Scottish Government
Riaghaltas na h-Alba

Pesticide Usage in Scotland

A National Statistics Publication for Scotland

NATIONAL STATISTICS

Arable crops and Potato stores 2022

Pesticide Usage in Scotland

Arable Crops 2022

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Executive summary

This report presents information from a survey of pesticide use on arable crops grown in Scotland. The survey period covers the 2022 growing season, from post-harvest pesticide applications in 2021 through to harvest in 2022. The crop groups surveyed included cereals, oilseeds, potatoes and legumes.

The estimated area of arable crops grown in Scotland in 2022 was ca. 487,000 hectares. Spring barley accounted for 48 per cent of the arable crop area, wheat 22 per cent, winter barley nine per cent, oilseeds seven per cent, potatoes six per cent and spring oats four per cent. Winter oats, winter rye, triticale and legumes together accounted for the remaining four per cent.

Data were collected from a total of 332 holdings, representing eight per cent of the total arable crop area grown in Scotland. Ratio raising was used to produce estimates of national pesticide use from the sample data.

The estimated total area of arable crops treated with a pesticide formulation was ca. 4,685,000 hectares (± three per cent Relative Standard Error, RSE) with a combined weight of ca. 1,200 tonnes (± four per cent RSE). Overall, pesticides were applied to 97 per cent of the arable crop area. Fungicides were applied to 94 per cent of the crop area, herbicides/desiccants to 93 per cent, growth regulators to 56 per cent, insecticides to 19 per cent and molluscicides to eight per cent. Pesticide treatments were applied to 82 per cent of seed in this survey.

Overall, use of pesticides in 2022 has remained broadly similar to the previous two arable surveys. Taking into account changes in crop area, the 2022 total pesticide treated area was two per cent lower than that reported in 2020 and one per cent higher than 2018. The weight of pesticide applied to arable crops in 2022 was 12 per cent lower than in 2020 and eight per cent lower than 2018.

Fungicide use by area treated increased three per cent while the weight applied decreased six per cent compared to 2020 levels. Herbicide/desiccant use decreased by eight and 19 per cent by area treated and by weight applied respectively when compared to 2020. The area treated with insecticides/ nematicides decreased by seven per cent from 2020, while the weight applied decreased by 50 per cent. Molluscicide use decreased 28 and 29 per cent by area treated and by weight respectively when compared to 2020. Seed treatment use decreased eight per cent by area treated and the weight applied decreased 17 per cent from 2020. The area treated in 2020 with growth regulators increased 16 per cent while there was no change in the weight applied from 2020 levels.

In terms of area treated, the most commonly used foliar fungicide active substance was prothioconazole. The most used herbicide and insecticide was fluroxypyr and lambda-cyhalothrin respectively. The most commonly used seed treatment active substance was fludioxonil. The herbicide thiencarbazone-methyl and the fungicides fenpicoxamid and laminarin were recorded for the first time in this survey.

Introduction

The Scottish Government (SG) is required by legislation[1][2] to carry out post-approval surveillance of pesticide use. This is conducted by the Pesticide Survey Unit at SASA, a division of the Scottish Government's Agriculture and Rural Economy Directorate.

This survey is part of a series of annual reports which are produced to detail pesticide usage in Scotland for arable, vegetable and soft fruit crops on a biennial basis and for fodder and forage crops every four years. The Scottish survey data are incorporated with England, Wales, and Northern Ireland data to provide estimates of annual UK-wide pesticide use. Information on all aspects of pesticide usage in the United Kingdom as a whole may be obtained from the Pesticide Usage Survey Team at Fera Science Ltd, Sand Hutton, York, or visit the Fera website.

An Accredited Official Statistics Publication for Scotland

These statistics are accredited official statistics. The Office for Statistics Regulation has independently reviewed and accredited these statistics as complying with the standards of trustworthiness, quality, and value in the Code of Practice for Statistics.

The Scottish Pesticide Usage reports have been accredited official statistics since October 2014.

Accredited official statistics are called National Statistics in the Statistics and Registration Service Act 2007.

Scottish Government statistics are regulated by the Office for Statistics Regulation (OSR). OSR sets the standards of trustworthiness, quality and value in the Code of Practice for Statistics that all producers of official statistics should adhere to.

As well as working closely with Scottish Government statisticians, SASA receive survey specific statistical support from Biomathematics and Statistics Scotland (BioSS).

All reports are produced according to a published timetable. For further information in relation to Pesticide Survey Unit publications and their compliance with the code of practice please refer to the pesticide usage survey section of the SASA website. The website also contains other useful documentation such as privacy and revision policies, user feedback and detailed background information on survey methodology and data uses.

Additional information regarding pesticide use can be supplied by the Pesticide Survey Unit. Please email psu@sasa.gov.scot or visit our website.

Structure of report and how to use these statistics

This report is intended to provide data in a useful format to a wide variety of data users. The general trends section provides commentary on recent changes in survey data and longer-term trends. The pesticide usage section summarises usage on all arable crops in 2022. Appendix 1 presents all estimated pesticide usage in two formats; area and weight of formulations by crop. The area and weight of active substances by crop data, which were previously published in this report, are now published as supplementary data in Excel format. These different measures are provided to satisfy the needs of different data users (see Appendix 3 for examples). Appendix 2 summarises survey statistics including the Single Application Farm (SAF, in absence of June 2022 Census) and holding information, raising factors and survey response rates. Appendix 3 defines many of the terms used throughout the report. Appendix 4 describes the methods used during sampling, data collection and analysis as well as measures undertaken to avoid bias and reduce uncertainty. Any changes in method from previous survey years are also explained.

It is important to note that the figures presented in this report are produced from surveying a sample of holdings rather than a census of all the holdings in Scotland. Therefore, the figures are estimates of the total pesticide use for Scotland and should not be interpreted as exact. To give an indication of the precision of estimates, the report includes relative standard errors. A full explanation of standard errors can be found in Appendix 5.

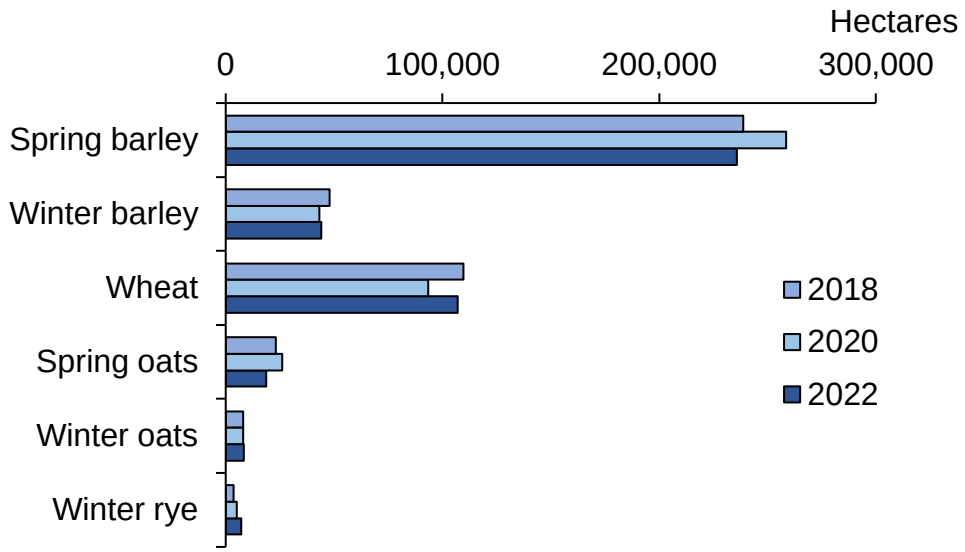
General trends

Crop area

The estimated area of arable crops grown in 2022 was 487,389 hectares (Table 28). This represents a two per cent decrease from 2020[(3)] and no change from 2018[(4)] (see Appendix 4 for changes in methodology between years). Since the last survey, areas of winter barley, wheat, winter oats, winter rye, oilseeds and legumes increased (3, 15, 6, 40, 15 and 23 per cent respectively), while spring barley, spring oats, seed potatoes and ware potatoes have decreased (9, 28, 1 and 6 per cent respectively) (Table 28, Figures 1 and 2).

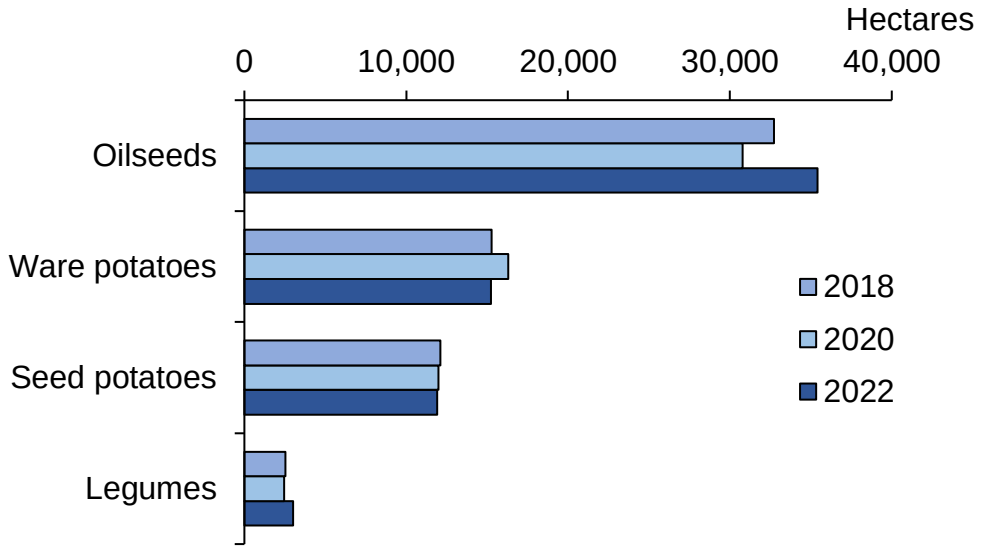
In 2022, cereals accounted for 87 per cent of the arable area (48 per cent spring barley, 22 per cent wheat, nine per cent winter barley, four per cent spring oats, two per cent winter oats and one per cent rye). The remaining area consisted of oilseeds, potatoes and legumes (accounting for 7, 6 and 1 per cent respectively, Figure 3). The largest area of arable crops was in the Aberdeen region, followed by Angus, Tweed Valley and Moray Firth (Figure 4).

Figure 1 Area of cereal crops grown in Scotland 2018-2022



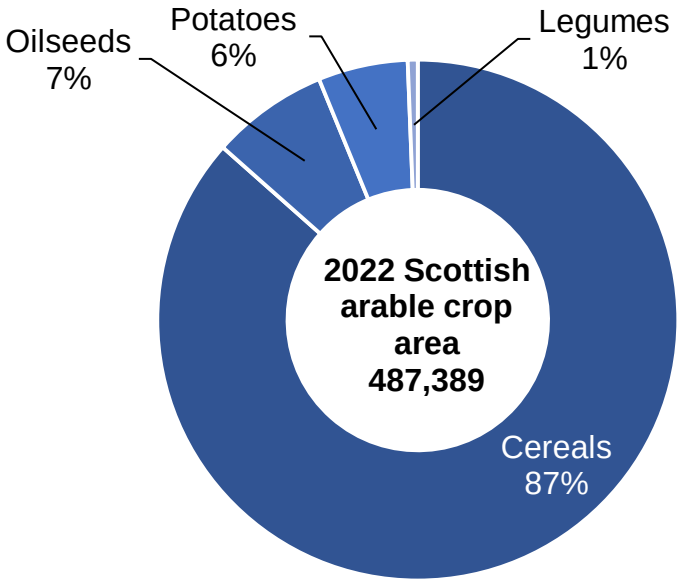
Note: triticale has been excluded as this represents < 500 ha.

Figure 2 Area of oilseeds, potatoes and legumes grown in Scotland 2018-2022



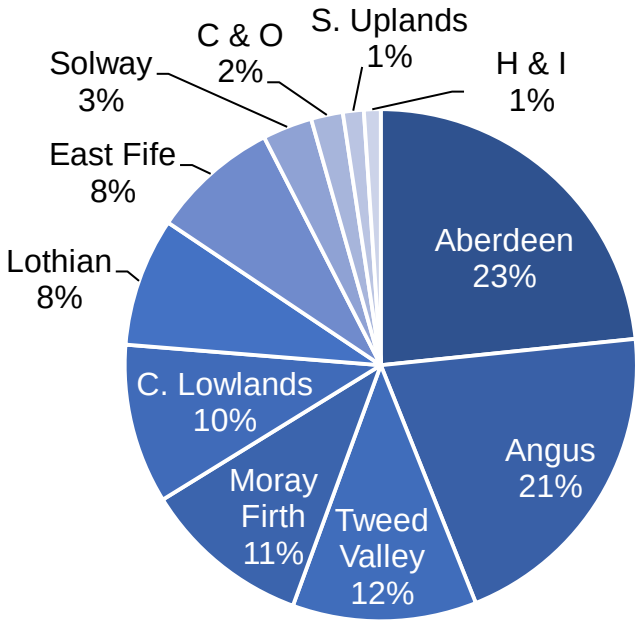
Note: oilseeds includes linseed (2022 only), winter and spring oilseed rape; legumes include field beans and dry harvest peas.

Figure 3 Arable crop areas 2022 (percentage of total area)



Note: cereals include winter and spring barley, wheat, oats, winter rye and triticale; potatoes includes seed and ware potatoes; oilseeds includes linseed, winter and spring oilseed rape; legumes includes field beans and dry harvest peas.

Figure 4 Regional distribution of arable crops in Scotland 2022



Note: H & I = Highlands and Islands, S. Uplands = Southern Uplands, C & O = Caithness and Orkney and C. Lowlands = Central Lowlands.

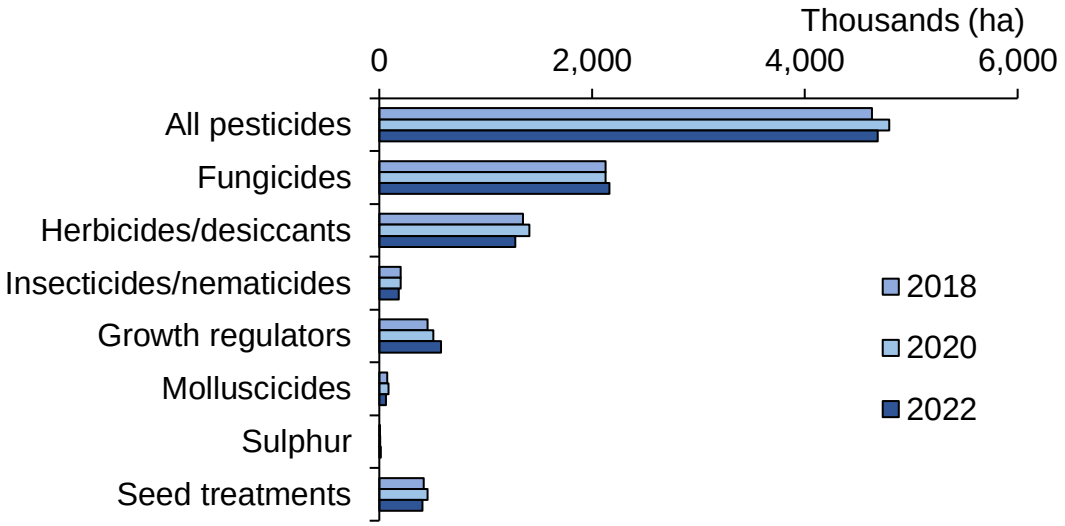
Pesticide usage

In 2022, as in 2020, the majority of arable crops (97 per cent) received a pesticide treatment.

Winter and spring barley, winter and spring wheat, winter oats, winter rye, oilseeds, seed and ware potatoes had the highest overall proportion of crop treated with a pesticide (between 96 and 100 per cent Table 1). Legumes and spring oats had lower proportions of treated crop area (91 and 83 per cent respectively). The average number of sprays applied to treated arable land, excluding seed treatments was 4.1, the same as recorded in 2020. Ware potatoes and seed potatoes received the highest average number of sprays (13.7 and 10.2 respectively), while spring barley, spring oats and winter rye received the lowest (2.5, 2.7 and 3.2 respectively, Table 1). These figures only apply to the treated area of crops.

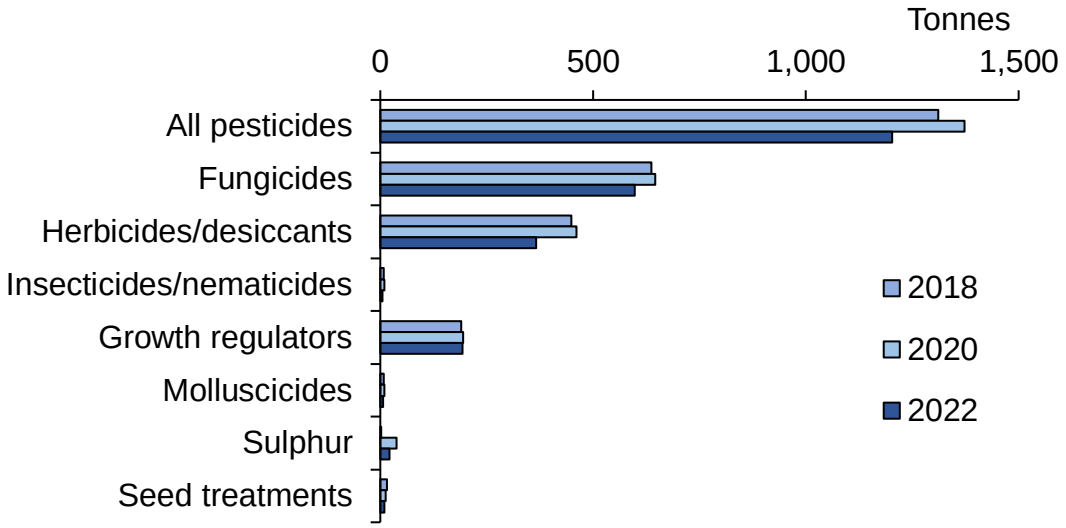
It is estimated that the area of arable crops treated with a pesticide formulation in 2022 was ca. 4,685,000 hectares compared with ca. 4,793,000 hectares in 2020 and ca. 4,632,000 hectares in 2018 (Table 21, Figure 5). This represents a decrease of two per cent since 2020 and is very similar to 2018.

Figure 5 Area of arable crops treated with major pesticide groups in Scotland 2018-2022



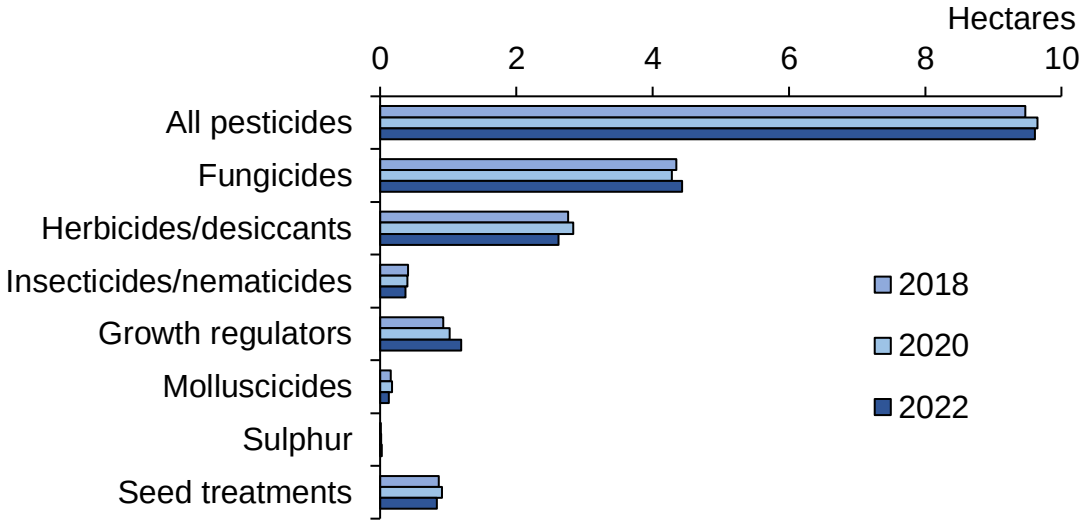
In terms of weight of pesticide applied, it is estimated ca. 1,200 tonnes were applied in 2022, representing a decrease of 12 per cent from 2020 and a decrease of eight per cent from 2018 (Table 21, Figure 6).

Figure 6 **Weight of major pesticide groups applied to arable crops in Scotland 2018-2022**



In order to make accurate comparisons between the 2022 data and the data collected in previous surveys, it is important to take into account the differences in crop area between survey years. Therefore, the number of treated hectares per hectare of crop grown and the total weight of pesticide used per hectare of crop grown were calculated. Once crop area is taken into account, there was no change from 2020 to 2022 and a two per cent increase from 2018 to 2022 in terms of the total pesticide treated area per area of crop grown (Figure 7).

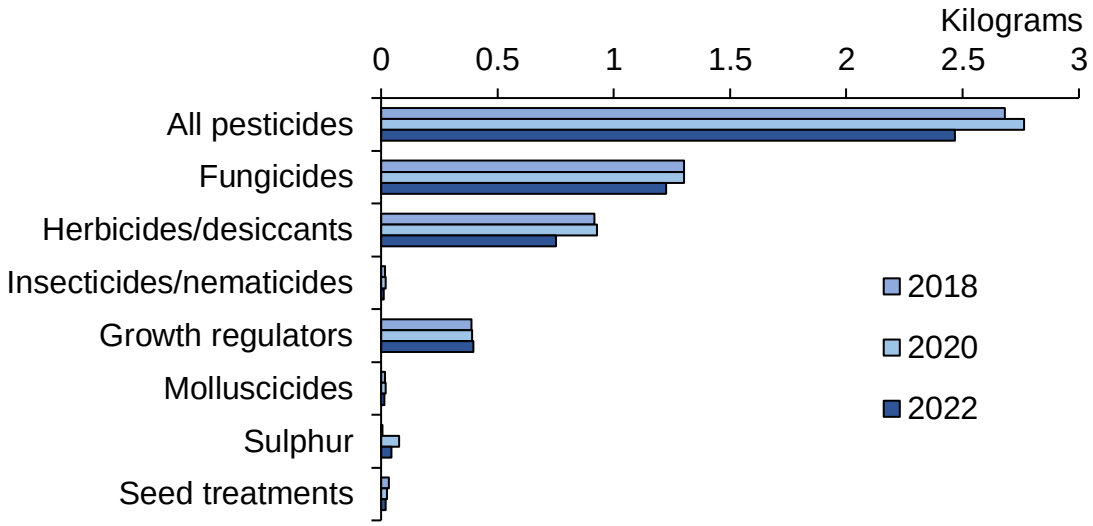
Figure 7 **Number of pesticide treated hectares (formulations) per hectare of crop grown in Scotland 2018-2022**



In terms of quantity of pesticides used per hectare of crop grown, there was a decrease of 11 per cent from 2020 to 2022 and a decrease of eight per cent from 2018 to 2022 (Figure 8).

Overall, winter crops for harvest in 2022 established well and a dry spring reduced disease pressure. Spring crops went in to cool, dry soils and there were some issues with emergence but establishment was usually good. Soils were very dry going into summer but rainfall in June and July went some way to alleviating this and crop yields were generally good despite being capped by earlier low rainfall. Pest and disease levels were reduced by the dry spring, but increased in wetter summer conditions[5].

Figure 8 Weight of pesticide applied per hectare of crop grown in Scotland 2018-2022

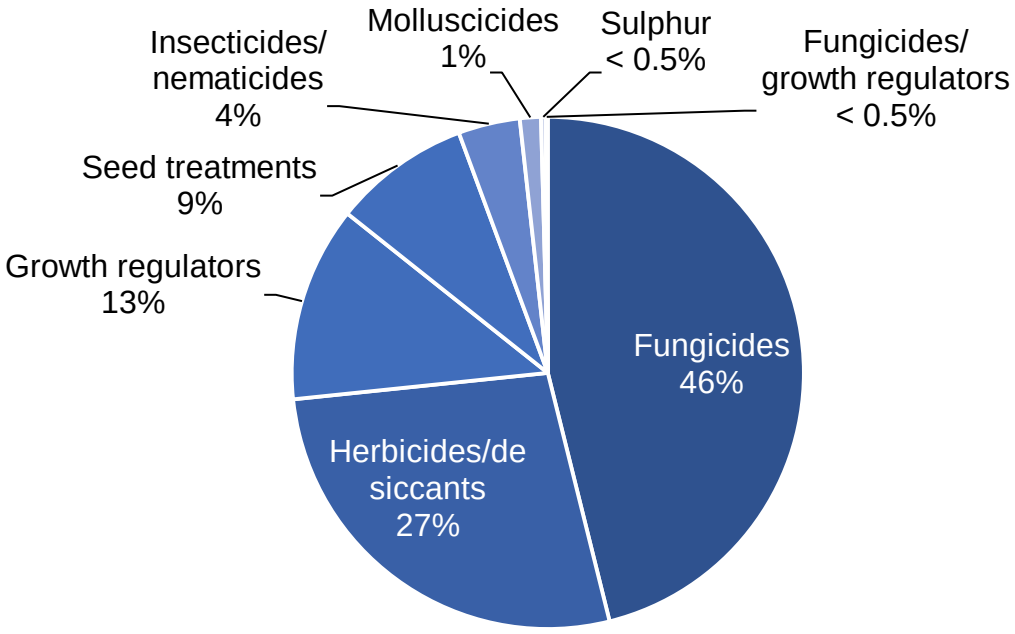


As in previous surveys in this series, fungicides were the most frequently used pesticides on arable crops, followed by herbicides/desiccants (Figure 5). In 2022, fungicides accounted for 46 per cent of the total pesticide treated area and 50 per cent of the total weight of active substances applied (Figures 9 and 10). When changes in crop area are taken into account, there was a three per cent increase in area treated with fungicides from 2020 to 2022, and a two per cent increase from 2018 to 2022 (Figure 7). The weight of fungicides applied per hectare decreased six per cent from both 2020 and 2018 to 2022 (Figure 8). The slight increase in treated area but decrease in weight applied may have been influenced by the withdrawal of chlorothalonil (May 2020), which would have been part of early programmes that year. To achieve the same degree of efficacy from programmes in 2022, other fungicidal inputs will have increased, including increased use of folpet, which is applied at lower rates than chlorothalonil, contributing to the decrease in weight of fungicide applied from 2020.

In 2022, herbicides/desiccants accounted for 27 per cent of the total pesticide treated area and 30 per cent of the total weight of active substances applied (Figures 9 and 10). When changes in crop area are taken into account, there

was an eight per cent decrease in the area treated with herbicides/desiccants from 2020 to 2022 and a five per cent decrease from 2018 to 2022. The weight of herbicides/desiccants applied decreased 19 per cent from 2020 to 2022 and decreased 18 per cent from 2018 to 2022 (Figures 7 and 8). Prolonged dry conditions in spring delayed weed germination[6], and weed levels continued to be fairly low as a consequence of the dry weather continuing through the summer months[7,8]. The area treated and weight applied of pre-harvest glyphosate decreased 34 and 35 per cent respectively in 2022 compared to 2020, likely due to the hot, dry weather at harvest time rapidly ripening crops naturally[7,8].

Figure 9 Use of pesticide on arable crops (percentage of total area treated with formulations) – 2022

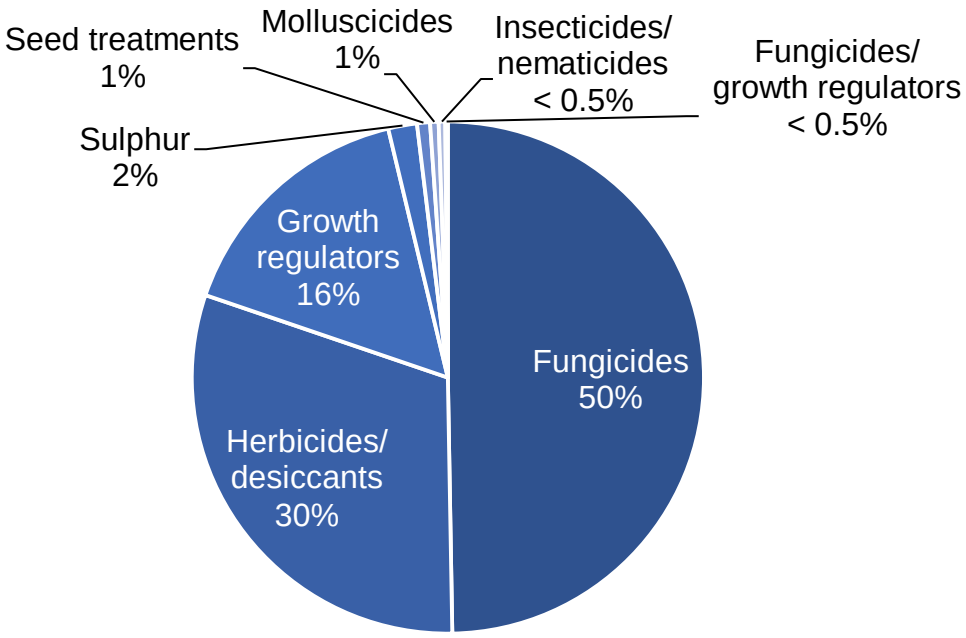


As was the case in 2020, insecticides (including nematicides) accounted for four per cent of the total pesticide treated area but less than 0.5 per cent of the total weight of active substances applied (Figures 9 and 10). When changes in crop area are taken into account, there was a seven per cent decrease in area treated with insecticide from 2020 to 2022 and a 10 per cent decrease from 2018 to 2022 (Figure 7). The weight of insecticides applied per hectare of crop grown decreased 50 per cent from 2020 to 2022 and decreased 42 per cent from 2018 to 2022 (Figure 8). This decrease in weight of insecticides applied since 2020 is primarily influenced by the withdrawal of oxamyl (final use December 2020) which was previously applied at high rates at planting of potato crops for the control of nematodes. The decline in insecticide use may also have been influenced by the withdrawal of thiacloprid in February 2021, which was previously applied mainly as a foliar spray to potato crops for aphid control.

Molluscicides accounted for one per cent of the total pesticide treated area and of the total weight of active substances applied (Figures 9 and 10). When changes in crop area are taken into account, there was a 28 per cent

decrease in area treated from 2020 to 2022 and a 17 per cent decrease from 2018 to 2022 (Figure 7). The weight of molluscicides applied per hectare of crop grown decreased by 29 per cent from 2020 to 2022 and by 26 per cent from 2018 to 2022. The decrease in area treated and weight applied of molluscicides since 2020 is influenced by the withdrawal of the active substance metaldehyde in March 2022, which meant it was not available for use on potato crops during the 2022 season. Metaldehyde was applied to winter cereal and oilseed rape crops planted late 2021 and none after March 2022. Notably, there was also a 13 and 24 per cent decrease in the area treated and weight applied of ferric phosphate, the only approved molluscicide active substance, from 2022 to 2020. Favourable autumn 2021 and spring 2022 crop growing conditions likely reduced slug pressure, allowing emerging crops to advance quickly[9,10,11]. This is in contrast to the 2020 season, where heavy autumnal rainfall in 2019 favoured slugs, and growers were reliant on slug pellets for slug management in oilseed rape and wheat during the autumn[12,13]. Wet weather during summer 2020 also increased slug pressure on potato crops[14].

Figure 10 Use of pesticides on arable crops (percentage of total quantity of active substances applied) – 2022



Growth regulators accounted for 13 per cent of the total pesticide treated area and 16 per cent of the total weight of active substances applied (Figures 9 and 10). When changes in crop area are taken into account, the area treated increased by 16 per cent from 2020 to 2022 and by 28 per cent from 2018 to 2022 (Figure 7). The weight of growth regulators applied per hectare of crop grown increased by one per cent from 2020 to 2022 and increased two per cent from 2018 to 2022 (Figure 8). As crops established well in 2022 and had good potential from early in the season, preventing lodging was a priority for farmers (Prof. Fiona Burnett, pers. comm).

Seed treatments accounted for nine per cent of the total pesticide treated area and one per cent of the total weight of active substances applied (Figures 9 and 10). When changes in crop area are taken into account, there was an eight per cent decrease in area treated between 2020 and 2022 and a three per cent decrease between 2018 and 2022 (Figure 7). The weight of seed treatments applied per hectare decreased 17 per cent from 2020 and by 38 per cent since 2018 (Figure 8). The decrease in the area and weight of seed treatments applied may relate to the withdrawal of some seed treatment formulations since the previous survey, including thiram which was the principal seed treatment on winter oilseed rape in 2020 (withdrawn January 2020) and penflufen and pencycuron which were common seed treatments on potatoes in 2020 (withdrawn June 2021 and March 2020 respectively).

Sulphur accounted for less than 0.5 per cent of the total pesticide treated area and two per cent of the total weight of active substances applied (Figures 9 and 10). When changes in crop area are taken into account, there was a 51 per cent increase in area treated from 2020 to 2022 and a 775 per cent increase from 2018 to 2022 (Figure 7). The quantity of sulphur applied per hectare of crop grown decreased by 44 per cent from 2020 to 2022 and increased 696 per cent from 2018 to 2022 (Figure 8). Sulphur, applied primarily to cereals, is a multisite alternative to fungicides and was used to control mildew, septoria and rhynchosporium. Spring barley and winter wheat accounted for 87 per cent of the sulphur treated area (43 and 44 per cent respectively) and 89 per cent of weight applied (45 and 44 per cent respectively) in 2022.

Three active substances were recorded for the first time in the 2022 arable survey (Table 18). These included the herbicide thiencarbazone-methyl (for brome control in winter wheat) and the fungicides fenpicoxamid (for disease control in cereals) and laminarin (a plant health elicitor which protects crops from fungal attack by activating the crops own defence systems and is one of the first biopesticides authorised for control of septoria and reduction of powdery mildew in winter wheat).

Whilst overall use of pesticides in 2022 has remained broadly similar to the previous two arable surveys, some individual active substances have exhibited considerable change. Declines or gaps in azole efficacy have influenced the use of a number of fungicides. The most effective remaining azole after withdrawal of the single-site fungicide epoxiconazole (withdrawn October 2021) was prothioconazole, the efficacy of which has declined against septoria and has always been slightly lower against rusts. This may have influenced increased use of the new active substance mefentrifluconazole (increased by 220 per cent in terms of area treated and 237 per cent by weight compared to 2020). The withdrawal of the multi-site chlorothalonil in May 2020 likely influenced increased use of the multi-site fungicide folpet (69 per cent increase of area treated and 80 per cent by weight compared to 2020 (Tables 19 and 20). The area treated and weight applied with the fungicide benzovindiflupyr also increased by 107 and 104 per cent respectively, partly influenced by crop composition, with greater areas of rye and field beans grown in 2022. In contrast, use of the potato fungicide cymoxanil decreased by 37 per cent by area treated and 33 per cent by weight applied. The principal cymoxanil formulation in 2020 was

cymoxanil/mancozeb. Use of this formulation was significantly lower in 2022 possibly due to supply issues in GB following the withdrawal of mancozeb in the EU in January 2021. Use of the fungicide prochloraz decreased by 57 per cent in area treated and 55 per cent in weight applied, influenced by product availability. A product containing prochloraz/proquinazid/tebuconazole was applied to 7,500 ha of cereals in 2020 but its use was withdrawn on barley and oats in July 2020.

While the overall area treated and weight applied of seed treatments decreased, the increased use of imazalil and ipconazole (123 and 128 per cent of area treated and 125 and 137 per cent by weight applied) may have been due a decrease in the overall number of seed treatments available. In addition, the area treated and weight applied of glyphosate decreased 34 and 35 per cent respectively in 2022 compared to 2020, this is likely to have been influenced by the hot, dry weather pre-harvest, rapidly ripening crops and naturally reducing the need for a desiccant. Use of the herbicide mecoprop-p also decreased by 44 per cent for area treated and 42 per cent by weight applied possibly due to the dry conditions and lower weed pressure in 2022. Finally, the withdrawal of linuron (June 2018) and diquat (February 2020) have will have led to an increase in use of other active substances such as the herbicide aclonifen, predominantly on ware potatoes, with an overall increase of 134 per cent in both area treated and weight applied. Aclonifen was a new active introduced in 2019.

2022 Pesticide usage

Winter barley

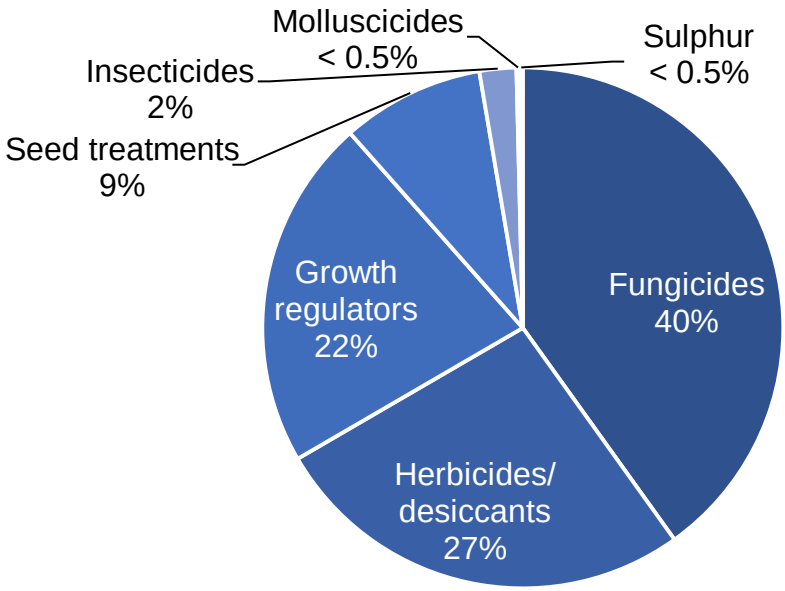
- An estimated 44,173 hectares of winter barley were grown in Scotland in 2022 (based on the Single Application Form (SAF) 2022 – see changes from previous years section for further explanation), an increase of three per cent since 2020
- 97 per cent of the crop was treated with a pesticide (see Figure 11 for types of pesticides used)
- Pesticides were applied to 434,175 treated hectares
- There were 124,919 kilograms of pesticide applied in total (see summary table)
- Winter barley received on average four pesticide sprays (Table 1). These sprays included 2.5 fungicide applications (applied to 97 per cent of crop area), 2.1 herbicide/desiccant applications (applied to 89 per cent), 1.8 applications of growth regulators (applied to 87 per cent) and one application of insecticide (applied to 22 per cent)
- The most common varieties encountered were LG Mountain and SY Kingsbarn (15 per cent each)
- The average reported yield was 8.4 t/ha

Summary of pesticide use on winter barley:

Pesticide group	Formulation area treated	Weight of pesticides applied	Percentage of crop treated	Most used formulations
	ha	kg	%	ha
Fungicides	174,124	42,820	97	Folpet (45,476)
Herbicides/ desiccants	115,115	44,296	89	Glyphosate (20,101)
Insecticides	9,911	45	22	Esfenvalerate (5,898)
Growth regulators	94,811	36,406	87	Chlormequat (35,271)
Molluscicides	858	98	2	Ferric phosphate (561)
Sulphur	846	605	2	[z]
Seed treatments	38,510	648	87	Fluopyram/ prothioconazole/ tebuconazole (15,929)
All pesticides	**434,175**	**124,919**	**97**	

Note: some shorthand is used in this table: [z] = not applicable.

Figure 11 Use of pesticides on winter barley (percentage of total area treated with formulations) – 2022



Spring barley

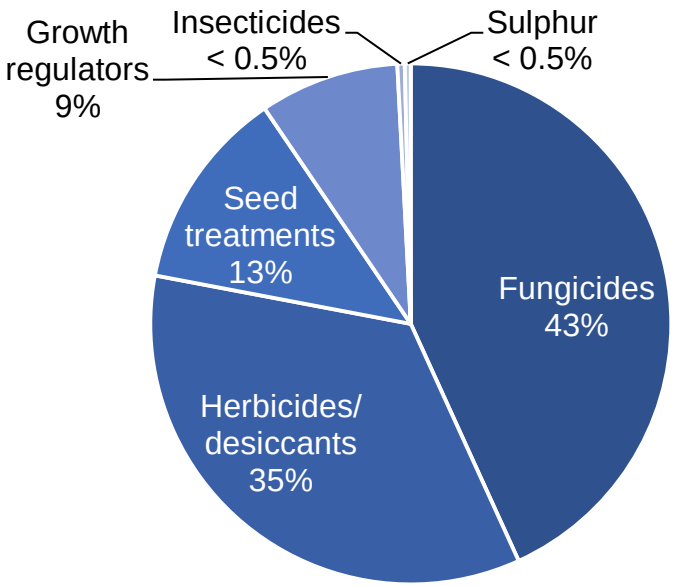
- An estimated 235,813 hectares of spring barley were grown in Scotland in 2022 (based on SAF 2022 – see changes from previous years section for further explanation), representing a decrease of nine per cent since 2020
- Ninety-seven per cent of the crop was treated with a pesticide (see Figure 12 for types of pesticide used)
- Pesticides were applied to 1,569,292 treated hectares
- There were 290,436 kilograms of pesticide used in total on the crop (see summary table)
- The spring barley crop received on average 2.5 pesticide applications (Table 1). These included 1.8 fungicide applications and 1.5 herbicide/desiccant applications (applied to 93 per cent of the crop area for both groups) and 1.4 applications of growth regulators (applied to 42 per cent)
- Laureate was the most common variety, accounting for 62 per cent of the sample area, followed by LG Diablo at 13 per cent
- The average reported yield was 7.1 t/ha

Summary of pesticide use on spring barley:

Pesticide group	Formulation area treated	Weight of pesticides applied	Percentage of crop treated	Most used formulations
	ha	kg	%	ha
Fungicides	677,963	157,229	93	Folpet (201,091)
Herbicides/ desiccants	545,815	99,592	93	Metsulfuron-methyl/ thifensulfuron-methyl (89,476)
Insecticides	7,162	35	3	Lambda-cyhalothrin (7,162)
Growth regulators	135,898	20,756	42	Trinexapac-ethyl (45,314)
Sulphur	5,825	9,377	2	[z]
Seed treatments	196,629	3,448	83	Imazalil/ipconazole (88,800)
All pesticides	**1,569,292**	**290,436**	**97**	

Note: some shorthand is used in this table: [z] = not applicable.

Figure 12 Use of pesticides on spring barley (percentage of total area treated with formulations) – 2022



Winter wheat

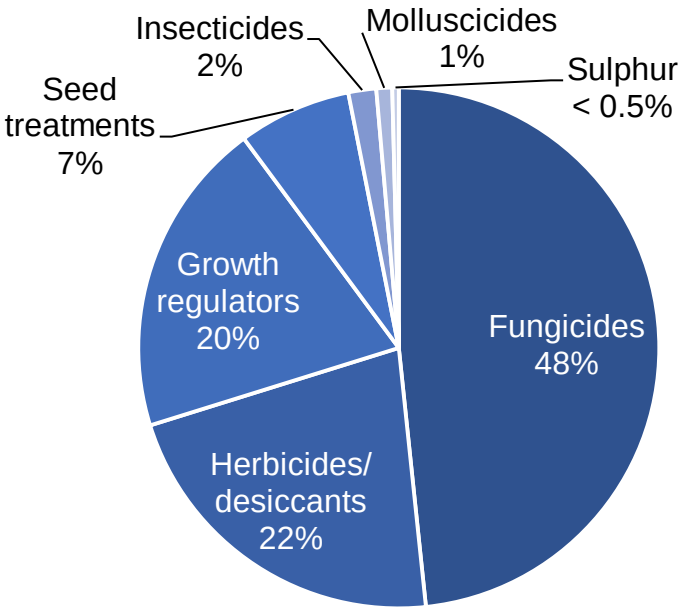
- An estimated 105,827 hectares of winter wheat were grown in Scotland in 2022 (based on SAF 2022 – see changes from previous years section for further explanation), representing an increase of 16 per cent since 2020
- Ninety-eight per cent of the crop was treated with a pesticide (see Figure 13 for types of pesticide used)
- Pesticides were applied to 1,454,363 treated hectares
- There were 376,930 kilograms of pesticide used in total on the crop (see summary table)
- The winter wheat crop received on average 5.1 pesticide applications (Table 1). These included 3.5 fungicide applications and 2.3 herbicide/desiccant applications (applied to 95 per cent and 94 per cent of the crop area respectively), two applications of growth regulators (applied to 93 per cent); molluscicides and insecticides received 1.2 and one application(s) (applied to 11 and 23 per cent of the area respectively)
- LG Skyscraper was the most common variety, accounting for 42 per cent of the sample area, followed by KWS Barrel at 11 per cent
- The average reported yield was 9.4 t/ha

Summary of pesticide use on winter wheat:

Pesticide group	**Formulation area treated**	**Weight of pesticides applied**	**Percentage of crop treated**	**Most used formulations**
	ha	kg	%	ha
Fungicides	702,982	176,352	95	Folpet (155,068)
Herbicides/ desiccants	317,876	83,620	94	Diflufenican/flufenacet (36,009)
Insecticides	25,133	146	23	Lambda-cyhalothrin (14,929)
Growth regulators	286,067	104,287	93	Trinexapac-ethyl (114,339)
Molluscicides	14,265	1,459	11	Ferric phosphate (13,399)
Sulphur	5,847	9,315	5	[z]
Seed treatments	102,194	1,751	91	Fludioxonil (51,891)
All pesticides	**1,454,363**	**376,930**	**98**	

Note: some shorthand is used in this table: [z] = not applicable.

Figure 13 Use of pesticides on winter wheat (percentage of total area treated with formulations) – 2022



Spring wheat

This crop was not recorded separately in SAF data. Based upon the proportions of spring and winter wheat encountered in the survey it was estimated that 1,291 hectares of spring wheat were grown in Scotland in 2022, representing a decrease of 43 per cent since 2020.

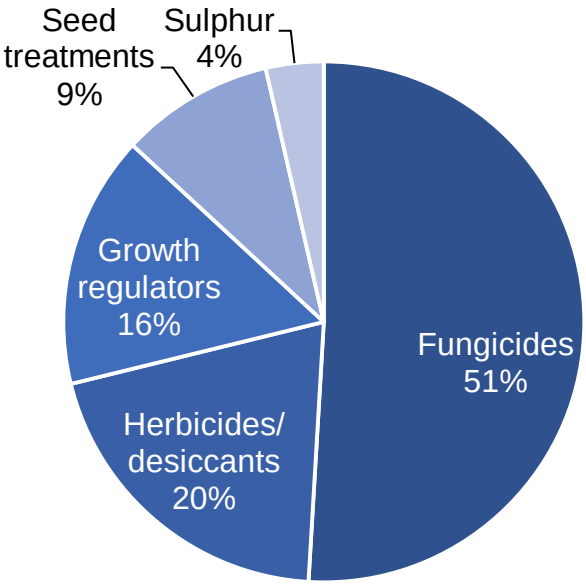
- Ninety-nine per cent of the crop was treated with a pesticide (see Figure 14 for types of pesticides used)
- Pesticides were applied to 12,478 treated hectares
- There were 2,890 kilograms of pesticide used in total on the crop (see summary table below)
- The spring wheat crop received on average 3.5 pesticide applications (Table 1). These included 2.7 fungicide applications and 1.4 herbicide/desiccant applications (applied to 92 per cent of the crop area for both groups) and 1.2 applications of growth regulators (applied to 92 per cent)
- The most common variety grown, accounting for 35 per cent of the sample area, was Mulika followed by Faller at 30 per cent
- The average reported yield was 6.9 t/ha

Summary of pesticide use on spring wheat:

Pesticide group	Formulation area treated	Weight of pesticides applied	Percentage of crop treated	Most used formulations
	ha	kg	%	ha
Fungicides	6,356	1,030	92	Tebuconazole (1,035)
Herbicides/ desiccants	2,525	547	92	Florasulam/ halauxifen-methyl (437)
Growth regulators	1,959	581	92	Trinexapac-ethyl (1,140)
Sulphur	448	718	7	[z]
Seed treatments	1,190	15	92	Fludioxonil (989)
All pesticides	**12,478**	**2,890**	**99**	

Note: some shorthand is used in this table: [z] = not applicable.

Figure 14 Use of pesticides on spring wheat (percentage of total area treated with formulations) – 2022



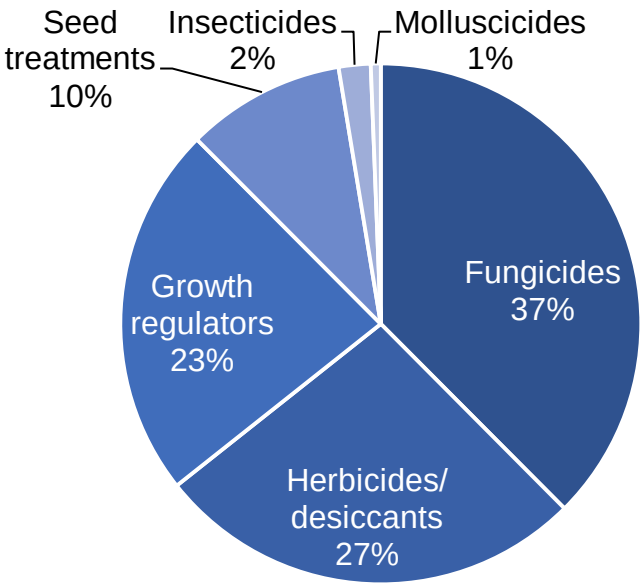
Winter oats

- An estimated 8,436 hectares of winter oats were gown in Scotland in 2022 (based on SAF 2022 – see changes from previous years section for further explanation), an increase of six per cent since 2020
- Ninety-eight per cent of the crop was treated with a pesticide (see Figure 15 for types of pesticides used)
- Pesticides were applied to 73,503 treated hectares
- There were 14,947 kilograms of pesticide applied in total (see summary table)
- Winter oats received on average 4.2 pesticide sprays (Table 1). These sprays included 2.5 fungicide applications and 2.3 herbicide/desiccant applications (applied to 96 per cent and 91 per cent of the crop area respectively), 1.5 applications of growth regulators (applied to 93 per cent) and one application of insecticides (applied to 17 per cent of the crop area)
- The most common variety encountered was Dalguise accounting for 51 per cent of the sample area followed by Gerald at 22 per cent
- The average reported yield was 7.9 t/ha

Summary of pesticide use on winter oats:

Pesticide group	**Formulation area treated**	**Weight of pesticides applied**	**Percentage of crop treated**	**Most used formulations**
	ha	kg	%	ha
Fungicides	27,591	2,887	96	Prothioconazole (10,097)
Herbicides/ desiccants	19,695	4,598	91	Diflufenican/flufenacet (5,670)
Insecticides	1,456	6	17	Lambda-cyhalothrin (1,456)
Growth regulators	17,048	7,341	93	Chlormequat (7,194)
Molluscicides	454	53	5	Ferric phosphate (454)
Seed treatments	7,259	62	86	Fludioxonil (6,204)
All pesticides	**73,503**	**14,947**	**98**	

Figure 15 Use of pesticides on winter oats (percentage of total area treated with formulations) – 2022



Spring oats

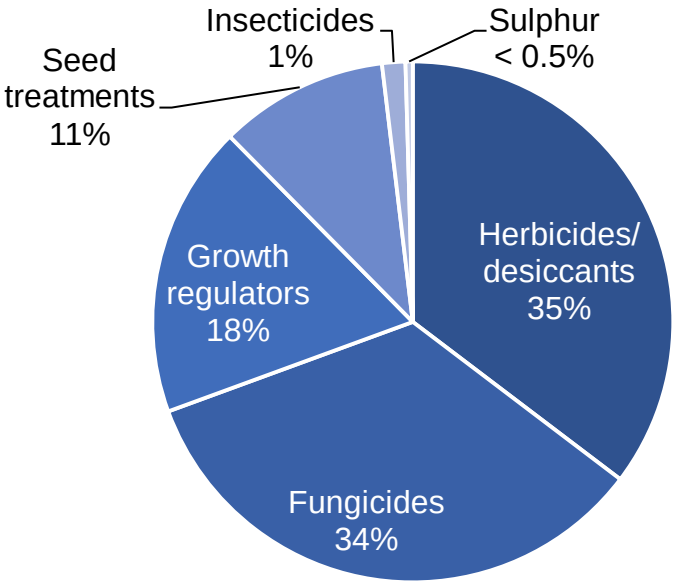
- An estimated 18,713 hectares of spring oats were grown in Scotland in 2022 (based on SAF 2022 – see changes from previous years section for further explanation), a decrease of 28 per cent since 2020
- Eighty-three per cent of the crop was treated with a pesticide (see Figure 16 for types of pesticides used)
- Pesticides were applied to 97,932 treated hectares
- There were 23,698 kilograms of pesticide applied in total (see summary table)
- Spring oats received on average 2.7 pesticide sprays (Table 1). These sprays included 1.8 fungicide applications and 1.5 herbicide/desiccant applications (applied to 78 per cent and 76 per cent of the crop area respectively) and 1.2 applications of growth regulators (applied to 71 per cent)
- The most common variety encountered was Canyon, accounting for 41 per cent of the sample area followed by Conway at 23 per cent
- The average reported yield was 6.4 t/ha

Summary of pesticide use on spring oats:

Pesticide group	Formulation area treated	Weight of pesticides applied	Percentage of crop treated	Most used formulations
	ha	kg	%	ha
Fungicides	33,383	5,153	78	Prothioconazole/ spiroxamine (5,551)
Herbicides/ desiccants	34,597	8,292	76	Fluroxypyr (8,381)
Insecticides	1,416	7	8	Lambda-cyhalothrin (1,416)
Growth regulators	17,815	9,095	71	Chlormequat (8,180)
Sulphur	440	1,038	2	[z]
Seed treatments	10,280	114	55	Fludioxonil (8,192)
All pesticides	**97,932**	**23,698**	**83**	

Note: some shorthand is used in this table: [z] = not applicable.

Figure 16 Use of pesticides on spring oats (percentage of total area treated with formulations) – 2022



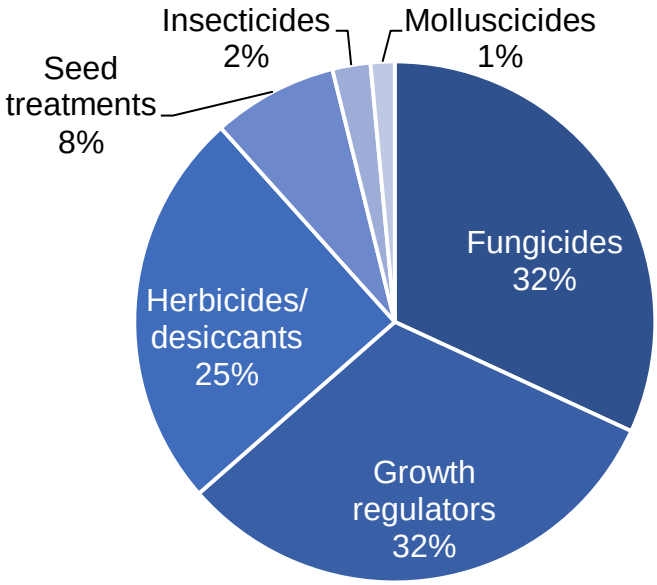
Winter rye

- An estimated 7,174 hectares of winter rye were gown in Scotland in 2022 (based on SAF 2022 – see changes from previous years section for further explanation), an increase of 40 per cent since 2020
- Ninety-six per cent of the crop was treated with a pesticide (see Figure 17 for types of pesticides used)
- Pesticides were applied to 52,441 treated hectares
- There were 15,342 kilograms of pesticide applied in total (see summary table)
- Winter rye received on average 3.2 pesticide sprays (Table 1). These sprays included 2.2 fungicide applications and 1.3 herbicide/desiccant applications (applied to 84 per cent and 90 per cent of the crop area respectively), 1.6 applications of growth regulators (applied to 96 per cent) and one application of both molluscicides and insecticides (applied to 11 per cent and 17 per cent of crop area respectively)
- The most common variety encountered was KWS Tayo accounting for 43 per cent of the sample area followed by SU Performer at 32 per cent

Summary of pesticide use on winter rye:

Pesticide group	**Formulation area treated**	**Weight of pesticides applied**	**Percentage of crop treated**	**Most used formulations**
	ha	kg	%	ha
Fungicides	16,722	3,202	84	Prothioconazole/ spiroxamine (2,763)
Herbicides/ desiccants	13,014	4,488	90	Pendimethalin/ picolinafen (3,273)
Insecticides	1,238	6	17	Lambda-cyhalothrin (1,238)
Growth regulators	16,604	7,528	96	Chlormequat (7,676)
Molluscicides	785	71	11	Metaldehyde (785)
Seed treatments	4,078	46	57	Fludioxonil/ fluxapyroxad/ triticonazole (2,515)
All pesticides	**52,441**	**15,342**	**96**	

Figure 17 Use of pesticides on winter rye (percentage of total area treated with formulations) – 2022



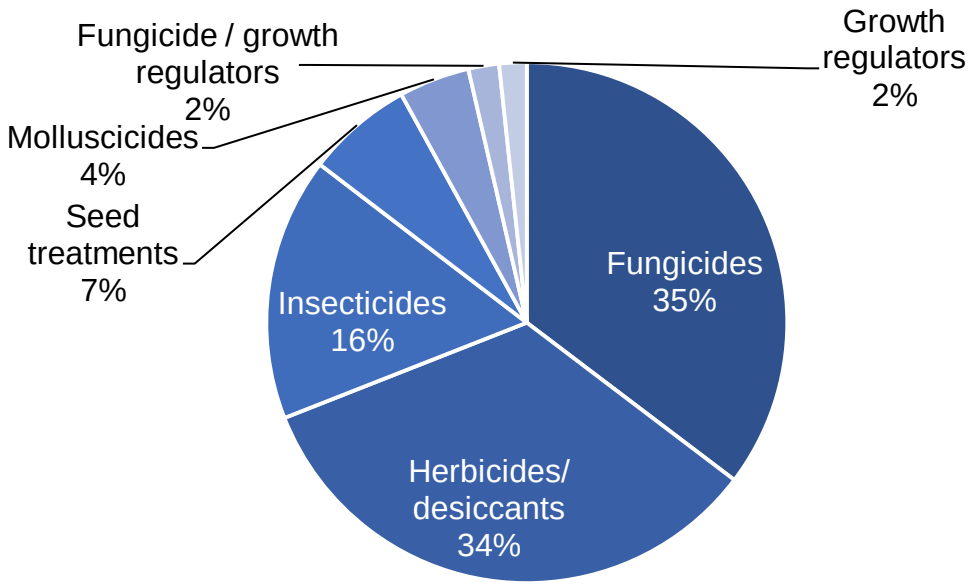
Oilseeds

- An estimated 35,431 hectares of oilseeds (linseed, winter and spring oilseed rape) were grown in Scotland in 2022 (based on SAF 2022 – see changes from previous years section for further explanation), representing an increase of 15 per cent since 2020
- One hundred per cent of the crop was treated with a pesticide (see Figure 18 for types of pesticides used)
- Pesticides were applied to 329,148 treated hectares
- There were 93,710 kilograms of pesticide used in total on the crop (see summary table)
- The oilseeds crop received on average 6.1 pesticide applications (Table 1). These included 2.7 fungicide applications and three herbicide/desiccant applications (applied to 98 and 94 per cent of the crop area respectively), one application of growth regulators (applied to 16 per cent), 1.2 molluscicide applications (applied to 34 per cent), 1.9 insecticides applications (applied to 80 per cent) and one application of a combined fungicide & growth regulator formulation applied to 15 per cent of the crop area
- Crome was the most common variety, accounting for 22 per cent of the sample area, followed by Aurelia at 16 per cent (both winter oilseed rape)
- The oilseeds average reported yield was 4.5 t/ha

Summary of pesticide use on oilseeds:

Pesticide group	Formulation area treated	Weight of pesticides applied	Percentage of crop treated	Most used formulations
	ha	kg	%	ha
Fungicides	116,260	18,997	98	Prothioconazole/ tebuconazole (27,681)
Fungicide/ growth regulators	6,275	1,894	15	Mepiquat chloride/ prohexadione-calcium/ pyraclostrobin (6,275)
Growth regulators	5,599	1,082	16	Mepiquat chloride/ metconazole (5,599)
Herbicides/ desiccants	110,972	69,398	94	Glyphosate (27,441)
Insecticides	53,831	854	80	Lambda-cyhalothrin (36,814)
Molluscicides	14,459	1,478	34	Ferric phosphate (13,684)
Seed treatments	21,752	7	61	*Bacillus amyloliquefaciens* strain MBI600 (21,752)
All pesticides	**329,148**	**93,710**	**100**	

Figure 18 Use of pesticides on oilseeds (percentage of total area treated with formulations) – 2022



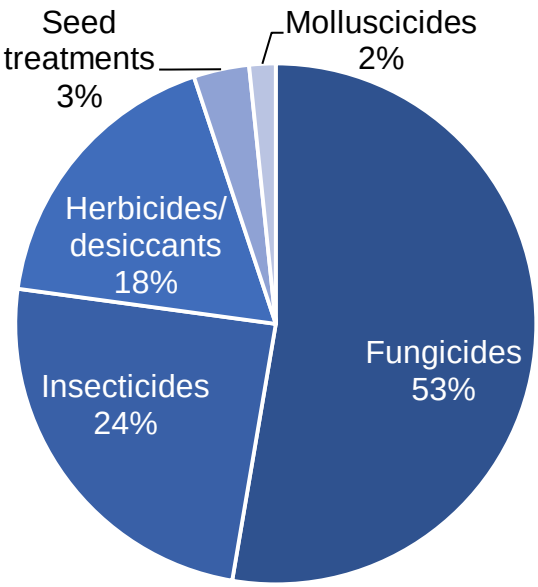
Seed potatoes

- An estimated 11,893 hectares of seed potatoes were grown in Scotland in 2022, (based on SAF 2022 – see changes from previous years section for further explanation) representing a decrease of one per cent since 2020
- One hundred per cent of the crop was treated with a pesticide (see Figure 19 for types of pesticide used)
- Pesticides were applied to 270,532 treated hectares
- There were 86,049 kilograms of pesticide used in total on the crop (see summary table below)
- The seed potato crop received on average 10.2 pesticide applications (Table 1). These included 8.2 fungicide applications and 2.2 herbicide/desiccant applications (applied to 100 per cent of the crop area), 5.4 and 1.9 applications of insecticide and molluscicide respectively (applied to 97 and 20 per cent of the area respectively)
- Maris Piper was the most common variety, accounting for 24 per cent of the sample area, followed by Innovator at seven per cent
- The average reported yield was 38.4 t/ha

Summary of pesticide use on seed potatoes:

Pesticide group	Formulation area treated	Weight of pesticides applied	Percentage of crop treated	Most used formulations
	ha	kg	%	ha
Fungicides	142,512	61,688	100	Mancozeb (25,119)
Herbicides/ desiccants	48,027	20,523	100	Carfentrazone-ethyl (13,273)
Insecticides	66,219	1,341	97	Lambda-cyhalothrin (27,997)
Molluscicides	4,444	456	20	Ferric phosphate (4,444)
Seed treatments	9,330	2,040	75	Flutolanil (4,538)
All pesticides	**270,532**	**86,049**	**100**	

Figure 19 Use of pesticides on seed potatoes (percentage of total area treated with formulations) – 2022



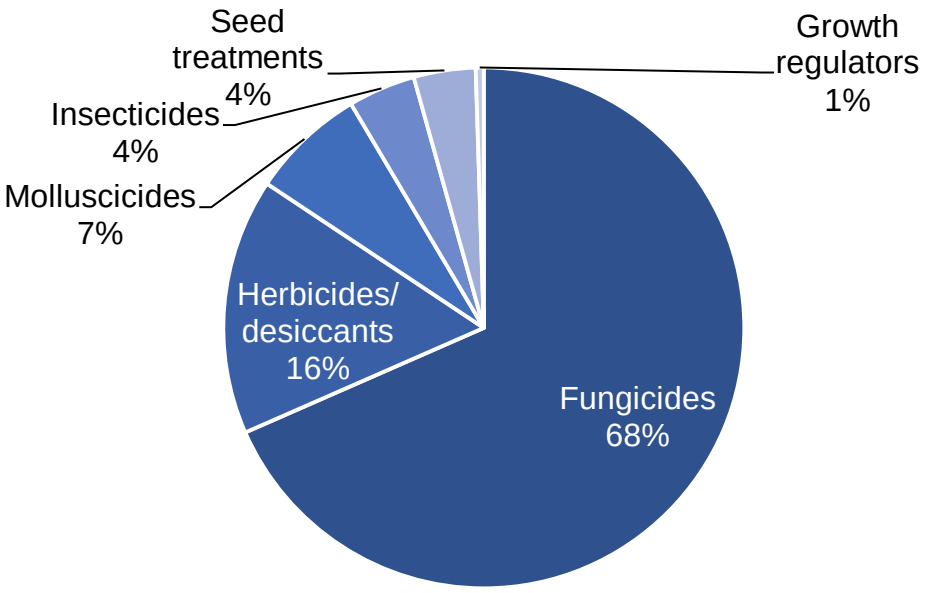
Ware potatoes

- An estimated 15,247 hectares of ware potatoes were grown in Scotland in 2022 (based on SAF 2022 – see changes from previous years section for further explanation), representing a decrease of six per cent since 2020
- Ninety-nine per cent of the crop was treated with a pesticide (see Figure 20 for types of pesticide used)
- Pesticides were applied to 376,918 treated hectares with 165,412 kilograms of pesticide applied in total (see summary table below)
- The ware potato crop received on average 13.7 pesticide applications (Table 1). These included 10.3 fungicide applications and 2.2 herbicide/desiccant applications (applied to 99 per cent of the crop area), insecticides and molluscicides received 2.1 and three applications each (applied to 46 per cent and 60 per cent respectively) and one application of growth regulators (applied to 12 per cent of the crop area)
- Maris Piper was the most common variety grown for ware, accounting for 42 per cent of the sample area followed by Saxon at nine per cent
- The average reported yield was 50.7 t/ha

Summary of pesticide use on ware potatoes:

Pesticide group	Formulation area treated	Weight of pesticides applied	Percentage of crop treated	Most used formulations
	ha	kg	%	ha
Fungicides	257,901	127,632	99	Mancozeb (56,750)
Herbicides/ desiccants	60,007	25,073	99	Pyraflufen-ethyl (18,062)
Insecticides	15,757	2,577	46	Esfenvalerate (5,845)
Growth regulators	1,869	5,606	12	Maleic hydrazide (1,869)
Molluscicides	26,909	2,826	60	Ferric phosphate (26,909)
Seed treatments	14,475	1,699	89	Fludioxonil (6,118)
All pesticides	**376,918**	**165,412**	**99**	

Figure 20 Use of pesticides on ware potatoes (percentage of total area treated with formulations) – 2022



Legumes

The legumes category includes dry harvest peas and field beans. These crops have been combined as too few holdings were encountered to report the pesticide use for each crop separately.

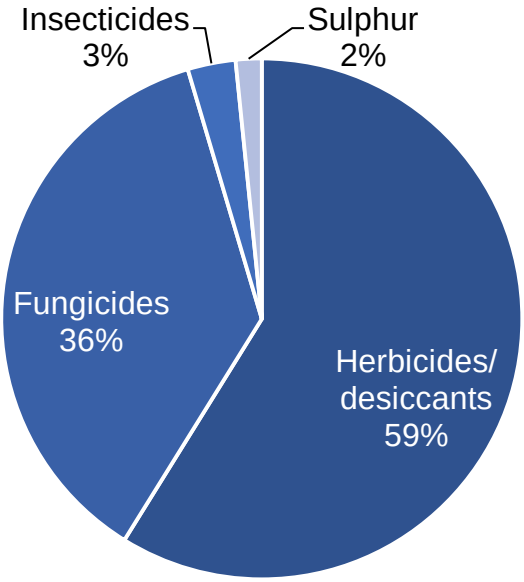
- An estimated 3,025 hectares of legumes were grown in Scotland in 2022 (based on SAF 2022 – see changes from previous years section for further explanation), representing an increase of 23 per cent since 2020
- Ninety-one per cent of the crop was treated with a pesticide (see Figure 21 for types of pesticide used)
- Pesticides were applied to 12,412 treated hectares
- There were 7,540 kilograms of pesticide used in total on the crop (see summary table below)
- The legume crop received on average 3.5 pesticide applications (Table 1). These included 1.5 fungicide applications and 2.1 herbicide/desiccant applications (applied to 84 and 88 per cent of the crop area respectively) and one application of insecticides to 12 per cent of the crop area
- The most common variety, accounting for 51 per cent of the sample area, was Fuego followed by Yukon at 13 per cent (both field beans)
- The average reported yield was 3.9 t/ha

Summary of pesticide use on legumes:

Pesticide group	**Formulation area treated**	**Weight of pesticides applied**	**Percentage of crop treated**	**Most used formulations**
	ha	kg	%	ha
Fungicides	4,538	708	84	Azoxystrobin (1,330)
Herbicides/ desiccants	7,304	6,050	88	Glyphosate (1,847)
Insecticides	369	3	12	Lambda-cyhalothrin (324)
Sulphur	200	780	3	[z]
All pesticides	**12,412**	**7,540**	**91**	

Note: some shorthand is used in this table: [z] = not applicable.

Figure 21 Use of pesticides on legumes (percentage of total area treated with formulations) – 2022



Appendix 1 – Estimated application tables

Table 1 Percentage of each crop treated with pesticides and mean number of spray applications – 2022

Crop	Fungicides		Herbicides[1]		Insecticides[2]		Molluscicide		Sulphur		Growth regulators		Any pesticide exc. STs		STs	Any pesticide inc. STs
	%	spray apps	%	spray apps	%	spray apps	%	spray apps	%	spray apps	%	spray apps	%	spray apps	%	%
Winter barley	97	2.5	89	2.1	22	1.0	2	1.0	2	1.0	87	1.8	97	4.0	87	97
Spring barley	93	1.8	93	1.5	3	1.0	0	0.0	2	1.0	42	1.4	95	2.5	83	97
Winter wheat	95	3.5	94	2.3	23	1.0	11	1.2	5	1.2	93	2.0	96	5.1	91	98
Spring wheat	92	2.7	92	1.4	0	0.0	0	0.0	7	5.0	92	1.2	99	3.5	92	99
Winter oats	96	2.5	91	2.3	17	1.0	5	1.0	0	0.0	93	1.5	96	4.2	86	98
Spring oats	78	1.8	76	1.5	8	1.0	0	0.0	2	1.2	71	1.2	81	2.7	55	83
Winter rye	84	2.2	90	1.3	17	1.0	11	1.0	0	0.0	96	1.6	96	3.2	57	96
Oilseeds[3]	98	2.7	94	3.0	80	1.9	34	1.2	0	0.0	16	1.0	100	6.1	61	100
Seed potatoes	100	8.2	100	2.2	97	5.4	20	1.9	0	0.0	0	0.0	100	10.2	75	100
Ware potatoes	99	10.3	99	2.2	46	2.1	60	3.0	0	0.0	12	1.0	99	13.7	89	99
Legumes[4]	84	1.5	88	2.1	12	1.0	0	0.0	3	2.0	0	0.0	91	3.5	0	91
Total arable crops[5]	**94**	**2.8**	**93**	**1.9**	**19**	**1.9**	**8**	**1.7**	**2**	**1.1**	**56**	**1.7**	**96**	**4.1**	**82**	**97**

(1) Includes desiccants.
(2) Includes nematicides.
(3) Includes linseed, spring and winter oilseed rape.
(4) Includes field beans and dry harvest peas.
(5) Includes triticale.
Note: STs = seed treatments.
The average number of spray applications is calculated only on the areas receiving each pesticide group and therefore the minimum number of applications is always one (see Appendix 3 – definitions and notes for details).

Table 2 Cereal seed treatment formulations – 2022

Area (ha), weight (kg) and percentage of crop treated

Seed treatments	Winter barley		Spring barley		Winter wheat		Spring wheat		Winter oats		Spring oats		Total 2022[1]		Total 2020[2,3]	
	ha	%	ha	%	ha	%	ha	%	ha	%	ha	%	**ha**	**kg**	ha	kg
Cypermethrin	0	0	0	0	336	<0.5	0	0	0	0	0	0	**336**	**42**	1,625	202
Difenoconazole/ fludioxonil/ tebuconazole	2,097	5	0	0	0	0	0	0	0	0	0	0	**2,097**	**49**	0	0
Fludioxonil	3,515	8	10,524	4	51,891	49	989	77	6,204	74	8,192	44	**82,354**	**817**	77,725	774
Fludioxonil/ fluxapyroxad/ triticonazole	665	2	0	0	2,318	2	0	0	0	0	0	0	**5,498**	**126**	0	0
Fludioxonil/ sedaxane	0	0	638	<0.5	15,477	15	0	0	0	0	684	4	**16,799**	**324**	9,155	181
Fluopyram/ prothioconazole/ tebuconazole	15,929	36	0	0	0	0	0	0	0	0	0	0	**15,929**	**285**	10,955	201
Imazalil/ ipconazole	10,172	23	88,800	38	4,799	5	0	0	0	0	0	0	**103,771**	**1,457**	46,853	636
Ipconazole	0	0	2,819	1	0	0	0	0	0	0	0	0	**2,819**	**12**	0	0
Prothioconazole	457	1	9,296	4	2,977	3	0	0	259	3	0	0	**13,175**	**261**	23,909	463
Prothioconazole/ tebuconazole	5,542	13	81,398	34	17,044	16	201	16	0	0	1,404	8	**106,113**	**2,426**	188,094	4,257
Silthiofam	0	0	0	0	5,610	5	0	0	0	0	0	0	**5,610**	**288**	6,381	330
Unspecified seed treatment[4]	134	<0.5	3,154	1	1,741	2	0	0	796	9	0	0	**5,826**	**[z]**	34,397	[z]

Cont…

Table 2 Cereals seed treatment formulations – 2022 continued

Area (ha), weight (kg) and percentage of crop treated

Seed treatments	Winter barley		Spring barley		Winter wheat		Spring wheat		Winter oats		Spring oats		Total 2022[1]		Total 2020[2,3]	
	ha	%	ha	%	ha	%	ha	%	ha	%	ha	%	**ha**	**kg**	ha	kg
All seed treatments	**38,510**	**87**	**196,629**	**83**	**102,194**	**91**	**1,190**	**92**	**7,259**	**86**	**10,280**	**55**	**360,327**	**6,088**	**402,746**	**7,091**
No information seed treatment[4]	1,961	4	3,218	1	3,883	4	0	0	193	2	7	<0.5	**10,282**	**[z]**	12,631	[z]
No seed treatment	3,702	8	35,966	15	5,820	5	101	8	984	12	8,425	45	**57,234**	**[z]**	23,857	[z]
Area grown	44,173		235,813		105,827		1,291		8,436		18,713		**421,772**		434,443	

(1) Includes winter rye and triticale.
(2) Includes winter rye. Winter rye data is available in excel format in the published supporting document.
(3) For full list of formulations recorded in 2020 please refer to the 2020 report[3].
(4) Refer to Appendix 3 for definitions.
Note: some shorthand is used in this table: [z] = not applicable.

Table 3 Cereal insecticide and molluscicide formulations - 2022

Area (ha), weight (kg) and percentage of crop treated

Insecticides	**Winter barley**		**Spring barley**		**Winter wheat**		**Spring wheat**		**Winter oats**		**Spring oats**		**Total 2022[1]**		**Total 2020[2,3]**	
	ha	%	ha	%	ha	%	ha	%	ha	%	ha	%	**ha**	**kg**	ha	kg
Esfenvalerate	5,898	13	0	0	9,404	9	0	0	0	0	0	0	**15,303**	**63**	8,502	33
Flonicamid	0	0	0	0	800	1	0	0	0	0	0	0	**800**	**34**	0	0
Lambda-cyhalothrin	4,013	9	7,162	3	14,929	14	0	0	1,456	17	1,416	8	**30,214**	**148**	51,871	240
All insecticides	**9,911**	**22**	**7,162**	**3**	**25,133**	**23**	**0**	**0**	**1,456**	**17**	**1,416**	**8**	**46,316**	**245**	**63,269**	**291**
Molluscicides																
Ferric phosphate	561	1	0	0	13,399	10	0	0	454	5	0	0	**14,415**	**1,488**	16,631	1,814
Metaldehyde	297	1	0	0	866	1	0	0	0	0	0	0	**1,948**	**193**	5,977	327
All molluscicides	**858**	**2**	**0**	**0**	**14,265**	**11**	**0**	**0**	**454**	**5**	**0**	**0**	**16,363**	**1,680**	**22,608**	**2,141**
Area grown	44,173		235,813		105,827		1,291		8,436		18,713		**421,772**		434,443	

(1) Includes winter rye and triticale.
(2) Includes winter rye. Winter rye data is available in excel format in the published supporting document.
(3) For full list of formulations recorded in 2020 please refer to the 2020 report[3].

Table 4 Cereal fungicide and sulphur formulations - 2022

Area (ha), weight (kg) and percentage of crop treated

Fungicides	Winter barley		Spring barley		Winter wheat		Spring wheat		Winter oats		Spring oats		Total 2022[1]		Total 2020[2,3]	
	ha	%	ha	%	ha	%	ha	%	ha	%	ha	%	**ha**	**kg**	ha	kg
Azoxystrobin	202	<0.5	4,178	2	7,669	7	817	39	1,270	15	319	2	**15,209**	**1,709**	15,478	1,466
Azoxystrobin/ cyproconazole	0	0	0	0	4,523	4	0	0	0	0	0	0	**4,523**	**614**	5,755	840
Benzovindiflupyr	2,398	5	15,059	6	7,306	7	135	10	0	0	0	0	**26,567**	**1,271**	14,112	718
Benzovindiflupyr/ prothioconazole	3,853	9	8,089	3	542	1	201	16	0	0	1,426	8	**14,132**	**1,890**	6,045	709
Bixafen	836	2	2,473	1	1,360	1	0	0	0	0	0	0	**4,668**	**160**	41,196	1,062
Bixafen/ fluopyram	896	2	3,190	1	1,184	1	0	0	0	0	0	0	**5,269**	**536**	185	26
Bixafen/ fluopyram/ prothioconazole	5,225	12	4,526	2	5,012	4	617	24	428	5	241	1	**16,049**	**3,062**	4,974	1,455
Bixafen/ fluoxastrobin/ prothioconazole	0	0	0	0	787	1	0	0	0	0	0	0	**787**	**166**	11,888	2,810
Bixafen/ prothioconazole	5,079	7	13,771	5	141	<0.5	101	4	428	5	1,211	6	**20,731**	**2,338**	34,832	3,946
Bixafen/ prothioconazole/ spiroxamine	11,026	22	31,285	12	19,245	18	135	10	1,699	19	4,436	24	**70,215**	**24,191**	45,675	17,217
Bixafen/ prothioconazole/ tebuconazole	0	0	0	0	1,967	2	0	0	0	0	0	0	**1,967**	**525**	5,882	1,553
Boscalid	0	0	0	0	19,544	18	0	0	0	0	0	0	**19,544**	**3,910**	0	0

Cont…

Table 4 Cereal fungicide and sulphur formulations – 2022 continued

Area (ha), weight (kg) and percentage of crop treated

Fungicides	Winter barley		Spring barley		Winter wheat		Spring wheat		Winter oats		Spring oats		Total 2022[1]		Total 2020[2,3]	
	ha	%	ha	%	ha	%	ha	%	ha	%	ha	%	**ha**	**kg**	ha	kg
Bromuconazole/ tebuconazole	0	0	0	0	11,172	11	0	0	0	0	0	0	**11,499**	**2,120**	7,125	1,751
Cyflufenamid	4,981	10	5,627	2	12,220	10	295	23	6,492	76	2,359	12	**32,565**	**300**	34,845	292
Cyprodinil	7,859	17	8,440	4	0	0	0	0	0	0	0	0	**16,298**	**3,898**	26,936	5,603
Fenpicoxamid	0	0	0	0	13,375	13	0	0	0	0	0	0	**13,375**	**871**	0	0
Fenpicoxamid/ Prothioconazole	0	0	0	0	25,308	24	0	0	0	0	0	0	**25,752**	**4,240**	0	0
Fluoxastrobin/ prothioconazole	0	0	465	<0.5	8,823	8	402	16	0	0	282	2	**9,973**	**1,494**	11,026	1,614
Fluoxastrobin/ prothioconazole/ trifloxystrobin	6,918	11	47,045	14	196	<0.5	0	0	0	0	0	0	**54,159**	**6,776**	67,861	8,605
Fluxapyroxad	5,110	11	26,284	10	28,927	22	0	0	0	0	549	3	**60,870**	**2,029**	62,675	2,439
Fluxapyroxad/ mefentrifluconazole	4,949	10	34,907	15	45,251	35	0	0	85	1	1,006	5	**86,305**	**10,226**	28,482	3,311
Fluxapyroxad/ metconazole	0	0	2,543	1	2,119	2	0	0	0	0	0	0	**4,662**	**369**	1,150	121
Fluxapyroxad/ pyraclostrobin	9,205	16	20,279	8	25,468	16	372	18	0	0	234	1	**56,205**	**6,898**	33,858	4,994
Folpet	45,476	70	201,091	74	155,068	73	671	42	0	0	0	0	**402,305**	**201,293**	237,775	111,591
Laminarin	0	0	0	0	6,723	6	0	0	0	0	0	0	**6,723**	**179**	0	0
Mancozeb	0	0	0	0	21,270	15	0	0	0	0	0	0	**21,270**	**20,765**	18,602	15,175
Mefentrifluconazole	2,722	5	8,740	4	33,647	24	0	0	0	0	0	0	**45,108**	**3,836**	21,300	1,636

Cont…

Table 4 Cereal fungicide and sulphur formulations – 2022 continued

Area (ha), weight (kg) and percentage of crop treated

Fungicides	Winter barley		Spring barley		Winter wheat		Spring wheat		Winter oats		Spring oats		Total 2022[1]		Total 2020[2,3]	
	ha	%	ha	%	ha	%	ha	%	ha	%	ha	%	**ha**	**kg**	ha	kg
Mefentrifluconazole/ pyraclostrobin	227	1	585	<0.5	27,395	22	0	0	0	0	0	0	**28,208**	**5,122**	0	0
Metconazole	0	0	908	<0.5	2,752	3	0	0	0	0	0	0	**3,660**	**219**	1,956	106
Metrafenone	0	0	0	0	0	0	0	0	636	8	446	2	**1,083**	**61**	300	19
Prochloraz	0	0	0	0	2,188	2	0	0	0	0	0	0	**2,188**	**545**	0	0
Prochloraz/ tebuconazole	0	0	0	0	5,883	6	0	0	0	0	0	0	**5,883**	**1,928**	11,401	4,377
Proquinazid	2,559	6	1,085	<0.5	7,105	6	676	28	492	6	4,595	19	**17,900**	**476**	13,446	363
Prothioconazole	16,363	27	65,276	24	45,467	37	337	26	10,097	73	5,396	19	**143,292**	**13,303**	86,392	8,201
Prothioconazole/ spiroxamine	14,442	27	41,644	15	17,720	14	194	15	1,600	17	5,551	30	**84,101**	**21,015**	75,448	16,439
Prothioconazole/ spiroxamine/ tebuconazole	1,965	4	3,683	2	1,799	2	0	0	0	0	1,037	4	**8,484**	**2,048**	4,645	781
Prothioconazole/ tebuconazole	6,936	15	65,028	25	46,213	40	251	19	947	11	1,449	8	**122,396**	**17,265**	125,925	15,894
Prothioconazole/ trifloxystrobin	6,144	11	32,991	13	4,768	5	0	0	0	0	0	0	**44,364**	**5,581**	94,890	11,553
Pyraclostrobin	1,020	2	3,538	2	9,757	8	118	5	576	7	1,089	4	**17,352**	**1,509**	3,016	245

Cont…

Table 4 Cereal fungicide and sulphur formulations – 2022 continued

Area (ha), weight (kg) and percentage of crop treated

Fungicides	Winter barley		Spring barley		Winter wheat		Spring wheat		Winter oats		Spring oats		Total 2022[1]		Total 2020[2,3]	
	ha	%	ha	%	ha	%	ha	%	ha	%	ha	%	**ha**	**kg**	ha	kg
Tebuconazole	2,925	5	2,245	1	72,629	47	1,035	52	2,840	27	1,758	7	**85,746**	**12,295**	49,627	6,727
Trifloxystrobin	4,808	10	22,991	8	460	<0.5	0	0	0	0	0	0	**28,259**	**1,801**	27,151	1,697
All fungicides	**174,124**	**97**	**677,963**	**93**	**702,982**	**95**	**6,356**	**92**	**27,591**	**96**	**33,383**	**78**	**1,639,648**	**388,834**	**1,619,439**	**390,727**
Sulphur	**846**	**2**	**5,825**	**2**	**5,847**	**5**	**448**	**7**	**0**	**0**	**440**	**2**	**13,407**	**21,053**	**9,135**	**38,254**
Area grown	44,173		235,813		105,827		1,291		8,436		18,713		**421,772**		434,443	

(1) Includes winter rye and triticale.
(2) Includes winter rye. Winter rye data is available in excel format in the published supporting document.
(3) For full list of formulations recorded in 2020 please refer to the 2020 report[3].

Table 5 Cereal herbicide/desiccant and growth regulator formulations – 2022

Area (ha), weight (kg) and percentage of crop treated

Herbicides/ desiccants	Winter barley		Spring barley		Winter wheat		Spring wheat		Winter oats		Spring oats		Total 2022[1]		Total 2020[2,3]	
	ha	%	ha	%	ha	%	ha	%	ha	%	ha	%	**ha**	**kg**	ha	kg
2,4-D/MCPA	0	0	284	<0.5	0	0	0	0	0	0	0	0	**284**	**192**	2,365	3,991
Amidosulfuron	0	0	855	<0.5	0	0	0	0	0	0	0	0	**855**	**26**	0	0
Amidosulfuron/ iodosulfuron-methyl-sodium	175	<0.5	0	0	385	<0.5	0	0	0	0	0	0	**561**	**9**	4,441	100
Amidosulfuron/ iodosulfuron-methyl-sodium/ mesosulfuron-methyl	0	0	0	0	3,959	4	0	0	0	0	0	0	**3,959**	**136**	411	15
Chlorotoluron/ diflufenican/ pendimethalin	3,479	8	5,298	2	8,040	8	135	10	0	0	0	0	**16,951**	**19,067**	16,943	18,913
Clodinafop-propargyl	0	0	0	0	19,310	16	194	15	0	0	0	0	**19,848**	**534**	6,714	181
Clopyralid	0	0	1,016	<0.5	0	0	0	0	129	2	0	0	**1,284**	**84**	1,764	123
Clopyralid/ florasulam/ fluroxypyr	1,587	4	3,040	1	4,103	3	201	16	0	0	387	2	**9,318**	**1,527**	9,216	1,378
Dicamba/ mecoprop-p	0	0	16,950	7	0	0	0	0	0	0	387	2	**17,337**	**8,467**	26,849	13,510
Dichlorprop-p/ MCPA/ mecoprop-p	0	0	1,351	1	510	<0.5	201	16	0	0	0	0	**2,062**	**1,816**	2,620	1,834

Cont…

Table 5 Cereal herbicide/desiccant and growth regulator formulations – 2022 continued

Area (ha), weight (kg) and percentage of crop treated

Herbicides/ desiccants	Winter barley		Spring barley		Winter wheat		Spring wheat		Winter oats		Spring oats		Total 2022[1]		Total 2020[2,3]	
	ha	%	ha	%	ha	%	ha	%	ha	%	ha	%	**ha**	**kg**	ha	kg
Diflufenican	8,970	20	23,486	10	26,739	25	59	5	638	8	2,254	12	**64,191**	**3,818**	65,158	4,277
Diflufenican/ florasulam	703	2	0	0	2,029	2	0	0	0	0	0	0	**2,732**	**90**	1,810	62
Diflufenican/ flufenacet	13,027	29	26,343	11	36,009	34	251	19	5,670	67	0	0	**83,900**	**15,821**	78,504	12,822
Diflufenican/ flufenacet/ metribuzin	467	1	0	0	1,937	2	0	0	0	0	0	0	**2,404**	**496**	0	0
Diflufenican/ iodosulfuron-methyl-sodium/ mesosulfuron-methyl	0	0	0	0	6,430	6	0	0	0	0	0	0	**6,430**	**368**	6,514	341
Diflufenican/ metsulfuron-methyl	0	0	0	0	776	1	0	0	0	0	0	0	**776**	**40**	0	0
Diflufenican/ pendimethalin	733	2	0	0	0	0	0	0	0	0	0	0	**733**	**520**	1,453	1,099
Fenoxaprop-p-ethyl	1,234	3	11,568	5	1,136	1	0	0	0	0	0	0	**13,938**	**725**	11,930	665
Florasulam	1,133	3	376	<0.5	2,521	2	0	0	227	3	0	0	**4,363**	**20**	9,712	35
Florasulam/ fluroxypyr	537	1	6,010	3	5,625	5	0	0	2,381	28	1,523	8	**16,264**	**1,331**	26,237	1,914

Cont…

Table 5 Cereal herbicide/desiccant and growth regulator formulations – 2022 continued

Area (ha), weight (kg) and percentage of crop treated

Herbicides/ desiccants	Winter barley		Spring barley		Winter wheat		Spring wheat		Winter oats		Spring oats		Total 2022[1]		Total 2020[2,3]	
	ha	%	ha	%	ha	%	ha	%	ha	%	ha	%	**ha**	**kg**	ha	kg
Florasulam/ halauxifen-methyl	6,097	14	35,051	15	21,088	20	437	34	1,590	19	0	0	**64,881**	**431**	36,794	265
Florasulam/ pyroxsulam	0	0	0	0	7,028	7	359	28	0	0	0	0	**7,387**	**158**	3,325	75
Florasulam/ tribenuron-methyl	762	2	16,592	7	1,622	2	0	0	689	8	4,022	21	**23,687**	**380**	5,458	86
Flufenacet	0	0	0	0	753	1	0	0	0	0	0	0	**753**	**171**	4,689	722
Flufenacet/ pendimethalin	362	1	147	<0.5	2,192	2	0	0	0	0	0	0	**2,701**	**1,471**	5,967	5,652
Flufenacet/ picolinafen	8,131	18	809	<0.5	21,732	21	0	0	0	0	0	0	**33,563**	**6,175**	19,100	3,348
Fluroxypyr	5,354	12	65,328	27	18,503	17	135	10	953	11	8,381	42	**98,840**	**12,534**	90,898	11,005
Fluroxypyr/ halauxifen-methyl	2,275	5	53,194	23	5,248	4	0	0	0	0	0	0	**60,716**	**6,319**	69,057	6,318
Fluroxypyr/ mesosulfuron-methyl/ thifensulfuron-methyl	731	2	0	0	0	0	0	0	0	0	0	0	**731**	**104**	0	0
Fluroxypyr/ metsulfuron-methyl	1,099	2	3,754	2	2,640	2	0	0	0	0	0	0	**7,493**	**753**	5,414	510
Glyphosate	20,101	45	41,151	17	23,757	20	0	0	2,949	35	4,002	18	**92,476**	**66,457**	161,783	127,410

Cont…

Table 5 Cereal herbicide/desiccant and growth regulator formulations – 2022 continued

Area (ha), weight (kg) and percentage of crop treated

Herbicides/ desiccants	Winter barley		Spring barley		Winter wheat		Spring wheat		Winter oats		Spring oats		Total 2022[1]		Total 2020[2,3]	
	ha	%	ha	%	ha	%	ha	%	ha	%	ha	%	**ha**	**kg**	ha	kg
Iodosulfuron-methyl-sodium/ mesosulfuron-methyl	0	0	0	0	9,980	9	0	0	0	0	0	0	**9,980**	**106**	13,934	149
Iodosulfuron-methyl-sodium/mesosulfuron-methyl/ thiencarbazone-methyl	0	0	0	0	75	<0.5	0	0	0	0	0	0	**75**	**2**	0	0
MCPA	302	1	1,538	1	0	0	0	0	0	0	0	0	**1,840**	**733**	5,296	4,992
Mecoprop-p	1,215	3	26,802	11	5,729	5	59	5	1,476	18	4,965	27	**40,245**	**27,180**	76,033	47,658
Mesosulfuron-methyl/ propoxycarbazone-sodium	0	0	0	0	554	1	0	0	0	0	0	0	**554**	**20**	567	19
Metsulfuron-methyl	2,178	5	7,913	3	9,368	9	59	5	814	10	570	3	**20,903**	**94**	16,413	73
Metsulfuron-methyl/ thifensulfuron-methyl	808	2	89,476	37	7,387	7	236	18	0	0	0	0	**97,907**	**2,717**	123,867	3,558

Cont…

Table 5 Cereal herbicide/desiccant and growth regulator formulations – 2022 continued

Area (ha), weight (kg) and percentage of crop treated

Herbicides/ desiccants	Winter barley		Spring barley		Winter wheat		Spring wheat		Winter oats		Spring oats		Total 2022[1]		Total 2020[2,3]	
	ha	%	ha	%	ha	%	ha	%	ha	%	ha	%	**ha**	**kg**	ha	kg
Metsulfuron-methyl/ tribenuron-methyl	5,996	14	24,506	10	10,747	10	0	0	731	9	2,611	14	**45,456**	**336**	51,260	396
Pendimethalin	4,986	11	3,730	2	10,752	10	0	0	0	0	0	0	**19,468**	**15,716**	21,462	16,982
Pendimethalin/ picolinafen	12,359	28	13,374	6	22,886	22	0	0	0	0	0	0	**52,100**	**38,012**	55,902	44,507
Pinoxaden	3,669	8	23,976	10	4,350	4	0	0	0	0	0	0	**31,995**	**1,021**	37,354	1,105
Prosulfocarb	2,736	6	0	0	1,709	2	0	0	0	0	0	0	**4,446**	**7,105**	11,018	13,217
Pyroxsulam	0	0	0	0	744	1	0	0	0	0	0	0	**744**	**14**	2,093	39
Sulfosulfuron	0	0	0	0	953	1	0	0	0	0	0	0	**953**	**19**	108	2
Thifensulfuron-methyl/ tribenuron-methyl	2,164	5	39,148	17	3,467	3	201	16	272	3	5,495	26	**50,933**	**1,133**	77,542	1,830
Tri-allate	250	1	0	0	575	1	0	0	0	0	0	0	**825**	**1,337**	484	481
Tribenuron-methyl	1,496	3	2,750	1	4,525	4	0	0	1,177	14	0	0	**9,948**	**56**	11,340	74
All herbicides/ desiccants	**115,115**	**89**	**545,815**	**93**	**317,876**	**94**	**2,525**	**92**	**19,695**	**91**	**34,597**	**76**	**1,049,791**	**245,638**	**1,190,313**	**357,315**

Cont…

Table 5 Cereal herbicide/desiccant and growth regulator formulations – 2022 continued

Area (ha), weight (kg) and percentage of crop treated

Growth regulators	Winter barley		Spring barley		Winter wheat		Spring wheat		Winter oats		Spring oats		Total 2022[1]		Total 2020[2,3]	
	ha	%	ha	%	ha	%	ha	%	ha	%	ha	%	**ha**	**kg**	ha	kg
2-chloroethyl-phosphonic acid	9,785	20	31,839	14	26,102	24	0	0	0	0	0	0	**68,240**	**11,225**	35,921	5,938
2-chloroethyl-phosphonic acid/ chlormequat	5,324	12	5,325	2	6,540	6	0	0	0	0	0	0	**17,190**	**8,103**	16,329	6,041
2-chloroethyl-phosphonic acid/ chlormequat chloride	605	1	0	0	768	1	0	0	0	0	0	0	**1,373**	**684**	2,510	964
2-chloroethyl-phosphonic acid/mepiquat	774	2	120	<0.5	1,811	2	0	0	0	0	0	0	**3,352**	**1,215**	2,644	1,005
2-chloroethyl-phosphonic acid/mepiquat chloride	1,521	3	2,797	1	2,845	3	0	0	0	0	0	0	**7,164**	**2,991**	1,549	508
Chlormequat	35,271	64	23,430	9	111,112	79	820	63	7,194	81	8,180	41	**193,703**	**148,158**	211,357	160,806
Mepiquat chloride/ prohexadione-calcium	5,344	11	16,236	7	8,466	7	0	0	3,445	37	4,240	23	**37,840**	**5,486**	44,470	8,117

Cont…

Table 5 Cereal herbicide/desiccant and growth regulator formulations – 2022 continued

Area (ha), weight (kg) and percentage of crop treated

Growth regulators	Winter barley		Spring barley		Winter wheat		Spring wheat		Winter oats		Spring oats		Total 2022[1]		Total 2020[2,3]	
	ha	%	ha	%	ha	%	ha	%	ha	%	ha	%	**ha**	**kg**	ha	kg
Prohexadione-calcium	316	1	0	0	6,514	6	0	0	0	0	0	0	**7,421**	**256**	5,316	143
Prohexadione-calcium/ trinexapac-ethyl	4,368	10	10,837	5	7,568	5	0	0	0	0	1,067	4	**24,706**	**793**	10,776	359
Trinexapac-ethyl	31,502	56	45,314	19	114,339	76	1,140	88	6,409	70	4,328	21	**209,582**	**7,180**	170,012	5,663
All growth regulators	**94,811**	**87**	**135,898**	**42**	**286,067**	**93**	**1,959**	**92**	**17,048**	**93**	**17,815**	**71**	**570,570**	**186,091**	**501,530**	**189,739**
Area grown	44,173		235,813		105,827		1,291		8,436		18,713		**421,772**		434,443	

(1) Includes winter rye and triticale.
(2) Includes winter rye. Winter rye data is available in excel format in the published supporting document.
(3) For full list of formulations recorded in 2020 please refer to the 2020 report[3].

Table 6 Oilseeds seed treatment formulations - 2022

Area (ha), weight (kg) and percentage of crop treated

Seed treatments	Total 2022[1]			Total 2020[2,3]	
	ha	%	kg	ha	kg
Bacillus amyloliquefaciens strain MBI600	**21,752**	**61**	**7**	7,783	2
All seed treatments	**21,752**	**61**	**7**	**22,944**	**93**
No information seed treatment[4]	**487**	**1**	**[z]**	1,987	[z]
No seed treatment	**13,145**	**37**	**[z]**	5,862	[z]
Area grown	**35,431**			30,793	

(1) Includes linseed, spring and winter oilseed rape.
(2) Includes spring and winter oilseed rape.
(3) For full list of formulations recorded in 2020 please refer to the 2020 report[3].
(4) Refer to Appendix 3 for definitions.
Note: some shorthand is used in this table: [z] = not applicable.

Table 7 Oilseeds insecticide and molluscicide formulations - 2022

Area (ha), weight (kg) and percentage of crop treated

Insecticides	Total 2022[1]			Total 2020[2,3]	
	ha	%	kg	ha	kg
Acetamiprid	**1,540**	**4**	**55**	656	26
Cypermethrin	**208**	**<0.5**	**5**	0	0
Deltamethrin	**2,128**	**6**	**13**	368	3
Indoxacarb	**742**	**2**	**14**	503	12
Lambda-cyhalothrin	**36,814**	**63**	**246**	26,390	182
Tau-fluvalinate	**12,399**	**35**	**522**	11,293	473
All insecticides	**53,831**	**80**	**854**	**41,369**	**801**
Molluscicides					
Ferric phosphate	**13,684**	**34**	**1,395**	14,546	1,754
Metaldehyde	**775**	**2**	**83**	5,434	384
All molluscicides	**14,459**	**34**	**1,478**	**19,980**	**2,138**
Area grown	**35,431**			30,793	

(1) Includes linseed, spring and winter oilseed rape.
(2) Includes spring and winter oilseed rape.
(3) For full list of formulations recorded in 2020 please refer to the 2020 report[3].

Table 8 Oilseeds fungicide and fungicide/growth regulator formulations - 2022

Area (ha), weight (kg) and percentage of crop treated

Fungicides	**Total 2022[1]**			**Total 2020[2,3]**	
	ha	**%**	**kg**	ha	kg
Azoxystrobin	**7,658**	**21**	**1,335**	4,898	701
Azoxystrobin/tebuconazole	**2,363**	**7**	**643**	714	217
Bixafen/prothioconazole	**2,884**	**8**	**506**	137	26
Bixafen/prothioconazole/ tebuconazole	**5,846**	**12**	**1,136**	3,549	985
Boscalid	**5,495**	**16**	**1,008**	4,080	671
Boscalid/dimoxystrobin	**7,119**	**15**	**1,021**	2,886	431
Boscalid/metconazole	**3,766**	**10**	**585**	7,724	1,231
Boscalid/pyraclostrobin	**3,079**	**9**	**894**	0	0
Difenoconazole	**1,605**	**4**	**85**	334	29
Fluopyram/ prothioconazole	**6,804**	**19**	**1,312**	9,073	1,752
Fluoxastrobin/ tebuconazole	**5,522**	**16**	**1,464**	2,259	534
Metconazole	**3,926**	**11**	**146**	3,309	71
Prothioconazole	**24,920**	**49**	**2,863**	24,014	2,711
Prothioconazole/ tebuconazole	**27,681**	**52**	**4,562**	25,499	4,133
Tebuconazole	**7,591**	**17**	**1,438**	6,897	1,090
All fungicides	**116,260**	**98**	**18,997**	**99,321**	**15,344**
Fungicide/growth regulator					
Mepiquat chloride/ prohexadione-calcium/ pyraclostrobin	**6,275**	**15**	**1,894**	0	0
All fungicides/growth regulators	**6,275**	**15**	**1,894**	**0**	**0**
Area grown	**35,431**			30,793	

(1) Includes linseed, spring and winter oilseed rape.
(2) Includes spring and winter oilseed rape.
(3) For full list of formulations recorded in 2020 please refer to the 2020 report[3].

Table 9 Oilseeds herbicide/desiccant and growth regulator formulations - 2022

Area (ha), weight (kg) and percentage of crop treated

Herbicides/desiccants	**Total 2022[1]**			**Total 2020[2,3]**	
	ha	**%**	**kg**	ha	kg
Aminopyralid/metazachlor/ picloram	**2,501**	**7**	**1,802**	1,776	1,264
Aminopyralid/propyzamide	**2,138**	**6**	**1,602**	1,163	957
Carbetamide	**415**	**1**	**748**	0	0
Clomazone	**6,101**	**17**	**440**	9,069	514
Clomazone/metazachlor	**4,450**	**13**	**3,104**	3,327	2,248
Clopyralid	**854**	**2**	**120**	1,119	113
Clopyralid/halauxifen-methyl	**4,311**	**12**	**411**	1,280	112
Clopyralid/picloram	**27**	**<0.5**	**3**	239	25
Cycloxydim	**380**	**1**	**46**	0	0
Dimethenamid-p/metazachlor/ quinmerac	**2,235**	**6**	**1,966**	3,046	3,328
Fluazifop-p-butyl	**10,938**	**27**	**888**	1,785	154
Glyphosate	**27,441**	**73**	**34,974**	21,228	29,860
Halauxifen-methyl/picloram	**1,670**	**4**	**25**	1,186	18
Imazamox/quinmerac	**362**	**1**	**103**	999	276
Metazachlor	**15,623**	**44**	**10,916**	14,679	9,041
Metazachlor/quinmerac	**3,199**	**9**	**3,150**	2,221	2,038
Propaquizafop	**9,318**	**26**	**459**	8,889	497
Propyzamide	**12,403**	**35**	**8,390**	11,663	7,821
Quizalofop-p-ethyl	**4,120**	**12**	**158**	8,245	287
Quizalofop-p-tefuryl	**2,486**	**7**	**94**	3,714	95
All herbicides/desiccants	**110,972**	**94**	**69,398**	**97,013**	**59,219**
Growth regulators[4]					
Mepiquat chloride/ metconazole	**5,599**	**16**	**1,082**	4,603	859
All growth regulators[4]	**5,599**	**16**	**1,082**	**4,603**	**859**
Area grown	**35,431**			30,793	

(1) Includes linseed, spring and winter oilseed rape.
(2) Includes spring and winter oilseed rape.
(3) For full list of formulations recorded in 2020 please refer to the 2020 report[3].
(4) Please refer to Table 8 for combined fungicide/growth regulator formulations.

Table 10 Potato seed treatment formulations - 2022

Area (ha), weight (kg) and percentage of crop treated

Seed treatments	Seed potatoes		Ware potatoes		Total 2022		Total 2020[1]	
	ha	%	ha	%	**ha**	**kg**	ha	kg
Fludioxonil	1,982	17	6,118	40	**8,100**	**524**	5,218	420
Flutolanil	4,538	38	5,170	34	**9,709**	**2,981**	12,148	3,832
Imazalil	2,809	24	3,186	21	**5,996**	**234**	2,648	113
All seed treatment	**9,330**	**75**	**14,475**	**89**	**23,804**	**3,739**	**25,150**	**4,888**
No information seed treatment[2]	468	4	0	0	**468**	**[z]**	1,565	[z]
No seed treatment	2,469	21	1,658	11	**4,127**	**[z]**	2,305	[z]
Area grown	11,893		15,247		**27,141**		28,298	

(1) For full list of formulations recorded in 2020 please refer to the 2020 report[3].
(2) Refer to Appendix 3 for definitions.
Note: some shorthand is used in this table: [z] = not applicable.

Table 11 Potato insecticide and molluscicide formulations - 2022

Area (ha), weight (kg) and percentage of crop treated

Insecticide/molluscicide	Seed potatoes		Ware potatoes		Total 2022		Total 2020[1]	
	ha	%	ha	%	**ha**	**kg**	ha	kg
Acetamiprid	10,325	68	1,591	8	**11,916**	**584**	8,033	383
Esfenvalerate	21,458	78	5,845	23	**27,303**	**130**	31,940	157
Flonicamid	6,194	32	1,334	9	**7,527**	**584**	8,033	634
Fluopyram[2]	177	1	3,221	21	**3,398**	**805**	0	0
Fosthiazate	0	0	648	4	**648**	**1,579**	744	1,873
Lambda-cyhalothrin	27,997	85	3,120	16	**31,117**	**230**	37,444	269
Spirotetramat	68	1	0	0	**68**	**5**	1,298	76
All insecticides	**66,219**	**97**	**15,757**	**46**	**81,976**	**3,918**	**102,686**	**9,097**
Molluscicide								
Ferric phosphate	4,444	20	26,909	60	**31,353**	**3,283**	36,785	4,534
All molluscicides	**4,444**	**20**	**26,909**	**60**	**31,353**	**3,283**	**41,906**	**4,945**
Area grown	11,893		15,247		**27,141**		28,298	

(1) For full list of formulations recorded in 2020 please refer to the 2020 report[3].
(2) Fluopyram is approved as both a fungicide and as a nematicide, the use recorded here is for nematode control.
Note: some shorthand is used in this table: [z] = not applicable.

Table 12 Potato fungicide formulations - 2022

Area (ha), weight (kg) and percentage of crop treated

Fungicide	Seed potatoes		Ware potatoes		Total 2022		Total 2020[(1)]	
	ha	%	ha	%	**ha**	**kg**	ha	kg
Ametoctradin	1,369	10	5,203	22	**6,572**	**1,486**	449	108
Ametoctradin/dimethomorph	5,893	43	13,685	52	**19,578**	**8,135**	16,612	6,883
Amisulbrom	6,921	42	17,729	56	**24,650**	**2,397**	21,372	1,832
Azoxystrobin	1,685	9	13,551	37	**15,237**	**3,905**	7,947	2,398
Benthiavalicarb	4,303	25	6,581	29	**10,884**	**532**	6,863	333
Benthiavalicarb/oxathiapiprolin	10,620	53	12,601	45	**23,221**	**914**	11,952	469
Benthiavalicarb isopropyl/ mancozeb	134	1	0	0	**134**	**22**	13,330	15,278
Cyazofamid	20,928	84	27,814	89	**48,742**	**3,871**	65,128	5,173
Cymoxanil	20,578	67	42,927	83	**63,504**	**6,141**	43,266	4,140
Cymoxanil/fluazinam	0	0	273	1	**273**	**74**	0	0
Cymoxanil/mancozeb	3,450	14	4,402	17	**7,853**	**10,384**	87,486	114,430
Cymoxanil/mandipropamid	677	5	375	1	**1,051**	**271**	5,287	1,361
Cymoxanil/propamocarb hydrochloride	3,514	25	3,938	18	**7,453**	**8,018**	10,879	11,596
Cymoxanil/zoxamide	3,760	14	6,879	20	**10,640**	**3,152**	4,397	1,279
Difenoconazole/mandipropamid	777	7	480	2	**1,257**	**372**	0	0
Dimethomorph	4,351	20	8,208	28	**12,559**	**1,884**	5,917	888
Dimethomorph/propamocarb hydrochloride	1,159	9	2,437	9	**3,597**	**4,244**	397	469
Dimethomorph/zoxamide	0	0	374	2	**374**	**135**	0	0

Cont…

Table 12 Potato fungicide formulations – 2022 continued

Area (ha), weight (kg) and percentage of crop treated

Fungicide	Seed potatoes		Ware potatoes		Total 2022		Total 2020[1]	
	ha	%	ha	%	**ha**	**kg**	ha	kg
Fluazinam	7,704	35	3,463	16	**11,168**	**4,316**	10,603	3,046
Fluopicolide/propamocarb hydrochloride	7,174	33	12,874	36	**20,048**	**19,795**	21,309	23,072
Fluopyram/prothioconazole	407	3	0	0	**407**	**51**	0	0
Fluxapyroxad	0	0	660	4	**660**	**130**	0	0
Mancozeb	25,119	72	56,750	77	**81,869**	**104,796**	12,614	16,014
Mancozeb/metalaxyl-M	0	0	251	2	**251**	**324**	0	0
Mandipropamid	11,033	62	16,443	65	**27,476**	**3,954**	28,106	4,160
Oxathiapiprolin	956	8	0	0	**956**	**14**	8,052	111
All fungicides	**142,512**	**100**	**257,901**	**99**	**400,413**	**189,319**	**398,601**	**240,046**
Area grown	11,893		15,247		**27,141**		28,298	

(1) For full list of formulations recorded in 2020 please refer to the 2020 report[3].

Table 13 Potato herbicide/desiccant and growth regulator formulations – 2022

Area (ha), weight (kg) and percentage of crop treated

Herbicides/desiccants	Seed potatoes		Ware potatoes		Total 2022		Total 2020[1]	
	ha	%	ha	%	**ha**	**kg**	ha	kg
Aclonifen	1,764	15	4,027	26	**5,791**	**6,066**	2,473	2,589
Carfentrazone-ethyl	13,273	78	11,952	61	**25,224**	**1,296**	28,013	1,393
Clomazone	289	2	441	3	**730**	**39**	2,601	146
Clomazone/pendimethalin	1,177	10	1,453	10	**2,631**	**1,786**	2,364	1,717
Cycloxydim	54	<0.5	0	0	**54**	**13**	508	173
Flufenacet/metribuzin	1,453	12	949	6	**2,401**	**2,237**	3,075	2,856
Glyphosate	71	1	689	5	**760**	**444**	680	477
Metobromuron	7,737	65	7,145	47	**14,882**	**16,973**	11,676	12,697
Metribuzin	9,057	76	12,830	84	**21,887**	**10,612**	21,771	9,554
Pendimethalin	68	1	113	1	**181**	**190**	1,097	1,097
Propaquizafop	0	0	73	<0.5	**73**	**5**	190	10
Prosulfocarb	1,224	10	1,147	8	**2,371**	**5,483**	3,110	7,288
Pyraflufen-ethyl	11,707	76	18,062	79	**29,769**	**426**	29,733	440
Quizalofop-p-ethyl	68	1	0	0	**68**	**4**	0	0
Quizalofop-p-tefuryl	85	1	337	2	**422**	**12**	0	0
Rimsulfuron	0	0	789	5	**789**	**8**	3,472	37
All herbicides/desiccants	**48,027**	**100**	**60,007**	**99**	**108,034**	**45,596**	**111,948**	**40,830**
Growth regulators								
Maleic hydrazide	0	0	1,869	12	**1,869**	**5,606**	0	3,830
All growth regulators	**0**	**0**	**1,869**	**12**	**1,869**	**5,606**	**0**	**3,830**
Area grown	11,893		15,247		**27,141**		28,298	

(1) For full list of formulations recorded in 2020 please refer to the 2020 report[3].

Table 14 Legume insecticide formulations - 2022

Area (ha), weight (kg) and percentage of crop treated

Insecticides	**Total 2022[1]**			**Total 2020[1]**	
	ha	**%**	**kg**	ha	kg
Esfenvalerate	**46**	**2**	**<0.5**	91	<0.5
Lambda-cyhalothrin	**324**	**11**	**2**	85	<0.5
All insecticides	**369**	**12**	**3**	**175**	**1**
Area grown	**3,025**			2,466	

(1) Includes field beans and dry harvest peas.
No molluscicides were recorded on legumes.

Table 15 Legume fungicide formulations - 2022

Area (ha), weight (kg) and percentage of crop treated

Fungicides	**Total 2022[1]**			**Total 2020[1,2]**	
	ha	**%**	**kg**	ha	kg
Azoxystrobin	**1,330**	**38**	**203**	772	123
Azoxystrobin/tebuconazole	**273**	**9**	**78**	0	0
Benzovindiflupyr/ prothioconazole	**1,066**	**35**	**142**	0	0
Boscalid/pyraclostrobin	**583**	**19**	**153**	277	66
Metalaxyl-M	**243**	**8**	**9**	0	0
Metconazole	**401**	**13**	**22**	570	31
Tebuconazole	**642**	**21**	**101**	91	13
All fungicides	**4,538**	**84**	**708**	**1,800**	**289**
Sulphur	**200**	**3**	**780**	**0**	**0**
Area grown	**3,025**			2,466	

(1) Includes field beans and dry harvest peas.
(2) For full list of formulations recorded in 2020 please refer to the 2020 report[3].

Table 16 Legume herbicide/desiccant formulations - 2022

Area (ha), weight (kg) and percentage of crop treated

Herbicides/desiccants	Total 2022[1]			Total 2020[1,2]	
	ha	%	kg	ha	kg
Bentazone	**533**	**18**	**499**	242	244
Clomazone	**785**	**26**	**54**	663	38
Clomazone/pendimethalin	**1,129**	**37**	**849**	617	630
Glyphosate	**1,847**	**51**	**2,338**	1,360	1,562
Imazamox/pendimethalin	**956**	**32**	**963**	1,250	1,057
Pendimethalin	**952**	**31**	**703**	563	393
Propaquizafop	**615**	**20**	**48**	163	10
Prosulfocarb	**314**	**10**	**588**	0	0
Quizalofop-p-tefuryl	**173**	**6**	**8**	0	0
All herbicides/desiccants	**7,304**	**88**	**6,050**	**5,319**	**3,993**
Area grown	**3,025**			2,466	

(1) Includes field beans and dry harvest peas.
(2) For full list of formulations recorded in 2020 please refer to the 2020 report[3].

Table 17 Active substances encountered in the arable survey for the first time in 2022

Active substance	Type[1]	Area treated (ha)	Weight (kg)
Fenpicoxamid	F	39,127	2,285
Laminarin	F	6,723	179
Thiencarbazone-methyl	H	75	1

(1) Pesticide type = F: Fungicide, H: Herbicide.

Table 18 Principal active substances by area treated

Area treated (1000 ha) with the 50 most used active substances, including seed treatments, on all crops surveyed

	Active substance	Type[1]	2022	2020	% change
1	Prothioconazole	F/S	**812**	871	-7
2	Tebuconazole	F	**406**	451	-10
3	Folpet	F	**402**	239	69
4	Trinexapac-ethyl	G	**234**	181	30
5	Fluxapyroxad	F/S	**213**	150	43
6	Chlormequat	G	**211**	228	-8
7	Fluroxypyr	H	**192**	200	-4
8	Metsulfuron-methyl	H	**173**	197	-12
9	Spiroxamine	F	**163**	125	30
10	Mefentrifluconazole	F	**159**	50	220
11	Diflufenican	H	**158**	155	2
12	Thifensulfuron-methyl	H	**150**	202	-26
13	Halauxifen-methyl	H	**131**	108	21
14	Tribenuron-methyl	H	**130**	145	-11
15	Bixafen	F	**128**	147	-13
16	Florasulam	H	**128**	93	38
17	Trifloxystrobin	F	**127**	189	-33
18	Flufenacet	H	**123**	108	14
19	Glyphosate	H	**123**	185	-34
20	Fludioxonil	S	**114**	94	21
21	Pyraclostrobin	F & F/G	**111**	61	82
22	Mancozeb	F	**111**	147	-25
23	Imazalil	S	**110**	49	123
24	Ipconazole	S	**107**	47	128
25	Lambda-cyhalothrin	I	**98**	116	-15
26	2-chloroethylphosphonic acid	G	**97**	59	65
27	Pendimethalin	H	**92**	102	-10
28	Cymoxanil	F	**91**	145	-37
29	Prohexadione-calcium	G & F/G	**76**	61	26
30	Picolinafen	H	**75**	74	2
31	Fluoxastrobin	F	**70**	93	-24
32	Mecoprop-p	H	**60**	107	-44
33	Ferric phosphate	M	**59**	68	-13
34	Mepiquat chloride	G & F/G	**57**	51	12
35	Cyazofamid	F	**49**	65	-25
36	Fluopyram	F/I/S	**48**	25	90
37	Azoxystrobin	F	**47**	40	18
38	Esfenvalerate	I	**43**	41	4
39	Benzovindiflupyr	F	**42**	20	107

Cont…

Table 18 Principal active substances by area treated - continued

Area treated (1000 ha) with the 50 most used active substances, including seed treatments, on all crops surveyed

	Active substance	Type(1)	2022	2020	% change
41	Fenpicoxamid	F	**39**	0	[z]
42	Dimethomorph	F	**36**	36	0
43	Benthiavalicarb	F	**34**	19	81
44	Cyflufenamid	F	**33**	35	-7
45	Pinoxaden	H	**32**	39	-18
46	Propamocarb hydrochloride	F	**31**	33	-5
47	Mandipropamid	F	**30**	33	-11
48	Pyraflufen-ethyl	H	**30**	30	0
49	Metazachlor	H	**28**	23	20
50	Metribuzin	H	**27**	25	7

(1) Pesticide type = F: Fungicide, G: Growth regulator, H: Herbicide, I: Insecticide, M: Molluscicide, S: Seed treatment. Note: some shorthand is used in this table: [z] = not applicable.

Table 19 Principal active substances by weight

Quantity (tonnes) of the 50 most used active substances, including seed treatments, on all crops surveyed

	Active substance	Type[(1)]	2022	2020	% change
1	Folpet	F	**201**	112	80
2	Chlormequat	G	**154**	165	-7
3	Mancozeb	F	**136**	177	-24
4	Glyphosate	H	**104**	160	-35
5	Pendimethalin	H	**68**	80	-15
6	Prothioconazole	F/S	**63**	59	6
7	Mecoprop-p	H	**35**	60	-42
8	Spiroxamine	F	**30**	22	37
9	Propamocarb hydrochloride	F	**29**	32	-9
10	Tebuconazole	S/F	**27**	21	27
11	Sulphur	F	**22**	38	-43
12	Fluroxypyr	H	**22**	20	7
13	Flufenacet	H	**19**	16	21
14	Metazachlor	H	**19**	16	21
15	Metobromuron	H	**17**	13	34
16	2-chloroethylphosphonic acid	G	**16**	9	77
17	Prosulfocarb	H	**13**	21	-36
18	Mefentrifluconazole	F	**13**	4	237
19	Metribuzin	H	**12**	11	8
20	Propyzamide	H	**10**	9	14
21	Pyraclostrobin	F & F/G	**10**	5	84
22	Cymoxanil	F	**9**	14	-33
23	Diflufenican	H	**9**	9	0
24	Mepiquat chloride	G & F/G	**9**	8	8
25	Fluxapyroxad	F/S	**9**	7	31
26	Chlorotoluron	H	**8**	8	1
27	Azoxystrobin	F	**8**	6	35
28	Trinexapac-ethyl	G	**8**	6	30
29	Boscalid	F	**6**	10	-37
30	Ferric phosphate	M	**6**	8	-24
31	Ametoctradin	F	**6**	4	52
32	Dimethomorph	F	**6**	6	-3
33	Aclonifen	H	**6**	3	134
34	Maleic hydrazide	G	**6**	4	46
35	Trifloxystrobin	F	**6**	8	-34
36	Bixafen	F	**5**	6	-7
37	Fluazinam	F	**4**	3	43
38	Mandipropamid	F	**4**	5	-13
39	Cyprodinil	F	**4**	6	-35
40	Cyazofamid	F	**4**	5	-25

Cont…

Table 19 Principal active substances by weight - continued

Quantity (tonnes) of the 50 most used active substances, including seed treatments, on all crops surveyed

	Active substance	Type(1)	2022	2020	% change
41	Thifensulfuron-methyl	H	**3**	4	-27
42	Flutolanil	S	**3**	4	-22
43	Picolinafen	H	**3**	2	22
44	Fluoxastrobin	F	**3**	4	-25
45	Fluopyram	F/I/S	**3**	1	100
46	Amisulbrom	F	**2**	2	31
47	Fenpicoxamid	F	**2**	0	[z]
48	Benzovindiflupyr	F	**2**	1	104
49	Prochloraz	F	**2**	4	-55
50	Fluopicolide	F	**2**	2	-14

(1) Pesticide type = F: Fungicide, G: Growth regulator, H: Herbicide, I: Insecticide, M: Molluscicide, S: Seed treatment. Note: some shorthand is used in this table: [z] = not applicable.

Table 20 Total arable crop, comparison with previous years

Pesticide usage in 2018, 2020 and 2022, area treated with formulations and active substances (a.s) and the weight (kg) applied

	2018			2020			2022		
	Formulations	**a.s.**	**Weight**	**Formulations**	**a.s.**	**Weight**	**Formulations**	**a.s.**	**Weight**
	ha	ha	kg	ha	ha	kg	**ha**	**ha**	**kg**
Insecticides/ nematicides	202,792	202,792	8,616	199,483	207,500	10,190	**182,493**	**182,493**	**5,019**
Molluscicides	75,033	75,033	8,716	88,431	84,493	9,223	**62,175**	**62,175**	**6,441**
Fungicides	2,128,624	3,273,378	636,729	2,128,892	3,233,754	646,406	**2,160,858**	**3,140,709**	**597,858**
Fungicides/ growth regulators	0	0	0	0	0	0	**6,275**	**18,826**	**1,894**
Sulphur	1,562	1,562	2,662	9,188	9,188	38,423	**13,606**	**13,606**	**21,833**
Herbicides/ desiccants	1,349,368	1,983,129	448,425	1,407,866	2,089,980	461,356	**1,276,102**	**1,930,662**	**366,683**
Growth regulators	454,237	548,541	190,656	507,946	590,582	194,429	**578,037**	**674,696**	**192,778**
Seed treatments	420,451	747,314	15,997	451,037	720,003	12,072	**405,883**	**678,965**	**9,833**
All pesticides	**4,632,066**	**6,831,748**	**1,311,801**	**4,792,843**	**6,935,500**	**1,372,098**	**4,685,432**	**6,702,133**	**1,202,340**
Total area grown (ha)(1)	**489,309**			**496,631**			**487,389**		

(1) Total area grown for 2018 and 2020 is taken from the June Agricultural Census. As there was no Census in 2022, the Total area grown in 2022 is taken from the SAF data. Please see Appendix 4 for further information.

Note: Unspecified treatments have been included in the formulation and active substance areas, however as their weights are unknown, they cannot be included in the quantities applied. Total arable crop includes cereals, oilseeds, potatoes and legumes. It should be noted that there may be minor differences in the range of crops surveyed between years.

Table 21 Cereals, comparison with previous years

Pesticide usage in 2018, 2020 and 2022, area treated with formulations and active substances (a.s) and the weight (kg) applied

	2018			2020			2022		
	Formulations	**a.s.**	**Weight**	**Formulations**	**a.s.**	**Weight**	**Formulations**	**a.s.**	**Weight**
	ha	ha	kg	ha	ha	kg	**ha**	**ha**	**kg**
Insecticides	78,127	78,127	385	63,269	63,269	291	**46,316**	**46,316**	**245**
Molluscicides	29,439	29,439	3,322	22,608	22,608	2,141	**16,363**	**16,363**	**1,680**
Fungicides	1,710,838	2,659,346	450,428	1,619,439	2,496,062	390,727	**1,639,648**	**2,455,317**	**388,834**
Sulphur	1,339	1,339	2,261	9,135	9,135	38,254	**13,407**	**13,407**	**21,053**
Herbicides/ desiccants	1,130,538	1,739,063	336,584	1,190,313	1,850,821	357,315	**1,049,791**	**1,672,423**	**245,638**
Growth regulators	448,775	537,939	188,943	501,530	580,099	189,739	**570,570**	**661,629**	**186,091**
Seed treatments	365,829	666,313	8,435	402,746	671,712	7,091	**360,327**	**633,409**	**6,088**
All pesticides	**3,764,885**	**5,711,567**	**990,358**	**3,809,039**	**5,693,705**	**985,558**	**3,696,421**	**5,498,863**	**849,630**
Total area grown (ha)[(1)]	**425,674**			**434,443**			**421,772**		

(1) Total area grown for 2018 and 2020 is taken from the June Agricultural Census. As there was no Census in 2022, the Total area grown in 2022 is taken from the SAF data. Please see Appendix 4 for further information.

Note: Unspecified treatments have been included in the formulation and active substance areas, however as their weights are unknown, they cannot be included in the quantities applied. Cereals crops include winter barley, spring barley, winter wheat, spring wheat, winter oats, spring oats and winter rye. It should be noted that there may be minor differences in the range of crops surveyed between years.

Table 22 Potatoes comparison with previous years

Pesticide usage in 2018, 2020 and 2022, area treated with formulations and active substances (a.s.) and the weight (kg) applied

	2018			2020			2022		
	Formulations	**a.s.**	**Weight**	**Formulations**	**a.s.**	**Weight**	**Formulations**	**a.s.**	**Weight**
	ha	ha	kg	ha	ha	kg	**ha**	**ha**	**kg**
Insecticides/ nematicides	90,685	90,685	7,675	102,686	102,686	9,097	**81,976**	**81,976**	**3,918**
Molluscicides	21,676	21,676	2,955	41,906	41,906	4,945	**31,353**	**31,353**	**3,283**
Fungicides	306,927	441,298	166,694	398,601	578,939	240,046	**400,413**	**496,034**	**189,319**
Herbicides/ desiccants	113,567	117,357	43,202	111,948	117,387	40,830	**108,034**	**113,066**	**45,596**
Growth regulators	323	323	775	1,277	1,277	3,830	**1,869**	**1,869**	**5,606**
Seed treatments	25,048	25,048	7,239	25,150	25,150	4,888	**23,804**	**23,804**	**3,739**
All pesticides	**558,227**	**696,387**	**228,539**	**681,568**	**867,346**	**303,635**	**647,450**	**748,104**	**251,460**
Total area grown (ha)[(1)]	**27,359**			**28,298**			**27,141**		

(1) Total area grown for 2018 and 2020 is taken from the June Agricultural Census. As there was no Census in 2022, the Total area grown in 2022 is taken from the SAF data. Please see Appendix 4 for further information.

Note: Unspecified treatments have been included in the formulation and active substance areas, however as their weights are unknown, they cannot be included in the quantities applied. Potatoes include seed potatoes and ware potatoes.

Table 23 Oilseeds, comparison with previous years

Pesticide usage in 2018, 2020 and 2022, area treated with formulations and active substances (a.s) and the weight (kg) applied

	2018			2020			2022		
	Formulations	**a.s.**	**Weight**	**Formulations**	**a.s.**	**Weight**	**Formulations**	**a.s.**	**Weight**
	ha	ha	kg	ha	ha	kg	**ha**	**ha**	**kg**
Insecticides	33,353	33,353	551	41,369	41,369	801	**53,831**	**53,831**	**854**
Molluscicides	23,917	23,917	2,439	19,980	19,980	2,138	**14,459**	**14,459**	**1,478**
Fungicides	109,052	169,723	18,933	99,321	156,585	15,344	**116,260**	**182,897**	**18,997**
Fungicides/growth regulators	0	0	0	0	0	0	**6,275**	**18,826**	**1,894**
Sulphur	223	223	401	53	53	169	**0**	**0**	**0**
Herbicides/ desiccants	100,286	120,243	64,895	97,013	115,057	59,219	**110,972**	**136,290**	**69,398**
Growth regulators	5,139	10,279	938	4,603	9,206	859	**5,599**	**11,197**	**1,082**
Seed treatments	29,574	55,953	323	22,944	22,944	93	**21,752**	**21,752**	**7**
All pesticides	**301,544**	**413,690**	**88,480**	**285,283**	**365,194**	**78,623**	**329,148**	**439,252**	**93,710**
Total area grown (ha)[(1)]	**32,735**			**30,793**			**35,431**		

(1) Total area grown for 2018 and 2020 is taken from the June Agricultural Census. As there was no Census in 2022, the Total area grown in 2022 is taken from the SAF data. Please see Appendix 4 for further information.

Note: Unspecified treatments have been included in the formulation and active substance areas, however as their weights are unknown, they cannot be included in the quantities applied. Oilseeds includes linseed (2022 only), winter and spring oilseed rape. It should be noted that there may be minor differences in the range of crops surveyed between years.

Appendix 2 – Survey statistics

Census and sample information

Table 24 Regional distribution of arable crops in 2022

Area (ha) of arable crops grown in Scotland

	H&I[1]	C&O[1]	Moray Firth	Abdn[1]	Angus	East Fife	Lothian	C. Low-lands[1]	Tweed Valley	S. Up-lands[1]	Solway	Scotland 2022	Scotland 2020	% change
Winter barley	129	186	1,725	12,351	7,039	3,318	3,826	5,135	6,208	1,060	3,197	**44,174**	43,091	3
Spring barley	4,262	7,461	37,020	73,766	41,723	11,799	10,956	25,765	12,844	3,432	6,789	**235,816**	258,702	-9
Wheat	84	*	4,680	10,911	24,653	13,789	16,741	9,843	21,678	1,142	3,496	**107,117**	93,538	15
Winter oats	*	*	*	867	1,095	1,988	296	678	2,785	399	143	**8,436**	7,984	6
Spring oats	348	1,935	1,355	3,253	2,861	2,343	1,361	2,541	2,204	153	360	**18,713**	26,000	-28
Winter rye	*	0	1,433	703	1,953	820	191	439	1,072	0	559	**7,174**	5,137	40
Triticale	*	0	*	141	*	*	0	106	0	0	*	**347**	448	-23
Winter oilseed rape	0	0	2,664	8,781	8,192	1,708	4,185	1,772	7,323	172	348	**35,145**	30,373	16
Spring oilseed rape[2]	0	0	*	*	*	78	41	*	0	0	*	**286**	537	-47
Seed potatoes	230	30	1,823	2,382	5,258	393	72	1,170	465	*	29	**11,894**	12,003	-1
Ware potatoes	84	30	755	492	7,142	2,360	1,461	1,263	1,454	*	207	**15,248**	16,294	-6

Cont…

Table 24 Regional distribution of arable crops in 2022 - continued

Area (ha) of arable crops grown in Scotland

	H&I[1]	C&O[1]	Moray Firth	Abdn[1]	Angus	East Fife	Lothian	C. Low-lands[1]	Tweed Valley	S. Up-lands[1]	Solway	Scotland 2022	Scotland 2020	% change
Field beans	*	*	77	50	380	662	402	308	576	*	132	**2,616**	2,138	22
Dry harvest peas	0	21	63	102	*	69	*	30	68	0	0	**410**	328	25
Lupins	0	0	*	0	*	0	0	*	0	0	0	**13**	17	-22
Mixed grain	0	0	0	0	0	0	0	0	0	0	0	**0**	41	-100
Totals	**5,161**	**9,797**	**51,810**	**113,835**	**100,360**	**39,327**	**39,567**	**49,119**	**56,678**	**6,416**	**15,319**	**487,389**	**496,631**	**-2**

* To prevent disclosure of information about individual holdings, entries relating to fewer than five holdings are not reported.
(1) H&I = Highlands & Islands, C&O = Caithness & Orkney, Abdn = Aberdeen, C. Lowlands = Central Low-lands, S. Up-lands = Southern Uplands.
(2) Includes linseed.
Note: areas grown for 2020 are taken from the 2020 June Agricultural Census. As there was no Census in 2022, the areas grown in 2022 are taken from the SAF data. Please see Appendix 4 for further information.

Table 25 Distribution of arable sample - 2022

Number of holdings surveyed in each region and size group

Size (ha)	H&I[1]	C&O[1]	Moray Firth	Abdn[1]	Angus	East Fife	Lothian	C. Low-lands[1]	Tweed Valley	S. Up-lands [1]	Solway	Scotland
0.1-19.99	2	3	2	3	1	1	1	3	1	1	3	**21**
20-49.9	1	2	6	12	7	2	2	7	4	0	4	**47**
50-99.9	2	3	7	18	18	7	7	10	5	1	2	**80**
100-149.9	0	1	6	14	12	7	6	6	12	1	1	**66**
150+	0	0	13	23	25	11	19	6	18	1	2	**118**
All sizes	**5**	**9**	**34**	**70**	**63**	**28**	**35**	**32**	**40**	**4**	**12**	**332**

(1) H&I = Highlands & Islands, C&O = Caithness & Orkney, Abdn = Aberdeen, C. Low-lands = Central Lowlands, S. Uplands = Southern Uplands.

Table 26 Sample area - 2022

Area (ha) of arable crops grown in sample

Size (ha)	H&I[1]	C&O[1]	Moray Firth	Abdn[1]	Angus	East Fife	Lothian	C. Low-lands[1]	Tweed Valley	S. Up-lands [1]	Solway	Scotland
0.1-19.99	18	25	22	33	11	42	8	21	10	17	22	**228**
20-49.9	28	59	186	397	216	51	68	251	160	0	81	**1,494**
50-99.9	114	186	521	1,324	1,214	413	442	657	317	98	117	**5,401**
100-149.9	0	130	786	1,741	1,414	800	765	726	1,546	143	105	**8,154**
150+	0	0	2,741	4,768	5,546	2,505	3,957	1,217	4,607	355	357	**26,052**
All sizes	**159**	**399**	**4,255**	**8,262**	**8,400**	**3,811**	**5,240**	**2,871**	**6,639**	**613**	**681**	**41,329**

(1) H&I = Highlands & Islands, C&O = Caithness & Orkney, Abdn = Aberdeen, C. Low-lands = Central Lowlands, S. Up-lands = Southern Uplands.

Table 27 SAF area - 2022

Area (ha) of arable crops grown in Scotland

Size (ha)	H&I[(1)]	C&O[(1)]	Moray Firth	Abdn[(1)]	Angus	East Fife	Lothian	C. Low-lands [(1)]	Tweed Valley	S. Uplands[(1)]	Solway	Scotland
0.1-19.99	1,399	3103	2,479	6,355	1,836	555	653	3,944	825	667	2,760	**24,578**
20-49.9	1,577	2222	7,117	16,448	9,369	3,464	2,454	9,324	2,897	1,011	4,913	**60,797**
50-99.9	1,427	1968	11,556	28,445	19,599	8,532	6,287	12,724	7,262	1,339	3,932	**103,071**
100-149.9	585	1078	9,130	19,601	16,517	8,459	7,362	7,962	10,136	1,632	1,414	**83,875**
150+	*	1424	21,529	42,985	53,039	18,317	22,810	15,165	35,558	1,767	2,300	**215,067**
All sizes	**5,161**	**9,797**	**51,810**	**113,835**	**100,360**	**39,327**	**39,567**	**49,119**	**56,678**	**6,416**	**15,319**	**487,389**

* To prevent disclosure of information about individual holdings, entries relating to fewer than five holdings are not reported.
(1) H&I = Highlands & Islands, C&O = Caithness & Orkney, Abdn = Aberdeen, C. Low-lands = Central Lowlands, S. Uplands = Southern Uplands.

Table 28 Raising factors - 2022

Size (ha)	H&I & C&O[(1)]	Moray Firth	Abdn[(1)]	Angus	East Fife	Lothian	C. Low-lands[(1)]	Tweed Valley	S. Uplands[(1)]	Solway
0.1-19.99	104.9620	113.5201	195.2452	169.5319	13.2245	78.3393	191.8259	85.1889	38.5078	126.2589
20-49.9	44.1543	38.3634	41.4693	43.4434	67.7869	36.2273	37.1663	18.1029	[z]	60.8301
50-99.9	11.3467	22.1773	21.4809	16.1467	20.6696	14.2188	19.3750	22.9427	13.6673	33.7484
100-149.9	12.8064	11.6218	11.2611	11.6825	10.5710	9.6257	10.9746	6.5580	11.3953	13.4797
150+	[z]	7.8554	9.0148	9.5635	7.3123	5.7649	12.4582	7.7187	4.9847	6.4438

(1) H&I = Highlands & Islands, C&O = Caithness & Orkney, Abdn = Aberdeen, C. Low-lands = Central Lowlands, S. Uplands = Southern Uplands.
Note: some shorthand is used in this table: [z] = not applicable.

Table 29 First and second adjustment factors - 2022

	H&I & C&O[(1)]	Moray Firth	Abdn[(1)]	Angus	East Fife	Lothian	C. Low-lands[(1)]	Tweed Valley	S. Uplands[(1)]	Solway	ADJ2
Winter barley	0.9721	1.6197	0.9821	0.8645	0.6334	0.8147	0.8816	1.2325	1.1086	0.7284	1.0000
Spring barley	1.1154	0.9093	0.9936	0.9890	1.0158	1.0889	1.0239	0.8432	2.8907	0.8957	1.0000
Total wheat	[z]	0.9051	0.9982	1.0521	0.9859	0.9715	1.1016	1.0842	0.4768	3.2893	1.0017
Winter oats	[z]	[z]	0.6566	1.8637	1.1293	1.2734	0.5812	0.7560	0.8700	[z]	1.0404
Spring oats	1.0280	0.6233	1.0941	1.1702	1.4439	0.9407	0.7057	0.8800	[z]	0.2635	1.0082
Winter rye	[z]	[z]	1.1376	0.4707	1.4379	[z]	[z]	0.5736	[z]	1.8655	1.4049
Triticale	[z]	[z]	0.1452	0.1046	[z]	[z]	0.2481	[z]	[z]	[z]	1.3233
Spring oilseed rape	[z]	[z]	[z]	[z]	0.3231	[z]	[z]	[z]	[z]	0.1702	3.5580
Winter oilseed rape	[z]	1.6606	1.0714	1.0559	1.2208	1.4192	0.8065	1.0900	0.4436	[z]	1.0100
Linseed	[z]	[z]	[z]	[z]	[z]	0.1769	[z]	[z]	[z]	[z]	27.1176
Seed potatoes	1.4472	2.5834	2.5774	0.7922	1.5202	[z]	2.7889	4.1568	2.2379	0.1042	1.0060
Ware potatoes	0.8982	3.9845	1.4291	1.5996	1.3284	0.6824	2.0464	1.5338	[z]	[z]	1.0137
Dry harvest peas	[z]	0.7144	0.1368	[z]	[z]	0.5189	[z]	[z]	[z]	[z]	2.0582
Field beans	[z]	0.7500	[z]	0.9219	0.6610	0.5540	0.4000	0.9987	[z]	0.7578	1.0309

(1) H&I = Highlands & Islands, C&O = Caithness & Orkney, Abdn = Aberdeen, C. Low-lands = Central Lowlands, S. Uplands = Southern Uplands

Note: some shorthand is used in this table: [z] = not applicable.

Response rates

The table below summarises the number of holdings contacted during the survey.

Table 30 Response rate

	2022	Percentage total
Target sample	350	100
Total achieved	**332**	**95**
Total number of refusals/non-contact	174	
Total number of farms approached	**506**	

Financial burden to farmers

In order to minimise the burden on farmers the survey team used non-visit methods of collection such as email, post or telephone call, where possible.

To determine the total burden that the 2022 arable crop survey placed on those providing the information, the surveyors recorded the time that 310 respondents spent providing the data during the survey. This sample represents 93 per cent of growers surveyed. The median time taken to provide the information was 20 minutes.

The following formula was used to estimate the total cost of participating:

Burden (£) = No. surveyed x median time taken (hours) x typical hourly rate*

(* using median "Full Time Gross" hourly pay for Scotland of £16.69)[15]

The total financial burden to all growers resulting from participation in the 2022 arable crop survey was calculated to be £1,847.

Appendix 3 – Definitions and notes

1) '**Pesticide**' is used throughout this report to include commercial formulations containing active substances (a.s.) used as herbicides, fungicides, insecticides, molluscicides, nematicides, biological control agents, biopesticides, growth regulators, seed treatments and physical control. A pesticide product consists of one or more active substances co-formulated with other materials.

2) An **active substance** (or active ingredient) is any substance or micro-organism which has a general or specific action: against harmful organisms; or on plants, parts of plants or plant products.

3) In this report the term '**formulation**(s)' is used to describe the pesticide active substance or mixture of active substances in a product(s). It does not refer to any of the solvents, pH modifiers or adjuvants also contained within a product that contribute to its efficacy.

4) A **fungicide** is a pesticide used to control fungal diseases in plants.

5) A **herbicide** is a pesticide used to control unwanted vegetation (weed killer). A **desiccant** is a pesticide used to dry out unwanted plant material.

6) A **growth regulator** is a pesticide used to regulate the growth of the plant, for example to prevent the crop from growing too tall.

7) An **insecticide** is a pesticide used to control unwanted insects. A **nematicide** is a pesticide used to control unwanted nematodes.

8) A **molluscicide** is a pesticide used to control unwanted slugs and snails.

9) A **seed treatment** is a pesticide applied to seed before planting to protect that plant against diseases and pests from the earliest stage of development. The pesticide can be a fungicide, an insecticide or a biological control agent.

10) In the pesticide tables, some pesticide treatments may be reported as '**unspecified**'. This description was used for occasions where the use of a particular treatment was reported by the grower, but they were unable to provide details of the product used. For these treatments, we are able to provide an area treated but no weight of pesticide used since the exact pesticide is unknown.

11) Some seed treatments were recorded as '**no information seed treatment**'. This description was used for occasions where the grower was unable to confirm whether the seed had received a treatment.

12) **Basic area** is the planted area of crop which was treated with a given pesticide or pesticide group, irrespective of the number of times it was applied to that area. Basic areas are not presented anywhere in the report, but their values are used to calculate the percentage of crop treated with a given pesticide or pesticide group.

13) **Area treated** is the basic area of a crop treated with a given pesticide multiplied by the number of treatments that area received. These terms are synonymous with "spray area" and "spray hectare" which have appeared in previous reports. For example, if a field of five hectares is sprayed with the

same fungicide twice, the basic area is five hectares, and the treated area is 10 hectares.

14) Farmers/growers can apply pesticides to crops by a number of different methods. Multiple pesticides can be applied to a crop in a single tank mix. For example, a crop could be sprayed with two different fungicides and an insecticide at the same time.

15) In this report data are reported in two formats. For each pesticide formulation (mixture of active substances in a product) the area treated and weight applied is reported. Areas and weights for individual active substances are not included in this report but are published in Excel format as supplementary tables. These different formats are provided to satisfy the needs of all data users and allow them to assess pesticide use trends. Some users may be interested in use of pesticide products which contain a number of active substances, thus formulation data would be required. Other users are interested in particular active substances which may be formulated on their own or in combination with other active substances. In addition, both weight and area of pesticide applications are important indicators of changes in use over time. Different pesticides are applied at different dose rates and only by comparing both area and weight can trends in use be elucidated.

16) It should be noted that some herbicides may not have been applied directly to the crop itself but either as land preparation treatments prior to sowing/planting the crop, or to control weeds at the field margins.

17) The **June Agricultural Census**[16] is conducted annually by the Scottish Government's Rural and Environmental Science Analytical Services (RESAS). The June Agricultural Census collects data on land use, crop areas, livestock and the number of people working on agricultural holdings. As there was no census conducted in 2022 (see changes from previous years section), for this report, the 2022 Single Application Form (SAF) data was used to draw a sample of farmers growing the relevant crops to participate in the survey.

18) Throughout this report the term '**census area**' refers to the total area for a particular crop or group of crops recorded within the June Agricultural Census. These are the areas which the sample areas are raised to. Please see Appendix 4 – survey methodology for details. The June Agricultural Census Form is divided up into different categories which relates to a particular crop or group of crops. These are referred to as '**census categories**' throughout this report.

19) During the survey, the wheat crop is differentiated as either winter wheat or spring wheat. In the census/SAF, wheat is not subdivided. Any data from the census refers to the wheat crop as 'total wheat', but the survey data refers to winter and spring wheat.

20) There were a limited number of holdings with triticale, winter rye and linseed sampled. Therefore, no details of pesticide use on these crops are reported separately. However pesticide use on triticale, winter rye and linseed are included in the totals for 'all cereals' in the pesticide usage tables.

20) Where quoted in the text, reasons for application are the grower's stated reasons for use of that particular pesticide on that crop and may not always seem appropriate.

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

22) Data from the 2018[4] and 2020[3] surveys are provided for comparison purposes in some of the tables, although it should be noted that there may be minor differences in the range of crops surveyed, together with changes in areas of each of the crops grown. Changes from previous surveys are described in Appendix 4. When comparisons are made between surveys it is important to consider changes in the area of crop grown. In order to take this into account, comparisons have been made on a per hectare grown basis, i.e. the number of hectares that have been sprayed (treated hectares) has been divided by the area of crop grown for each survey, and the weight (kilograms) applied has also been divided by the area of crop grown. This is to enable like for like comparisons between surveys, so that changes in pesticide use patterns are not masked by changes in crop area.

23) The **average number of applications** indicated in the text for each crop is based on the occurrence of a pesticide group on at least 10 per cent of the area grown. The average number of applications is calculated only on the areas receiving each pesticide group and therefore the minimum number of applications is always one. Several pesticides may be applied as a tank mix as part of the same spray event; therefore the average number of pesticide sprays reported is less than the sum of sprays of each pesticide group.

24) The crop type '**dry harvest peas'** is used for consistency with the Fera Science Ltd UK pesticide usage reports. This equates to peas for combining on the Scottish Agricultural Census form and is synonymous with 'combine peas' which appeared in previous Scottish reports.

Appendix 4 – Survey methodology

Sampling and data collection

Using the May 2022 Single Application Form (SAF) data, a sample was drawn representing arable cultivation in Scotland. The country was divided into 11 land-use regions (Figure 31). Each sample was stratified by these land-use regions and according to holding size. The sampling fractions used within both regions and size groups were based on the areas of relevant crops grown rather than number of holdings, so that smaller holdings would not dominate the sample.

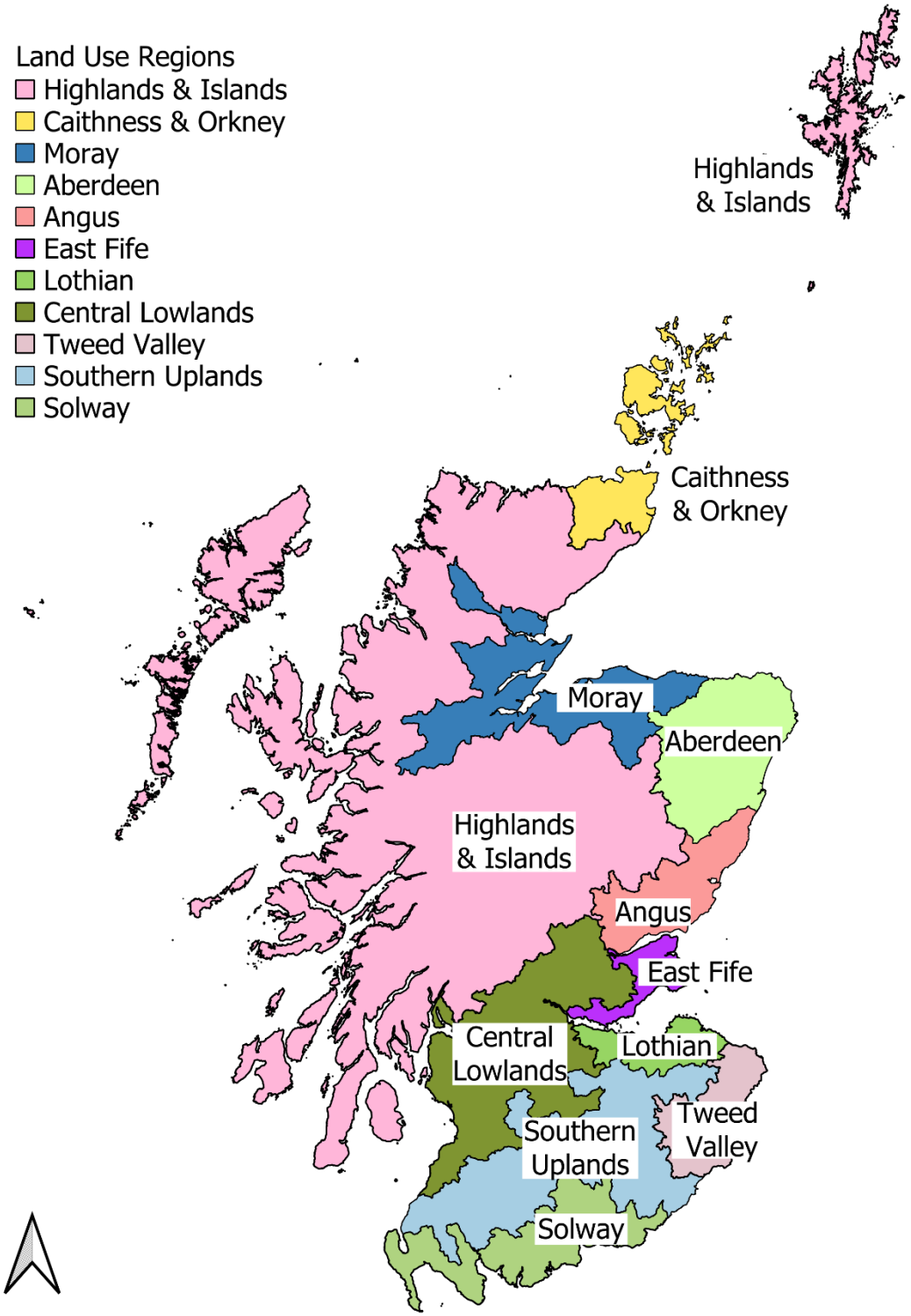
The survey covered pesticide applications to arable crops where all, or the majority, of the growing season was in 2022. As well as recording treatments applied directly to the crop, data was also collected on land preparation treatments prior to sowing or planting the crop.

Following an introductory letter and phone call, data were collected during a phone interview or by email. Where necessary, information was also collected from agronomists and contractors. In total, information was collected from 332 holdings growing arable crops (Table 26). These holdings represent eight per cent of the total crop area grown.

Raising factors

National pesticide use was estimated by ratio raising. This is a standard statistical technique for producing estimates from a sample. It is the same methodology used by the other UK survey teams and has been used for all historical datasets produced by the Pesticide Survey Unit, allowing comparability over time. The sample data were multiplied by raising factors (Tables 29). These factors were calculated by comparing the sample area to the areas recorded in the May 2022 SAF data within each region and size group (please see changes from previous years section for further detail). An adjustment (Table 29) was made for each crop within each region by applying the raising factors to the sample area of each crop grown and comparing this with the SAF area. This adjustment modifies the estimate to take into account differences in composition of crops encountered in the sample and those present in the population. A second adjustment was necessary for some crops which were present in the population but were not encountered in the sample in some strata.

Figure 22 Land use regions of Scotland[17]



Changes from previous years

There are changes which should be noted when comparing the 2022 data with the previous survey.

For previous reports, the June Agricultural Census was used to draw a sample of farmers growing the relevant crops to participate in the survey. National pesticide use was then estimated by ratio raising, by comparing the sample area to the areas recorded in the June Agricultural Census data.

To allow for the Agricultural Statistics Transformation Programme[18], the June 2022 Agricultural Census was paused. This pause was agreed with the Office for Statistical Regulation and data users.

For this report, the May 2022 Single Application Form (SAF) data was used to draw the sample and estimate national pesticide use using the same methodology as previous surveys. SAF data accounts for the majority of land area for arable crops. The sample drawn is based on area of crop grown, rather than number of holdings. As such, no attempt is made to account for holdings that are not captured by SAF returns. (Note: The difference in total Scottish arable area recorded between SAF 2022 and Agricultural Census 2021 was less than one per cent. The largest difference was biased towards the smaller size groups, less than five per cent of a difference).

Some data published in previous reports such as modes of action data, reasons for use and timing of application data have been excluded from the current survey due to resource and time constraints.

The 2020 report contained information about grower adoption of Integrated Pest Management (IPM). IPM data was not collected during the 2022 survey. It is anticipated that IPM data will be collected and published every 4 years. This allows IPM uptake to be monitored over time but reduces the burden on growers and surveyors.

Data quality assurance

The dataset underwent several validation processes as follows; (i) checking for any obvious errors upon data receipt (ii) checking and identifying inconsistencies with use and pesticide approval conditions once entered into the database (iii) checking of data held in the database against the raw data. Where inconsistencies are found these are checked against the records and with the grower if necessary. Additional quality assurance is provided by sending reports for review to members of the Working Party on Pesticide Usage Surveys and other agricultural experts. In addition, the Scottish Pesticide Survey Unit is accredited to ISO 9001:2015. All survey related processes are documented in Standard Operating Procedures (SOPs) and our output is audited against these SOPs by internal auditors annually and by external auditors every three years.

Main sources of bias

The use of a random stratified sample is an appropriate survey methodology. A stratified random sample, grouped by farm size and region, is used to select holdings used in this survey. Sampling within size groups is based on area rather than numbers of holdings, so that smaller size groups are not over-represented in the sample. The pesticide survey may be subject to

measurement bias as it is reliant on farmers/growers recording data accurately. As this survey is not compulsory it may also subject to non-response bias, as growers on certain farm/holding types may be more likely to respond to the survey than others. Reserve lists of holdings are held for each stratum to allow non-responding holdings to be replaced with similar holdings.

Experience indicates that stratified random sampling, including reserves, coupled with personal interview technique, delivers the highest quality data and minimises non-response bias.

Appendix 5 – Standard errors

The figures presented in this report are produced from surveying a sample of holdings rather than a census of all the holdings in Scotland. Therefore, the figures are estimates of the total pesticide use for Scotland and should not be interpreted as exact. To give an idea of the precision of estimates, the report includes relative standard errors (RSE) (Table 32). Standard errors are produced using the raising factors. An overall variance is calculated by summing the variance estimates for individual strata (region and size group) multiplied by the square of their raising factors. These variance estimates include a finite population correction. The overall standard error is calculated from the overall variance by taking its square root. This method of standard estimation was implemented as it is both relatively straightforward and has advantages over ratio estimator methods when within-strata sample sizes are small.

Standard errors are expressed as percentage relative standard errors (Table 32) for both total pesticide use by area treated and for weight applied. Larger relative standard errors mean that the estimates are less precise. A relative standard error of zero per cent would be achieved by a census. A relative standard error of 100 per cent indicates that the error in the survey is of the same order as the measurement. Relative standard errors may be reduced with larger sample sizes. However, larger relative standard errors can also result from greater variability in pesticide use among holdings.

The RSE for estimates of total pesticide use on arable crops (Table 32) was three per cent for area and four per cent for weight, the same as in 2020. For constituent crop groups, the RSE varied from four to 44 per cent for area and four to 61 per cent for weight, varying with sample size and uniformity of pesticide regime encountered. For spring oilseed rape, linseed and dry harvest peas, a standard error could not be calculated due to too few active substances being recorded; therefore, pesticide estimates for these crops should be treated with caution. Higher standard errors mean that there is more uncertainty associated with estimates of pesticide use.

Table 31 Relative standard errors - 2022

Relative standard errors (RSE) for the area treated (ha) with pesticide and for weight of active substance (kg) applied

	Area SE (%)	Weight SE (%)
Winter barley[1]	5	6
Spring barley	4	4
Wheat (winter and spring)[1]	5	6
Winter oats[1]	13	14
Spring oats[1]	9	13
Winter rye	44	61
Winter oilseed rape	6	6
Spring oilseed rape[2]	NC	NC
Linseed[2]	NC	NC
Seed potatoes	13	14
Maincrop potatoes[1]	10	12
Dry harvest peas[2]	NC	NC
Field beans[1]	20	21
All pesticides	3	4

(1) For these crops standard errors could not be calculated for all strata due to insufficient data in the sample, as these strata have not been used in the aggregate totals for the region the overall RSE values should be treated with caution.
(2) Standard errors could not be calculated (NC) for spring oilseed rape, linseed and dry harvest peas because there were too few active substances recorded. Therefore, estimates for these crops should be treated with caution.

Acknowledgements

The authors would like to thank all the farmers, agronomists, contractors and seed merchants who agreed to provide information for this survey. Thanks are also due to Gillian Reay and Jackie Hughes (SASA), Fiona Burnett (SRUC), Sara Cook (ADAS) and Ingrid den Hoed (CRD) for editorial assistance. In addition, the authors are grateful for support and advice from Lewis Ridley and David Garthwaite at Fera Science Ltd, Paul Gavin at the Scottish Government's Agricultural Census Analysis Team and Adrian Roberts of Biomathematics & Statistics Scotland.

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Pesticide Usage in Scotland

Potato Stores 2022

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Executive summary

This report presents information from a survey of pesticide use on stored potatoes harvested in Scotland in 2022. Data were collected from 73 growers, who collectively cultivated 28 per cent of the area of potatoes grown in Scotland. Pesticide use in potato stores was recorded for crops grown for seed production and for consumption (ware potatoes). Ratio raising was used to produce estimates of national pesticide usage from the sample data.

The overall estimated quantity of potatoes stored in Scotland in 2022 was ca 951,000 tonnes, a slight decrease of four per cent compared with the previous survey in 2020 and a nine per cent increase compared with 2018. Seed potato storage decreased by an estimated 15 per cent to ca. 332,700 tonnes. Ware potato storage increased by an estimated four percent to ca. 618,400 tonnes. However, there has been a significant change in survey estimation methodology which must be taken into account when comparing storage data from this survey and previous surveys.

Seventy eight per cent of seed and 82 per cent of ware potatoes sampled in 2022 were stored in refrigerated stores. The majority of the remaining stores were ambient ventilated stores. All the potatoes surveyed were stored in boxes.

The proportion of seed potatoes treated with a pesticide in 2022 was 25 per cent. This is lower than the 39 per cent treated in 2020 but similar to the proportion treated in 2018 (28 per cent). The proportion of stored ware potatoes treated with a pesticide in 2022 was eight per cent, similar to the six per cent treated in 2020, but lower than the 13 per cent treated in 2018.

The only pesticide encountered on seed potatoes was the fungicide imazalil, applied to an estimated 25 per cent of the stored crop for control of a range of tuber diseases. Imazalil was also the principal pesticide encountered in 2020.

As in 2020, the principal pesticide used on ware potatoes in 2022 was the growth regulator ethylene applied to an estimated four per cent of the stored ware crop, compared with four percent in 2020 and eight per cent in 2018. The sprout suppressant spearmint oil was applied to an estimated three per cent of the stored ware potato crop in 2022, similar to the one and two per cent treated in 2020 and 2018 respectively. Another sprout suppressant, 1,4-dimethylnaphthalene was applied to an estimated one per cent. This new active substance was only approved for use in potato stores from August 2022. Chlorpropham (which was withdrawn in 2020) had been the principal active substance in 2018 and 2016 (applied to nine and ten per cent respectively). Less than 0.5 per cent of the stored crop was treated with a fungicide in 2020.

Introduction

The Scottish Government (SG) is required by legislation[1][2] to carry out post-approval surveillance of pesticide use. This is conducted by the Pesticide Survey Unit at SASA, a division of the Scottish Government's Agriculture and Rural Economy Directorate.

This survey is part of a series of annual reports which are produced to detail pesticide usage in Scotland for arable, vegetable and soft fruit crops on a biennial basis and for fodder and forage crops every four years. The Scottish survey data are incorporated with England, Wales, and Northern Ireland data to provide estimates of annual UK-wide pesticide use. Information on all aspects of pesticide usage in the United Kingdom as a whole may be obtained from the Pesticide Usage Survey Team at Fera Science Ltd, Sand Hutton, York, or visit the Fera website.

An Accredited Official Statistics Publication for Scotland

These statistics are accredited official statistics. The Office for Statistics Regulation has independently reviewed and accredited these statistics as complying with the standards of trustworthiness, quality, and value in the Code of Practice for Statistics.

The Scottish Pesticide Usage reports have been accredited official statistics since October 2014.

Accredited official statistics are called National Statistics in the Statistics and Registration Service Act 2007.

Scottish Government statistics are regulated by the Office for Statistics Regulation (OSR). OSR sets the standards of trustworthiness, quality and value in the Code of Practice for Statistics that all producers of official statistics should adhere to.

As well as working closely with Scottish Government statisticians, SASA receive survey specific statistical support from Biomathematics and Statistics Scotland (BioSS).

All reports are produced according to a published timetable. For further information in relation to Pesticide Survey Unit publications and their compliance with the code of practice please refer to the pesticide usage survey section of the SASA website. The website also contains other useful documentation such as privacy and revision policies, user feedback and detailed background information on survey methodology and data uses.

Additional information regarding pesticide use can be supplied by the Pesticide Survey Unit. Please email psu@sasa.gov.scot or visit our website.

Structure of report and how to use these statistics

This report is intended to provide data in a useful format to a wide variety of data users. The general trends section provides commentary on recent changes in survey data and longer-term trends. The 2022 pesticide usage section summarises pesticide use on stored potatoes in 2022. Appendix 1 presents estimated pesticide usage data. Appendix 2 summarises survey statistics including census and holding information, raising factors and the financial burden to farmers. Appendix 3 defines many of the terms used throughout the report. Appendix 4 describes the methods used during sampling, data collection and analysis as well as measures undertaken to avoid bias and reduce uncertainty. Any changes in method from previous survey years are also explained.

It is important to note that the figures presented in this report are produced from surveying a sample of holdings rather than a census of all the holdings in Scotland. Therefore, the figures are estimates of the total pesticide use for Scotland and should not be interpreted as exact.

General trends

Scottish potato storage

The total estimated quantity of potatoes stored in Scotland in 2022 was 951,194 tonnes. This is four per cent less than the 987,615 tonnes reported in 2020[3] and nine per cent more than the estimated 875,687 tonnes in 2018[4]. However, there has been a significant change in survey methodology which must be taken into account when comparing data from this survey and previous surveys (see Appendix 4 – changes from previous years for further information).

The quantity of seed potatoes stored in 2022 was estimated to be 332,745 tonnes, representing a 15 per cent decrease in stored seed potatoes since the previous survey in 2020 and a six percent increase since 2018.

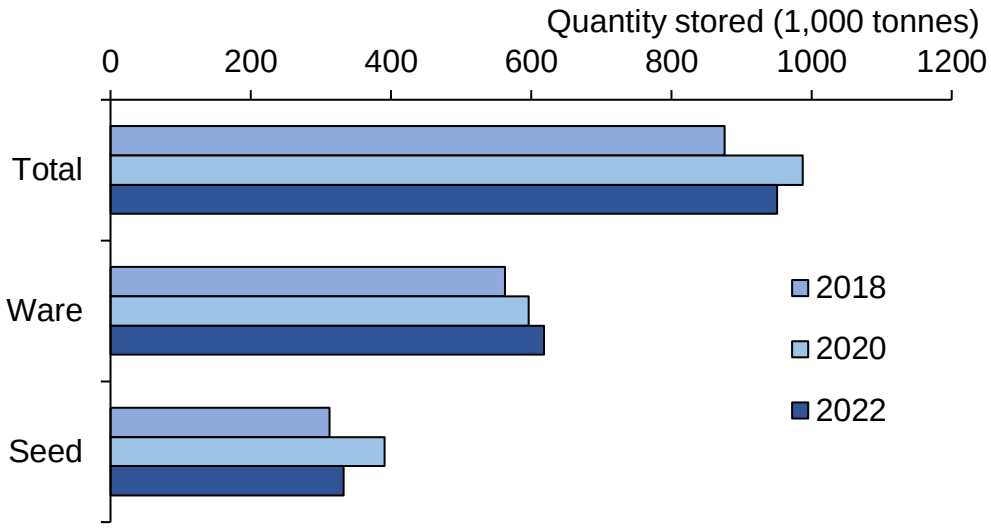
The estimated quantity of ware potatoes stored in 2022 was 618,449 tonnes, representing a four per cent increase from 2020 and a ten per cent increase from 2018.

As in 2020 and 2018, all potatoes surveyed in 2022 were stored in boxes. Seed crops were mainly held in refrigerated stores (78 per cent) with the remainder in ambient ventilated stores (22 per cent). There were no seed potatoes encountered in unventilated stores in 2022 (<0.5 per cent in 2020). The majority of seed crops were also held in refrigerated stores in 2020 and 2018 (60 and 67 per cent respectively).

Ware potatoes were mostly refrigerated in 2022 (82 per cent) with 17 per cent in ambient ventilated stores and a very small proportion in unventilated stores (<0.5 per cent). The proportion of ware potatoes refrigerated was similar in 2022 compared to 2020 (86 per cent). However, prior to this the proportion of

ware potatoes held in refrigerated stores steadily increased (80, 77 and 66 per cent in 2018, 2016 and 2014 respectively).

Figure 1 Estimated total potato storage in Scotland 2018-2022



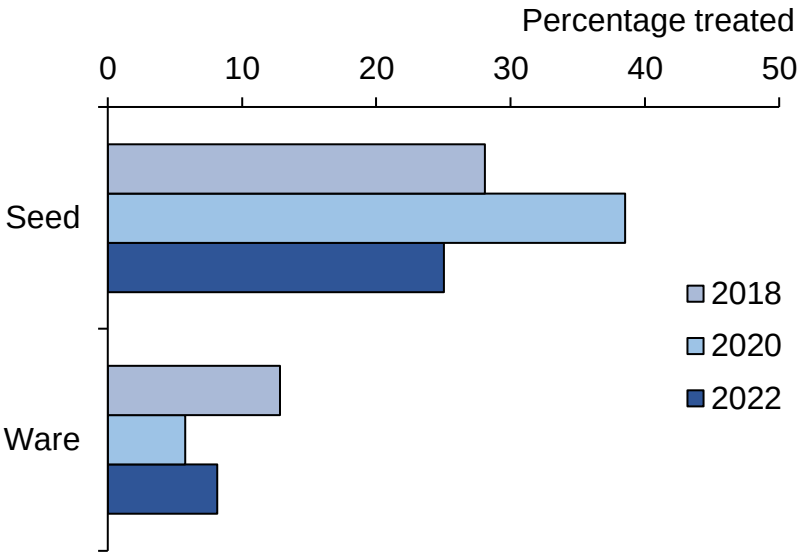
Please note, there has been a significant change in survey methodology which must be taken into account when comparing data from 2022 and previous surveys, see Appendix 4 for further information. The above figure presents the estimated total potato storage in Scotland for 2018 using the methodology from the 2020 survey (not the 2018 survey) for comparison purposes.

Pesticide usage

Seed potatoes

The proportion of seed potatoes treated with a pesticide in 2022 was 25 per cent. This is lower than the 39 per cent treated in 2020 but similar to the proportion treated in 2018 (28 per cent). Seed potatoes were lifted in good condition in 2022, which reduced the risk of rots associated with wet soils and a heavy soil loading at harvest[5], which may have influenced the decline in pesticide use in store. Likewise, pesticide use on seed potatoes in 2018 was considered to be low, with the assumption that this was influenced by the good quality of seed potatoes harvested that year.

Figure 2 Percentage of stored potatoes treated with pesticides in Scotland 2018-2022



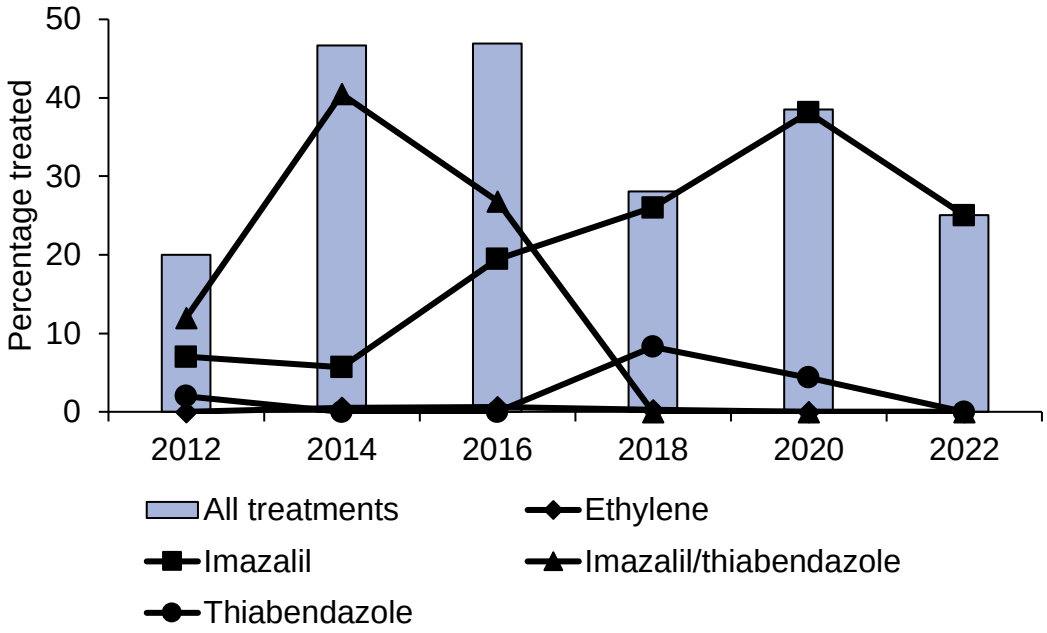
The only active substance encountered in seed potato stores in 2022 was the fungicide imazalil applied to 25 per cent of the seed crop (Figure 3, Table 2). Imazalil was also the most commonly used fungicide in 2020 and 2018 applied to 38 and 26 per cent of the seed crops respectively. No thiabendazole use was encountered on seed crops in 2022. Its use has declined in recent years (eight per cent in 2018 and four per cent in 2020) which may have been influenced by the occurrence of resistance to thiabendazole in some storage diseases[6].

Prior to 2018 the most commonly used fungicide was a formulation of imazalil/thiabendazole which was applied to 27 per cent of stored seed in 2016 and 40 per cent in 2014. This imazalil/thiabendazole formulation lost approval in 2015 and had a final use date of June 2017.

No ethylene was recorded on stored seed potatoes in 2022 or in 2020. In the three surveys prior to 2020 a small proportion (<1 per cent) of stored seed potatoes were treated with ethylene. In these previous surveys, ethylene use on seed potatoes was only encountered in one commercial store which is no-longer operating. Ethylene, which is generated from ethanol, is not approved

as a plant protection product for stored seed potatoes. However, it is approved as a commodity substance for plant growth regulation for post-harvest crops under COPR[7].

Figure 3 Percentage of stored seed potatoes treated with a pesticide in Scotland 2012-2022



Ware potatoes

The proportion of stored ware potatoes treated with a pesticide in 2022 was eight per cent, similar to the six per cent in 2020, but lower than the 13 per cent in 2018 (Figure 2). The decrease in the proportion of the ware crop treated between 2018 and 2020 may have been influenced by the reduced number of approved products available following the loss of the growth regulator active substance chlorpropham.

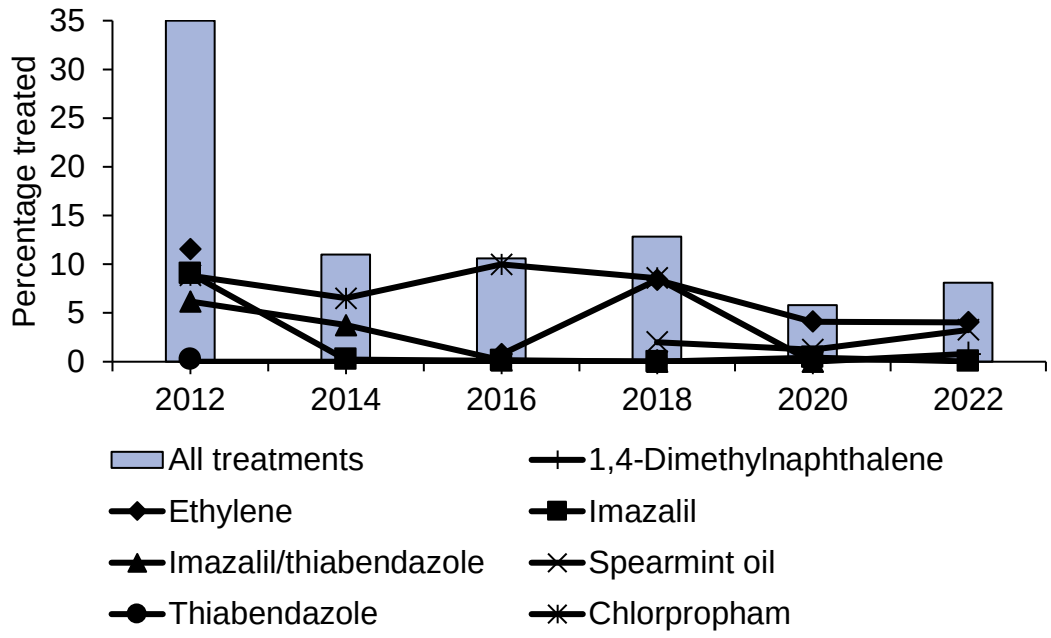
Similar to the previous survey, less than 0.5 per cent of the stored crop was treated with a fungicide in 2022. Historically, with the exception of 2012, which was an outlier, less than five per cent of stored ware potatoes have been treated with a fungicide over the last decade. Imazalil, the only fungicide encountered in ware potato stores in 2022, is not approved as a plant protection product for stored ware potatoes. It was applied to seed crops which were later reclassified as ware. During 2023, Scottish Government officials wrote to seed potato growers highlighting that imazalil treated crops cannot be used for human or animal consumption.

Almost all the pesticides used in ware stores were growth regulators (>99 per cent, Figure 4). 1,4-dimethylnaphthalene, a sprout suppressant approved for use in potato stores in August 22, was applied to an estimated one per cent of ware potatoes. This active may in future increase in use as chlorpropham which had been the principal active substance in 2018 and 2016 (applied to nine and ten per cent respectively) was withdrawn in 2020.

Ethylene was applied to an estimated four per cent of the stored ware potato crop in 2022 and 2020, compared with eight per cent in 2018. Spearmint oil,

which is a sprout suppressant, applied as a fog in store, was applied to an estimated three per cent of the stored ware potato crop in 2022, similar to previous surveys (one per cent in 2020 and two per cent in 2018). It is worth noting, since the loss of chlorpropham in 2020, there has not been a significant increase in the use of other growth regulators in store. However, an increase in the use of maleic hydrazide, applied as a field treatment to prevent sprouting during storage was recorded in the recent Pesticide Usage in Arable Crop reports. Maleic hydrazide was applied to 12 per cent of the ware crop in 2022, compared to eight per cent in 2020 and two per cent in 2018. Although it should be noted that the use of growth regulators has shown variation over time, as have the compounds encountered (Figure 4) and it is difficult to interpret trends within this data series.

Figure 4 Percentage of stored ware potatoes treated with a pesticide in Scotland 2012-2022



Note: this figure corrects some minor errors published in previous reports. Previously, the percentage of stored ware potatoes treated was calculated using the total tonnage treated, rather than basic tonnage treated. See Appendix 3 for definitions. The difference in the percentage of stored ware potatoes treated with a pesticide between methods is low (less than one per cent for all treatments except for chlorpropham, which is impacted by one and two per cent in 2012, 2014 and 2018, and seven per cent in 2016).

2022 Potato storage and pesticide usage

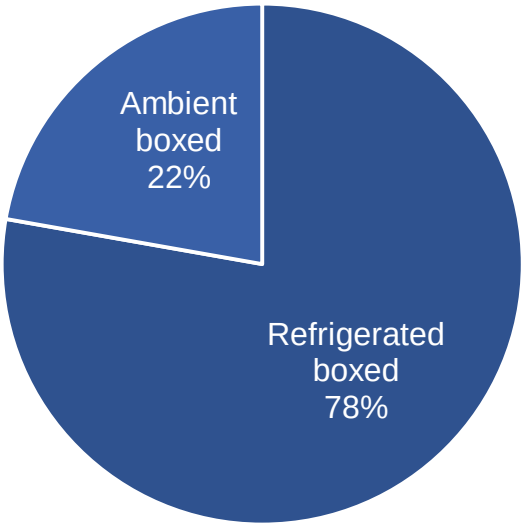
Seed potatoes

- An estimated 332,745 tonnes of seed potatoes were stored in Scotland in 2022, compared with an estimated 391,208 tonnes stored in 2020
- 78 per cent of seed potatoes were stored in refrigerated stores and 22 per cent in ambient ventilated stores (Figure 5)
- All seed potatoes sampled in 2022 were stored in boxes
- Overall, 25 per cent of seed potatoes received a pesticide treatment in store
- The percentage of seed potatoes receiving an in-store pesticide treatment was 53 per cent in ambient ventilated stores and 17 per cent in refrigerated stores (Table 1)
- The fungicide imazalil was the only active substance encountered in seed potatoes (summary below)
- Imazalil is applied as a spray to tubers
- Reasons for use were supplied for 95 per cent of the crop which was treated with fungicides. General storage diseases was the only reason supplied

Summary of estimated pesticide use on seed potatoes in store:

Pesticide formulation	Total tonnes treated	Percentage treated
Imazalil	83,276	25

Figure 5 Seed potato storage by type – 2022



Ware potatoes

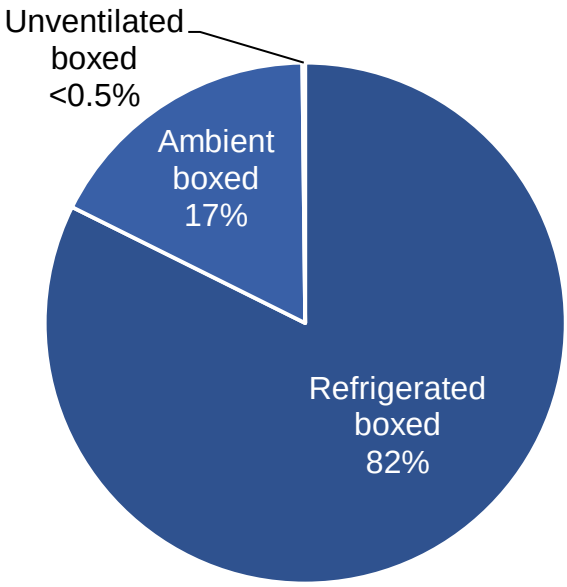
- An estimated 618,449 tonnes of ware potatoes were stored in Scotland in 2022, compared with the estimated 596,407 tonnes stored in 2020
- 82 per cent of ware potatoes were stored in refrigerated stores, 17 per cent were stored in ambient ventilated stores and less than one per cent in unventilated stores (Figure 6)
- All ware potatoes sampled were stored in boxes
- Eight per cent of ware potatoes received a pesticide treatment in store
- The percentage of ware potatoes receiving an in-store pesticide treatment was seven and 14 per cent in refrigerated stores and ambient ventilated stores respectively (Table 1)
- One fungicide (imazalil) and three growth regulators (ethylene, spearmint oil & 1,4-dimethylnaphthalene) were encountered in ware potato stores (summary below)
- Imazalil is applied as a spray to tubers. Ethylene is applied as a gas, spearmint oil and 1,4-dimethylnaphthalene are applied as a fog to stores
- Reasons for use were supplied for less than 0.5 per cent of the crop which was treated with fungicides. Storage diseases was the only reason given
- The only specified reason for use of growth regulators was sprout suppression

Summary of estimated pesticide use on ware potatoes in store:

Pesticide formulation	Total tonnes treated	Percentage treated
1,4-dimethylnaphthalene	10,024	1
Ethylene	24,941	4
Imazalil(1)	201	0.03
Spearmint oil	23,280	3

(1) This formulation is not approved as a plant protection product for stored ware potatoes. Refer to Pesticide usage – Ware potatoes section for details.

Figure 6 Ware potato storage by type – 2022



Appendix 1 – Estimated application tables

Table 1 Potatoes stored, and proportion treated, by storage type – 2022

	Store type			Total
	Unventilated	Ventilated	Refrigerated	
Seed				
Tonnes stored	0	73,952	258,793	**332,745**
Percentage type	[z]	22	78	
Basic tonnes treated	0	39,094	44,182	**83,276**
Percentage treated	[z]	53	17	**25**
Ware				
Tonnes stored	1,087	108,071	509,291	**618,449**
Percentage type	0.2	17	82	
Basic tonnes treated	0	14,683	35,619	**50,302**
Percentage treated	[z]	14	7	**8**
All stored potatoes				
Tonnes stored	1,087	182,023	768,084	**951,194**
Percentage type	0.1	19	81	
Basic tonnes treated	0	53,777	79,801	**133,578**
Percentage treated	[z]	30	10	**14**

Note: some shorthand is used in this table: [z] = not applicable.

Table 2 Potato storage treatment formulations by storage type – 2022

	Store type			Total tonnes treated	Percentage treated
	Unventilated	Ventilated	Refrigerated		
Seed					
Imazalil	0	39,094	44,182	**83,276**	25
Basic tonnes treated(2)	0	39,094	44,182	**83,276**	25
Ware					
1,4-dimethylnaphthalene	0	10,024	0	**10,024**	1
Ethylene	0	0	24,941	**24,941**	4
Imazalil(1)	0	201	0	**201**	0.03
Spearmint oil	0	12,603	10,677	**23,280**	3
Basic tonnes treated(2)	0	14,683	35,619	**50,302**	8

(1) This formulation is not approved on ware potatoes. It was applied to seed crops, a proportion of which was later reclassified as ware.
(2) This represents the total tonnage treated, not the column sum, as more than one formulation may be applied to potatoes in store.

Table 3 Potato storage treatment active substances – 2022

	Tonnes treated	kg
Seed		
Imazalil	83,276	1,196
Ware		
1,4-Dimethylnaphthalene	10,024	200
Ethylene	24,941	[z](1)
Imazalil(2)	201	2
Spearmint oil	23,281	1,655

Note: some shorthand is used in this table: [z] = not applicable.
(1) The mass of ethylene used cannot be estimated (refer to Appendix 3 – definitions and notes).
(2) This active substance is not approved as a plant protection product for stored ware potatoes. Refer to Pesticide usage – Ware potatoes section.

Table 4 Potato cultivation and storage, comparison with previous surveys – 2022

	Crop	2018	2020	2022
Area grown (ha)(1)	Seed	12,092	12,003	11,894
	Ware	15,268	16,294	15,248
Tonnes stored(2)	Seed	312,793	391,208	332,745
	Ware	562,894	596,407	618,449

(1) This is the census area of the crops intended to be grown for seed and ware production. Some of the seed crop was reclassified as ware post-harvest. As there was no June Agricultural Census in 2022 the SAF area has been used.
(2) Please note, there has been a significant change in survey methodology which must be taken into account when comparing data from 2022 and previous surveys, see Appendix 4 for further information.

Table 5 Percentage of stored potatoes treated, comparison with previous surveys – 2022

	Crop	2018	2020	2022
Total tonnage treated (%)	Seed	28	39	25
	Ware	13	6	8

Appendix 2 – Survey statistics

Census and sample information

Table 6 Distribution of sampled potato stores - 2022

Number of potato growers sampled in each region

Region		Number of stores
North:	Highlands & Islands, Caithness & Orkney, Moray Firth and Aberdeen	11
Angus		36
Central:	East Fife, Central Lowlands and Lothian	18
South:	Tweed Valley, Southern Uplands and Solway	8
Scotland		73

Table 7 Distribution of stored potatoes in sample - 2022

Quantity (tonnes) of potatoes sampled in each region

Crop	North	Angus	Central	South	Scotland
Seed potatoes	17,980	73,675	14,026	7,608	**113,289**
Ware potatoes	16,008	112,996	58,645	43,681	**231,330**
Total	**33,988**	**186,671**	**72,671**	**51,289**	**344,619**

Table 8 Distribution of sample areas – 2022

Areas (ha) of potatoes sampled in each region

Crop	North	Angus	Central	South	Scotland
Seed potatoes	524	2,530	424	261	**3,738**
Ware potatoes	384	1,639	1,153	820	**3,996**
Total	**908**	**4,169**	**1,577**	**1,081**	**7,735**

Table 9 Distribution of SAF areas – 2022

Areas (ha) of potato crops grown in Scotland

Crop	North	Angus	Central	South	Scotland
Seed potatoes	4,465	5,258	1,635	536	**11,894**
Ware potatoes	1,361	7,142	5,084	1,661	**15,248**
Total	**5,826**	**12,400**	**6,719**	**2,197**	**27,142**

Table 10 Raising factors – 2022

Region	Seed	Ware
North	8.5186	3.5461
Angus	2.0781	4.3572
Central	3.8602	4.4092
South	2.0566	2.0251

Table 11 First adjustment factors for ware potatoes – 2022

Region	Ware
North	1.1439
Angus	0.9289
Central	0.9980
South	1.0001

Table 12 Second adjustment factors – 2022

Crop	Adjustment factor
Seed potatoes	0.8848
Ware potatoes	0.7118

Financial burden to farmers

To minimise the burden on farmers, the survey team used non-visit methods of collection such as email, post, or telephone call.

To determine the total burden that the 2022 Potato Storage survey placed on those providing the information, the surveyors recorded the time that 73 respondents spent providing the data during the surveys. This sample represents 97 per cent of growers surveyed. The median time taken to provide the information was 10 minutes.

The following formula was used to estimate the total cost of participating:

Burden (£) = No. surveyed x median time taken (hours) x typical hourly rate*

(* using median "Full Time Gross" hourly pay for Scotland of £16.69)[9]

The total financial burden to all growers resulting from participation in the 2022 Potato Storage survey was calculated to be £203.06.

Appendix 3 - Definitions and notes

1) Pesticide information recorded in this survey relates to **any pesticide usage during potato storage** and to **post-harvest applications**, carried out in the field at lifting, prior to entry to the store. Pre-planting treatments with a fungicide intended to control disease post-planting e.g. black scurf, are not included, even if the fungicide had been applied in store. Use of pesticides in this situation is recorded in the seed treatment section of the preceding arable crop report.

2) '**Pesticide**' is used throughout this report to include commercial formulations containing active substances (a.s.) used as herbicides, fungicides, insecticides, molluscicides, biological control agents, growth regulators, seed treatments and physical control. A pesticide product consists of one or more active substances co-formulated with other materials. In this survey, only fungicides and sprout suppressants (growth regulators) were encountered.

3) An **active substance** is any substance or micro-organism which has a general or specific action against harmful organisms or on plants, parts of plants or plant products.

4) In this report the term '**formulation**(s)' is used to describe the pesticide active substance or mixture of active substances in a product(s). It does not refer to any of the solvents, pH modifiers or adjuvants also contained within a product that contribute to its efficacy.

5) A **fungicide** is a pesticide used to control fungal diseases in plants or potato tubers.

6) A **growth regulator** is a pesticide used to regulate the growth of the plant, for example to suppress the growth of sprouts by potato tubers in store.

7) A **seed treatment** is a pesticide applied to seed or potato tuber before planting to protect that plant against disease and pests from the earliest stage of development.

8) **Basic tonnage** is the quantity of potatoes treated with a pesticide, irrespective of the number of times they were treated or the number of pesticides used. This figure is used to calculate the percentage of potatoes treated with a given pesticide or pesticide group.

9) **Tonnage treated** is the basic tonnage of potatoes treated with a pesticide multiplied by the number of treatments applied to those potatoes. For example, if ten tonnes of potatoes are treated with a pesticide twice, the basic tonnage is five tonnes, and the tonnage treated is twenty tonnes.

10) **Seed potatoes** are crops grown for marketing or planting as seed for next season's crop. A fraction of the crop intended for seed production may not meet the necessary requirements and may be reclassified as ware potatoes post-harvest.

11) **Ware potatoes** are those grown for the ware (consumption) market, including those processed by a manufacturer. Ware potatoes may include a proportion of potatoes originally planned for seed production but later classified as ware.

12) **Unventilated stores** are defined as simple stores without fans that are naturally ventilated.

13) **Ventilated stores** can either be **adapted ambient** or **purpose built ambient ventilated stores**. These stores use forced air ventilation; they are not refrigerated.

14) **Adapted ambient ventilated stores** are basic stores with forced air ventilation. These stores commonly contain temporary fans and raised vents (normally wire hoops) on the floor of the store.

15) **Purpose built ambient ventilated stores** are purpose-built stores with forced air ventilation including open walled letterbox systems or suction wall systems. The potatoes are often stored to a depth of 3-5 metres; the floor is concrete and contains ventilation ducts. Pesticides can be applied by means of fogs and gases dispersed through the ventilation system.

16) **Refrigerated Stores** are purpose-built stores which may also have mechanically assisted ventilation. Potatoes are stored at low temperatures which can help reduce the use of pesticides. Pesticides can be applied through the ventilation system.

17) Potatoes can be stored either in **bulk** (loose potatoes) or in **wooden boxes**. Potatoes stored in bags are excluded from this survey.

18) **Ethanol** is used as an **ethylene** generator to suppress tuber sprouting in stores. There is no standard recommended rate per tonne for the use of ethanol in potato stores and the quantity used varies according to store capacity, crop volume, type of store and duration of storage. In most cases the actual rate of application is not available and total quantity cannot be estimated. Therefore, estimated use of this pesticide is presented only as tonnes of potatoes treated.

19) In this report each estimated use of each pesticide is reported in three formats; tonnes treated with pesticide formulations (mixture of active substances in a product) and of individual active substances and quantities of active substance applied (Table 2 formulation data, Table 3 for active substance treated tonnes and quantity data). All three different formats are provided to satisfy the needs of all data users and allow them to assess pesticide use trends. Some users may be interested in use of pesticide products which contain a number of active substances, thus formulation data would be required. Other users are interested in particular active substances which may be formulated on their own or in combination with other active substances. Therefore, active substance data would be required. In addition, both quantity and tonnes treated with pesticides are important indicators of

changes in use over time. Only single active substance formulations were encountered in 2022.

20) The **June Agricultural Census**[9] is conducted annually by the Scottish Government's Rural and Environmental Science Analytical Services (RESAS). The June Agricultural Census collects data on land use, crop areas, livestock and the number of people working on agricultural holdings. For previous reports the June Agricultural Census was used to draw a sample of growers growing the relevant crops to participate in the survey. As there was no census conducted in 2022 (see changes from previous years section), for this report, the 2022 Single Application Form (SAF) data was used to draw a sample of farmers growing the relevant crops to participate in the survey.

21) Where quoted in the text or within figures, reasons for application are the grower's stated reasons for use of that particular pesticide on that crop and may not always seem appropriate. It should be noted that growers do not always provide reasons; therefore, those presented in the figures only reflect those specified and may not reflect overall reasons for use.

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

23) Data from the 2020[3] and 2018[4] surveys are provided for comparison purposes in some of the tables and figures. It should be noted that there may be changes in areas of seed and ware potatoes grown between survey years. Also, when comparisons are made between surveys it is important to take into account that there may be changes in quantity of potatoes stored.

24) For notes on quality and sources of bias please refer to the notes and definitions section of the preceding arable report.

Appendix 4 – Survey methodology

Sampling and data collection

Using the May 2022 Single Application Form (SAF) data, a sample was drawn representing arable cultivation in Scotland. The country was divided into 11 land-use regions (Figure 7). Each sample was stratified by these land-use regions and according to holding size. The holding size groups were based on the total area of arable crops grown. The sampling fractions used within both regions and size groups were based on the areas of relevant crops grown rather than number of holdings, so that smaller holdings would not dominate the sample.

Data relating to pesticide use in potato stores were collected from all potato growers encountered in the arable sample, either during an on-farm or telephone interview, or via e-mail. In instances where the potato land was let, and storage was on a separate holding, the potato grower was contacted individually to obtain storage details. Data were collected for all potatoes stored by these growers, not just for those crops grown on the holdings sampled. Therefore, the sample of stored potatoes relates to a greater area of potato cultivation than that for which field pesticide treatments were collected in the 2022 arable pesticide survey report. In total, data were collected from 73 growers. The crops grown by these growers represent 28 per cent of the total 2022 potato crop SAF area.

The data collected included the areas of seed and ware crops grown, quantities of potatoes sold and stored, storage type, storage method and post-harvest pesticide applications at crop lifting and during storage. Fungicidal seed treatments applied prior to planting are included in the arable crop report.

Raising factors

National pesticide use was estimated by ratio raising. This is a standard statistical technique for producing estimates from a sample. It is the same methodology used by the other UK survey teams and has been used for all historical datasets produced by the Pesticide Survey Unit, allowing comparability over time. The sample data were multiplied by raising factors (Table 10). These factors were calculated by comparing the sample area to the areas recorded in the May 2022 SAF data within each region and size group (please see changes from previous years section for further detail). An adjustment (Table 11) was made to the ware fraction to correct for the potatoes grown as seed that were then designated as ware. A second adjustment (Table 12) was made to align the survey estimates of total tonnes stored with the estimated tonnage of Scottish potato stocks held in store at the end of November provided by SASA Potato section. This represents a change in methodology from previous surveys (see next section).

Due to the low numbers of potatoes grown and sampled in some geographic regions, stored data were amalgamated into four regions to allow more robust estimation of pesticide use: the North (Highlands & Islands, Caithness & Orkney, Moray Firth and Aberdeen), Angus (the main potato growing area in

Scotland), Central (East Fife, Lothian, and Central Lowlands) and the South (Tweed Valley, Southern Uplands, and Solway).

Changes from previous years

There are a number of changes which should be noted when comparing the 2022 data with the previous survey.

For previous reports, the June Agricultural Census was used to draw a sample of farmers growing the relevant crops to participate in the survey. National pesticide use was then estimated by ratio raising, by comparing the sample area to the areas recorded in the June Agricultural Census data.

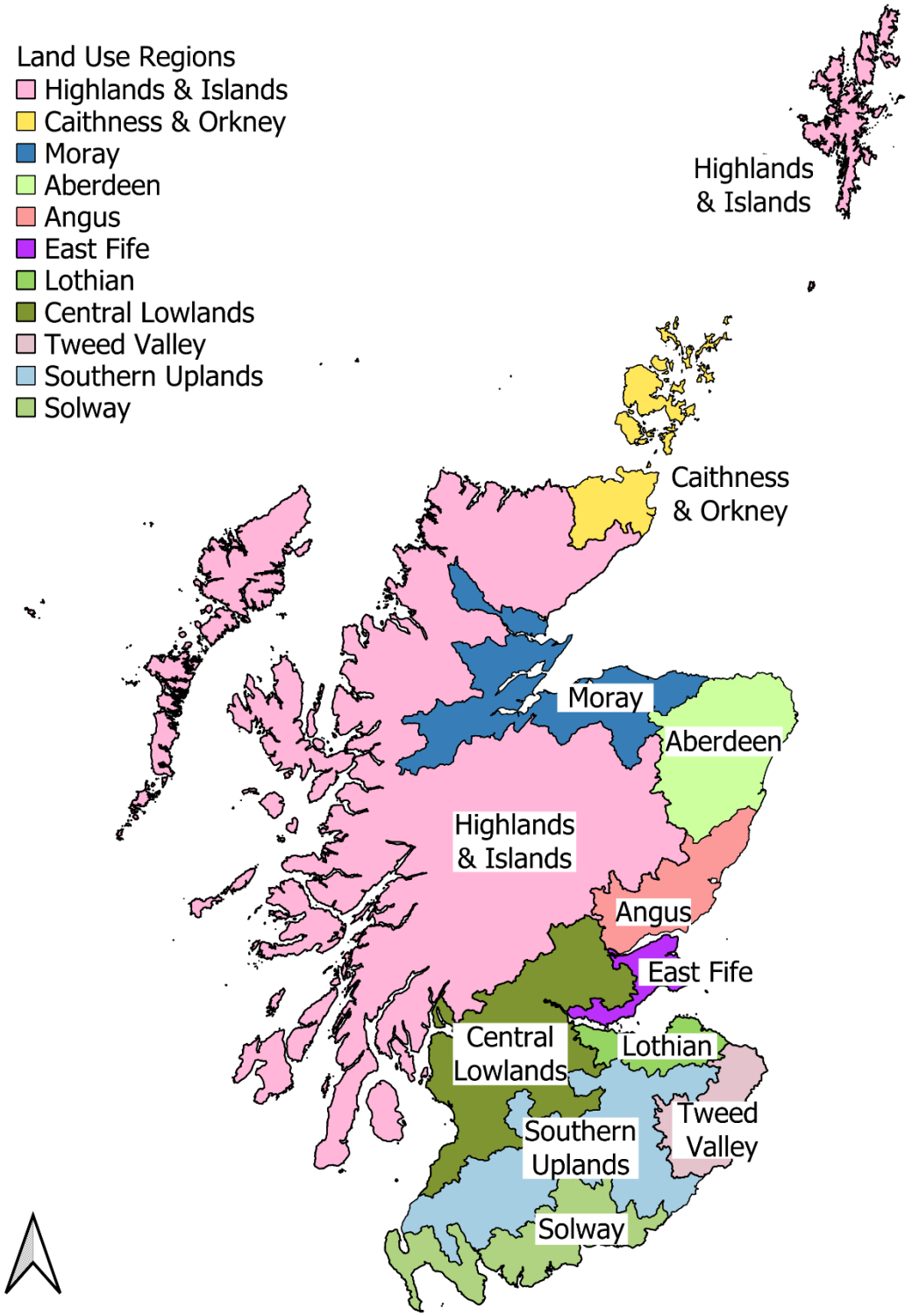
To allow for the Agricultural Statistics Transformation Programme[11], the June 2022 Agricultural Census was paused. This pause was agreed with the Office for Statistical Regulation and data users.

For this report, the May 2022 Single Application Form (SAF) data was used to draw the sample and estimate national pesticide use using the same methodology as previous surveys. SAF data accounts for the majority of land area for arable crops. The sample drawn is based on area of crop grown, rather than number of holdings. As such, no attempt is made to account for holdings that are not captured by SAF returns.

There has been a further significant change in the raising process. During the statistical estimation of national pesticide use on stored crops from the sample surveyed (see raising factor section), an adjustment is made to align the survey estimates of total tonnes stored with production estimates previously provided by AHDB Potatoes. All market intelligence work by AHDB potatoes ceased from July 2021, therefore this data was no longer available. Instead, in 2022, production and storage figures were obtained using data provided by the SASA potato department and the Seed Potato Classification Scheme. It was estimated that 80 per cent of the seed and ware potatoes produced in Scotland were still in storage at the end of November 2022.

There was also a significant change in the statistical estimation of national pesticide use on stored crops from the sample surveyed between 2018 and 2020. Please refer to the 2020 report for a full explanation. The 2020 report published a correction to the 2018 storage methods using the new method. The 2020 and updated 2018 figures from the 2020 report have been included in this report for comparison purposes.

Figure 7 Land use regions of Scotland[10]



Acknowledgements

Thanks are due to all the growers who provided the information for this report. Thanks, are also due to John Ellicott (SASA) for information on Scottish potato production, and to Gillian Reay and Jackie Hughes (SASA), Fiona Burnett (SRUC), Sara Cook (ADAS) and Ingrid den Hoed (CRD) for editorial assistance. In addition, the authors are grateful for the support from Lewis Ridley and colleagues at Fera Science Ltd, Paul Gavin at the Scottish Government's Agricultural Census Analysis Team and to Adrian Roberts of Biomathematics & Statistics Scotland for support.

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ISBN 978-1-83521-719-1 (Web only)

Scottish Government
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Any enquiries regarding this publication should be sent to us at

The Scottish Government
St Andrew's House
Edinburgh
EH1 3DG

ISBN: 978-1-83521-719-1 (web only)

Published by The Scottish Government, December 2023

Produced for The Scottish Government by APS Group Scotland, 21 Tennant Street, Edinburgh EH6 5NA
PPDAS1391474 (12/23)

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