	A	3491	680	10	8378	3552	42	NA	NA
London & SE	B	6722	337	13	21972	4061	18	14013	29931
London & SE	C	6589	173	11	26062	4925	19	16410	35714
London & SE	D	6908	106	8	17922	4705	26	8700	27144
London & SE	E	9547	65	9	17859	4281	24	9469	26250
North East	ALL	3469	147	4	9258	3988	43	NA	NA
North West	A	2939	535	6	14205	4233	30	5908	22503
North West	BC	7782	330	11	24262	1767	7.3	20799	27726
North West	DE	4357	48	5	12771	3863	30	NA	NA
Northern Ireland	A	2567	538	52	6351	818	13	4748	7955
Northern Ireland	B	1970	109	15	8431	819	9.7	6826	10036
Northern Ireland	CDE	1566	31	5	6717	1654	25	3476	9958
Scotland	A	9438	2253	101	14017	1220	8.7	11626	16407
Scotland	BCD	6527	321	52	12803	1483	12	9896	15711
South West	A	11504	1995	20	29082	5363	18	18571	39593
South West	B	19678	1021	29	59301	6615	11	46336	72265
South West	C	13871	363	18	45207	7617	17	30277	60137
South West	D	13027	202	18	47651	3902	8.2	40003	55298
South West	E	11412	81	14	36296	7039	19	22498	50093
Wales	ALL	27067	1786	5	27067	12091	45	NA	NA

West Midlands	A	5608	957	8	25236	5487	22	14482	35990
West Midlands	B	9686	505	11	48765	7435	15	34193	63337
West Midlands	C	6037	157	7	26266	2043	7.8	22261	30270
West Midlands	DE	12054	139	12	57555	10725	19	36534	78576
Yorks & Humber	A	2599	537	12	17189	3224	19	10870	23507
Yorks & Humber	B	3658	191	8	16279	2847	17	10699	21859
Yorks & Humber	CD	4745	100	7	30690	4576	15	21720	39659
Yorks & Humber	E	2362	16	10	13524	1029	7.6	11507	15540

Table A.2: Estimates of mass applied by and region size group- Fodder

Region	Size group	Total Area (Ha)	Number of holdings	Number surveyed	Estimate (Kg)	s.e (Kg)	RSE (%)	95% Confidence Interval (Kg)	
East Midlands	A	3101	609	14	6153	1445	23	3320	8986
East Midlands	B	5350	274	14	10609	1357	13	7949	13269
East Midlands	CD	9537	195	6	17096	5354	31	NA	NA
East Midlands	E	12162	43	10	26379	3626	14	19272	33486
Eastern	A	3271	767	13	4091	1076	26	1982	6199
Eastern	B	6381	318	14	11154	1759	16	7707	14602
Eastern	C	5365	137	6	8041	2628	33	NA	NA
Eastern	D	6837	105	11	11299	1945	17	7487	15111
Eastern	E	9702	60	12	15066	2153	14	10847	19285
London & SE	A	3491	680	10	3035	1947	64	NA	NA
London & SE	B	6722	337	13	9624	2355	24	5009	14239
London & SE	C	6589	173	11	10935	2345	21	6338	15532
London & SE	D	6908	106	8	5369	1790	33	NA	NA
London & SE	E	9547	65	9	7643	2896	38	NA	NA
North East	ALL	3469	147	4	4506	2634	58	NA	NA
North West	A	2939	535	6	3882	1934	50	NA	NA
North West	BC	7782	330	11	8089	1905	24	4355	11824
North West	DE	4357	48	5	3889	1741	45	NA	NA
Northern Ireland	A	2567	538	52	2532	408	16	1732	3332
Northern Ireland	B	1970	109	15	3828	470	12	2906	4750
Northern Ireland	CDE	1566	31	5	2770	762	28	1276	4264
Scotland	A	9438	2253	101	3175	489	15	2217	4134
Scotland	BCD	6527	321	52	5268	1085	21	3142	7394
South West	A	11504	1995	20	12328	2652	22	7129	17526
South West	B	19678	1021	29	16548	3245	20	10188	22908
South West	C	13871	363	18	13791	3327	24	7270	20312
South West	D	13027	202	18	15691	2454	16	10882	20500
South West	E	11412	81	14	10365	2585	25	5299	15431
Wales	ALL	27067	1786	5	17133	10941	64	NA	NA

West Midlands	A	5608	957	8	7277	2379	33	NA	NA
West Midlands	B	9686	505	11	20471	4793	23	11077	29865
West Midlands	C	6037	157	7	9126	1404	15	6374	11878
West Midlands	DE	12054	139	12	21999	5792	26	10647	33352
Yorks & Humber	A	2599	537	12	6807	1255	18	4348	9266
Yorks & Humber	B	3658	191	8	7710	1883	24	4019	11400
Yorks & Humber	CD	4745	100	7	9853	1595	16	6728	12979
Yorks & Humber	E	2362	16	10	5100	654	13	3818	6383

Table A.3: Estimates of total area of application- Fodder

Region	Estimate (Ha)	s.e (Ha)	RSE(%)	95% C.I (Ha)	
East Midlands	163904	11916	7.3	140548	187259
Eastern	121788	9844	8.1	102494	141083
London & SE	92194	9686	11	73209	111179
North East	9258	3988	43	NA	NA
North West	51239	5997	12	39484	62993
N. Ireland	21499	2018	9.4	17543	25455
Scotland	26820	1920	7.2	23056	30584
South West	217536	13975	6.4	190145	244928
Wales	27067	12091	45	NA	NA
West Midlands	157822	14303	9.1	129788	185856
Yorks & Humber	77681	6364	8.2	65208	90154
UK	966809	31288	3.2	905484	1028133

Table A.4: Estimates of total mass applied- Fodder

Region	Estimate (Kg)	s.e (Kg)	RSE(%)	95% C.I (Kg)	
East Midlands	60236	6764	11	46980	73493
Eastern	49650	4424	8.9	40978	58322
London & SE	36605	5140	14	26530	46681
North East	4506	2634	58	NA	NA
North West	15860	3225	20	9539	22181
N. Ireland	9130	984	11	7201	11060
Scotland	8443	1190	14	6111	10775
South West	68723	6429	9.4	56122	81324
Wales	17133	10941	64	NA	NA
West Midlands	58873	8009	14	43175	74571
Yorks & Humber	29471	2844	9.7	23896	35046
UK	358632	18567	5.2	322240	395024

Table A.5: Estimates of area of application by region and size group - Maize

Region	Size group	Total Area (Ha)	Number of holdings	Number surveyed	Estimate (Ha)	s.e (Ha)	RSE (%)	95% Confidence Interval (Ha)	
East Midlands	A	2353	721	7	8019	683	8.5	6681	9357
East Midlands	B	4578	335	11	18260	1700	9.3	14927	21592
East Midlands	CD	7746	235	6	31990	4434	14	23300	40680
East Midlands	E	10126	47	10	44365	3841	8.7	36837	51893
Eastern	A	2419	955	5	5806	1231	21	3393	8218
Eastern	B	4790	394	12	21585	2022	9.4	17621	25549
Eastern	CD	9114	268	9	45427	1711	3.8	42073	48781
Eastern	E	7614	67	8	41061	4085	9.9	33056	49067
London & SE	AB	8506	1269	12	28961	4840	17	19474	38448
London & SE	C	5782	221	8	27296	3486	13	20465	34128
London & SE	D	5904	123	7	19679	4271	22	11308	28049
London & SE	E	7035	71	7	23483	2509	11	18565	28401
North	AB	6744	912	8	20083	2012	10	16140	24027
North	CDE	6249	158	7	22623	3503	15	15756	29489
Northern Ireland	ALL	1381	127	20	3622	363	10	2911	4333
Scotland	ALL	792	51	9	2455	198	8	2067	2842
South West	A	9431	2311	12	31178	4800	15	21770	40586
South West	B	17537	1251	24	56717	3988	7	48900	64535
South West	C	12114	422	14	40191	5240	13	29920	50462
South West	D	10890	236	18	42016	3006	7.2	36124	47909
South West	E	8861	93	10	36122	3636	10	28995	43249
Wales & WM	AB	16973	2010	10	59406	3787	6.4	51984	66828
Wales & WM	C	7769	273	7	33800	2652	7.8	28603	38997
Wales & WM	DE	14101	196	10	54278	3377	6.2	47660	60896
Yorks & Humber	AB	4105	710	11	19205	1662	8.7	15947	22463
Yorks & Humber	CD	2677	85	6	9803	1695	17	6480	13126
Yorks & Humber	E	1884	21	10	9741	707	7.3	8355	11127

Table A.6: Estimates of mass applied by and region size group- Maize

Region	Size group	Total Area (Ha)	Number of holdings	Number surveyed	Estimate (Kg)	s.e (Kg)	RSE (%)	95% Confidence Interval (Kg)	
East Midlands	A	2353	721	7	3121	901	29	1354	4888
East Midlands	B	4578	335	11	8384	1072	13	6283	10485
East Midlands	CD	7746	235	6	13420	4483	33	NA	NA
East Midlands	E	10126	47	10	18346	2309	13	13821	22871
Eastern	A	2419	955	5	2772	1485	54	NA	NA
Eastern	B	4790	394	12	9373	1140	12	7138	11607
Eastern	CD	9114	268	9	19143	3149	16	12970	25316
Eastern	E	7614	67	8	13967	2214	16	9628	18306
London & SE	AB	8506	1269	12	11233	2861	25	5626	16841
London & SE	C	5782	221	8	11314	2160	19	7081	15548
London & SE	D	5904	123	7	4837	1693	35	NA	NA
London & SE	E	7035	71	7	8369	2433	29	3600	13137
North	AB	6744	912	8	6338	1671	26	3063	9614
North	CDE	6249	158	7	7903	2288	29	3418	12388
Northern Ireland	ALL	1381	127	20	2503	324	13	1868	3139
Scotland	ALL	792	51	9	1012	200	20	620	1403
South West	A	9431	2311	12	12128	2124	18	7965	16292
South West	B	17537	1251	24	15391	2780	18	9943	20839
South West	C	12114	422	14	12170	2752	23	6776	17565
South West	D	10890	236	18	13791	2012	15	9849	17734
South West	E	8861	93	10	11496	2539	22	6519	16472
Wales & WM	AB	16973	2010	10	17782	5307	30	7382	28183
Wales & WM	C	7769	273	7	11744	1822	16	8172	15316
Wales & WM	DE	14101	196	10	20370	4188	21	12161	28579
Yorks & Humber	AB	4105	710	11	9031	1857	21	5393	12670
Yorks & Humber	CD	2677	85	6	2857	1143	40	NA	NA
Yorks & Humber	E	1884	21	10	3787	570	15	2670	4904

Table A.7: Estimates of total area of application- Maize

Region	Estimate (Ha)	s.e (Ha)	RSE(%)	95% C.I (Ha)	
East Midlands	102634	6145	6.0	90589	114678
Eastern	113879	5022	4.4	104036	123721
London & SE	99419	7753	7.8	84223	114616
North	42706	4040	9.5	34788	50624
N Ireland	3622	363	10	2911	4333
Scotland	2455	198	8.0	2067	2842
South West	206225	9416	4.6	187769	224681
Wales & WM	147485	5725	3.9	136265	158705
Yorks & Humber	38749	2477	6.4	33893	43605
UK	757172	16345	2.2	725136	789208

Table A.8: Estimates of total mass applied- Maize

Region	Estimate (Kg)	s.e (Kg)	RSE(%)	95% C.I (Kg)	
East Midlands	43270	5234	12	33012	53528
Eastern	45255	4281	9.5	36865	53645
London & SE	35754	4651	13	26637	44870
North	14241	2834	20	8687	19795
N Ireland	2503	324	13	1868	3139
Scotland	1012	200	20	620	1403
South West	64977	5505	8.5	54187	75766
Wales & WM	49896	7002	14	36173	63619
Yorks & Humber	15676	2253	14	11259	20093
UK	272583	12646	4.6	247797	297370

Table A.9: Estimates of area of application by region and size group- Grassland

Region	Size group	Total Area (Ha)	Number of holdings	Number surveyed	Estimate (Ha)	s.e (Ha)	RSE (%)	95% Confidence Interval (Ha)	
East Midlands	A	62739	7005	20	12300	5615	46	NA	NA
East Midlands	B	64589	1515	15	17823	10592	59	NA	NA
East Midlands	CD	106265	1170	15	21911	10719	49	NA	NA
East Midlands	E	78708	285	10	7909	7741	98	NA	NA
Eastern	A	55390	7438	21	6970	3468	50	NA	NA
Eastern	B	38450	908	12	12633	6891	55	NA	NA
Eastern	C	24605	339	8	8129	5594	69	NA	NA
Eastern	D	25335	220	8	2004	1722	86	NA	NA
Eastern	E	49750	163	11	1608	1557	97	NA	NA
London & SE	A	70127	7742	25	8895	3680	41	NA	NA
London & SE	B	75328	1765	27	20378	8952	44	NA	NA
London & SE	C	59649	813	16	3581	1461	41	NA	NA
London & SE	D	71533	626	14	7398	3742	51	NA	NA
London & SE	E	124423	486	19	15038	4961	33	NA	NA
North East	A	20875	2016	5	15	15	100	NA	NA
North East	BC	54406	985	9	1546	790	51	NA	NA
North East	D	41743	356	9	707	395	56	NA	NA
North East	E	223608	589	9	18637	12603	68	NA	NA
North West	A	60348	5931	14	9843	5769	59	NA	NA
North West	B	92375	2108	17	17441	6065	35	NA	NA
North West	C	89429	1216	10	1225	1220	100	NA	NA
North West	D	143322	1242	14	8371	4302	51	NA	NA
North West	E	319971	1009	8	79701	52878	66	NA	NA
Northern Ireland	A	215793	15301	108	19131	3498	18	12274	25987
Northern Ireland	B	231085	5490	69	19032	3746	20	11689	26375
Northern Ireland	C	139488	2576	32	13256	4737	36	NA	NA
Northern Ireland	D	132952	1190	32	13315	3288	25	6871	19759
Northern Ireland	E	85634	399	35	10733	2759	26	5324	16141
Scotland	A	201495	28831	197	9664	2189	23	5373	13954
Scotland	B	186043	4289	129	15167	2605	17	10061	20273

Scotland	C	177059	2399	84	8378	2320	28	3831	12925
Scotland	D	273980	2386	106	16878	3863	23	9306	24449
Scotland	E	480231	1881	176	26044	3454	13	19274	32814
South West	A	138952	13679	44	14636	4806	33	NA	NA
South West	B	192263	4424	48	24415	6778	28	11130	37700
South West	C	171526	2336	39	9858	2740	28	4487	15228
South West	D	229857	2022	36	24107	6761	28	10855	37360
South West	E	335694	1225	25	58889	25132	43	NA	NA
Wales	A	169314	20662	34	10594	6046	57	NA	NA
Wales	BC	402851	7437	17	1253	1252	100	NA	NA
Wales	DE	665145	4216	13	85815	52814	62	NA	NA
West Midlands	A	80499	8122	19	5942	4270	72	NA	NA
West Midlands	B	99093	2300	30	19033	6796	36	NA	NA
West Midlands	C	75952	1042	16	12655	5159	41	NA	NA
West Midlands	D	87439	768	10	23301	9580	41	NA	NA
West Midlands	E	91812	377	8	17834	11052	62	NA	NA
Yorks & Humber	A	67408	7336	18	18497	7195	39	NA	NA
Yorks & Humber	B	67991	1593	22	8246	3937	48	NA	NA
Yorks & Humber	C	51827	711	10	4253	2231	52	NA	NA
Yorks & Humber	DE	275459	1204	11	22384	11043	49	NA	NA

Table A.10: Estimates of mass applied by and region size group- Grassland

Region	Size group	Total Area (Ha)	Number of holdings	Number surveyed	Estimate (kg)	s.e (kg)	RSE (%)	95% Confidence Interval (kg)	
East Midlands	A	62739	7005	20	11950	7667	64	NA	NA
East Midlands	B	64589	1515	15	11760	8414	72	NA	NA
East Midlands	CD	106265	1170	15	13480	7539	56	NA	NA
East Midlands	E	78708	285	10	2847	2787	98	NA	NA
Eastern	A	55390	7438	21	7848	4852	62	NA	NA
Eastern	B	38450	908	12	10740	5350	50	NA	NA
Eastern	C	24605	339	8	1667	1117	67	NA	NA
Eastern	D	25335	220	8	367	237	64	NA	NA
Eastern	E	49750	163	11	281	273	97	NA	NA
London & SE	A	70127	7742	25	4044	1835	45	NA	NA
London & SE	B	75328	1765	27	18217	10766	59	NA	NA
London & SE	C	59649	813	16	1199	565	47	NA	NA
London & SE	D	71533	626	14	4448	2255	51	NA	NA
London & SE	E	124423	486	19	14373	5143	36	NA	NA
North East	A	20875	2016	5	6	6	100	NA	NA
North East	BC	54406	985	9	938	489	52	NA	NA
North East	D	41743	356	9	62	61	99	NA	NA
North East	E	223608	589	9	12558	9952	79	NA	NA
North West	A	60348	5931	14	7293	5137	70	NA	NA
North West	B	92375	2108	17	10407	5083	49	NA	NA
North West	C	89429	1216	10	793	790	100	NA	NA
North West	D	143322	1242	14	9163	5103	56	NA	NA
North West	E	319971	1009	8	43461	29179	67	NA	NA
Northern Ireland	A	215793	15301	108	16761	3669	22	9569	23952
Northern Ireland	B	231085	5490	69	17386	4826	28	7927	26845
Northern Ireland	C	139488	2576	32	5520	1482	27	2615	8425
Northern Ireland	D	132952	1190	32	7266	1951	27	3442	11090
Northern Ireland	E	85634	399	35	6736	1944	29	2926	10546
Scotland	A	201495	28831	197	4930	1047	21	2879	6982
Scotland	B	186043	4289	129	11050	2047	19	7038	15062

Scotland	C	177059	2399	84	3615	912	25	1827	5403
Scotland	D	273980	2386	106	10291	2180	21	6018	14564
Scotland	E	480231	1881	176	18427	2620	14	13291	23563
South West	A	138952	13679	44	5709	2187	38	NA	NA
South West	B	192263	4424	48	10184	3227	32	NA	NA
South West	C	171526	2336	39	4665	1390	30	1941	7390
South West	D	229857	2022	36	17503	5667	32	NA	NA
South West	E	335694	1225	25	37595	17171	46	NA	NA
Wales	A	169314	20662	34	4743	3069	65	NA	NA
Wales	BC	402851	7437	17	0	0	NA	0	0
Wales	DE	665145	4216	13	25284	13716	54	NA	NA
West Midlands	A	80499	8122	19	3137	1829	58	NA	NA
West Midlands	B	99093	2300	30	9465	3244	34	NA	NA
West Midlands	C	75952	1042	16	5691	1762	31	NA	NA
West Midlands	D	87439	768	10	14301	5444	38	NA	NA
West Midlands	E	91812	377	8	8295	5263	63	NA	NA
Yorks & Humber	A	67408	7336	18	22782	9991	44	NA	NA
Yorks & Humber	B	67991	1593	22	6844	4033	59	NA	NA
Yorks & Humber	C	51827	711	10	4879	3464	71	NA	NA
Yorks & Humber	DE	275459	1204	11	15910	8400	53	NA	NA

Table A.11: Estimates of total area of application- Grassland

Region	Estimate (Ha)	s.e (Ha)	RSE(%)	95% C.I (Ha)	
East Midlands	59943	17847	30	24962	94924
Eastern	31344	9808	31	NA	NA
London & SE	55289	11594	21	32565	78014
North East	20905	12634	60	NA	NA
North West	116580	53723	46	NA	NA
N. Ireland	75467	8193	11	59408	91526
Scotland	76131	6619	8.7	63157	89105
South West	131905	27457	21	78089	185721
Wales	97662	53174	54	NA	NA
West Midlands	78765	17463	22	44537	112993
Yorks & Humber	53381	13935	26	26067	80694
UK	797372	88241	11	624420	970323

Table A.12: Estimates of total mass applied- Grassland

Region	Estimate (kg)	s.e (kg)	RSE(%)	95% C.I (kg)	
East Midlands	40037	13935	35	NA	NA
Eastern	20903	7317	35	NA	NA
London & SE	42281	12293	29	18186	66376
North East	13564	9964	73	NA	NA
North West	71117	30501	43	11334	130899
N. Ireland	53669	6822	13	40298	67039
Scotland	48313	4211	8.7	40059	56568
South West	75657	18550	25	39300	112014
Wales	30026	14056	47	NA	NA
West Midlands	40889	8620	21	23994	57784
Yorks & Humber	50416	14094	28	22792	78040
UK	486872	48035	9.9	392724	581020

APPENDIX 5 – FIRST RAISING FACTORS USED FOR THE FODDER SAMPLE – 2017

Table 14 – First Raising factors for the Fodder survey in the United Kingdom - 2017

Region	Size Group	RF1	Area grown (ha)	Area surveyed (ha)	Number of farms
East Midlands	A	36.07	3,101	86	14
	B	18.13	5,350	295	14
	C	56.19	4,352	77	*
	D	20.20	5,185	257	*
	E	7.84	12,162	1,551	10
Eastern	A	40.33	3,271	81	13
	B	19.79	6,381	322	14
	C	21.96	5,365	244	6
	D	8.68	6,837	787	11
	E	4.92	9,702	1,971	12
London & South East	A	45.60	3,491	77	10
	B	24.23	6,722	277	13
	C	15.14	6,589	435	11
	D	13.90	6,908	497	8
	E	7.95	9,547	1,201	9
North East	A	29.00	512	18	*
	B	20.70	414	20	*
	E	5.75	1,544	269	*
North West	A	63.33	2,939	46	6
	B	31.46	4,759	151	8
	C	26.14	3,023	116	*
	D	11.67	2,263	194	*
	E	8.73	2,094	240	*
Northern Ireland	A	7.80	2,567	329	52
	B	6.59	1,970	299	15
	C	4.95	770	156	*
	D	5.95	491	83	*
Scotland	A	14.29	9,438	660	101
	B	5.61	5,163	920	48
	C	8.02	889	111	*
	D	5.96	475	80	*
South West	A	73.42	11,504	157	20
	B	33.59	19,678	586	29
	C	19.40	13,871	715	18
	D	11.03	13,027	1,181	18
	E	4.85	11,412	2,351	14
Wales	A	240.18	7,454	31	*
West Midlands	A	122.96	5,608	46	8
	B	48.28	9,686	201	11
	C	25.31	6,037	239	7
	D	13.01	6,748	519	8
	E	13.52	5,306	393	*
Yorkshire & the Humber	A	29.27	2,599	89	12
	B	19.86	3,658	184	8
	C	16.36	2,494	152	*
	D	9.51	2,251	237	*
	E	1.45	2,362	1,631	10

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

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

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