Scottish Government
Riaghaltas na h-Alba

Pesticide Usage in Scotland

A National Statistics Publication for Scotland

Soft Fruit Crops 2022

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Executive summary

This report presents information from a survey of pesticide use on soft fruit crops grown in Scotland during 2022. The crops surveyed included strawberries, raspberries, blackcurrants and other minor soft fruit crops.

It should be noted that as there was no June 2022 Agricultural Census, crop areas and as a result, 2022 pesticide usage estimates are based on 2021 crop census data (see Appendix 4 for full details). From the 2021 data, the estimated areas of soft fruit grown in Scotland was 2,198 hectares, including 39 hectares of multi-cropping. Strawberries accounted for 56 per cent of the soft fruit area, other soft fruit crops 19 per cent, blackcurrants 14 per cent and raspberries 11 per cent. Data were collected from a total of 81 holdings in 2022, collectively representing 61 per cent of the total 2021 soft fruit crop area. Ratio raising was used to produce estimates of national pesticide use from the sampled data.

The estimated total area of soft fruit crops treated with a pesticide formulation (area grown multiplied by number of treatments) was ca. 36,000 hectares (± 12 per cent Relative Standard Error, RSE) with a combined weight of ca. 13 tonnes (± 17 per cent RSE). Overall, pesticides were applied to 92 per cent of the soft fruit crop area. Fungicides were applied to 86 per cent of the crop area, insecticides/acaricides to 83 per cent, biological controls to 55 per cent, herbicides to 34 per cent, sulphur to 13 per cent and molluscicides to 11 per cent.

Taking into account changes in crop area, the 2022 total pesticide treated area was similar to that reported in 2020 and eight per cent higher than in 2018. The weight of pesticides applied to soft fruit crops in 2022 was 25 per cent lower than in 2020 and 29 per cent lower than in 2018. The application of all pesticide groups decreased since the previous survey in 2020 with the exception of biological control agents, biopesticides and physical controls which increased by 135, 129 and 108 per cent in treated area respectively. Use of biological and physical controls play an increasingly important part in growers Integrated Pest Management (IPM) programmes as the availability of active chemical substances become more restricted. As invertebrate biological control agents are applied by number of organisms rather than weight, only the area treated is recorded, which contributes to the reduction in overall weight of pesticides used. Biological (both biological control agents and biopesticides) and physical control products represented ca. 32 per cent of pesticide formulations used in 2022 in comparison to ca. 14 per cent in 2020. The biggest increase in use was in relation to invertebrate biological control agents (135 per cent increase from 2020) with a large number encountered for the first time in 2022 (Table 17).

In contrast, the application of sulphur, molluscicides, insecticides/ acaricides, herbicides/desiccants and fungicides decreased by 73, 59, 25, 25 and 14 per cent in treated areas respectively.

The most commonly used active substance, in terms of area treated, was the biological control agent *Neoseiulus cucumeris*. The fungicides pyraclostrobin and boscalid were the most used fungicides and *Bacillus subtilis* strain QST 713, spirotetramat and carfentrazone-ethyl were the most used biopesticide,

insecticide/acaricide and herbicide/desiccant active substances respectively. Sulphur, which is used at high application rates, was the most commonly used pesticide by weight. This has been the case in every soft fruit survey since 2014.

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 soft fruit 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 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.

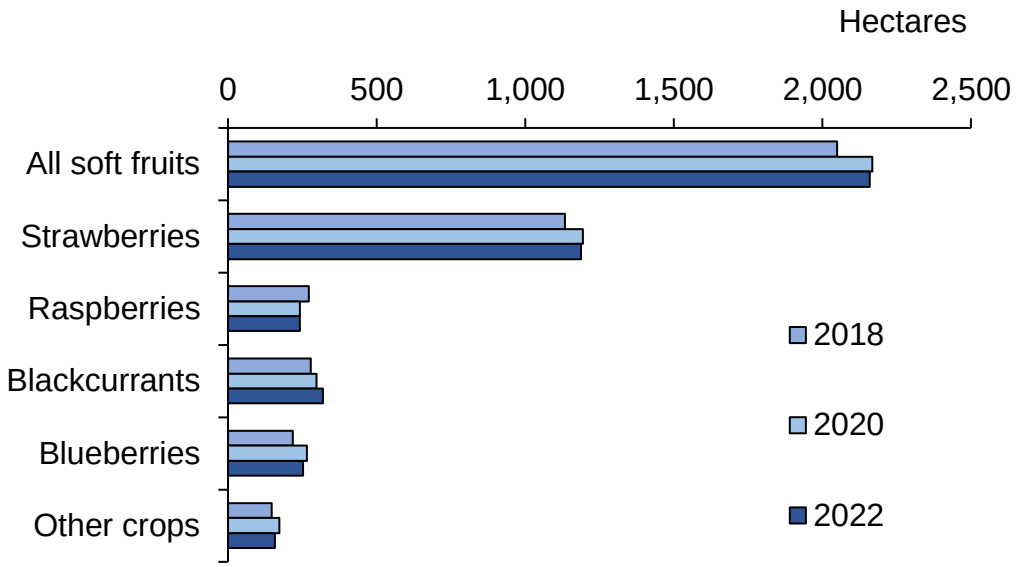
General trends

Crop area

It should be noted that as there was no June 2022 Agricultural Census, crop areas reported and used to estimate 2022 pesticide usage data are those returned in the 2021 census (see Appendix 4, Changes from previous years for full details).
In 2022 the estimated area of soft fruit crops grown was 2,198 hectares (based on the June 2021 Agricultural Census, Table 21). This is very similar to the estimated 2,168 ha grown in 2020[3] and a five per cent increase from 2018[4]. Strawberry and raspberry areas were very similar to the 2020 survey, both changing by less than one per cent. The areas of mixed/other soft fruits and blueberries decreased since the last survey in 2020 (nine and four per cent respectively), while the area of blackcurrants increased eight per cent (Figure 1).

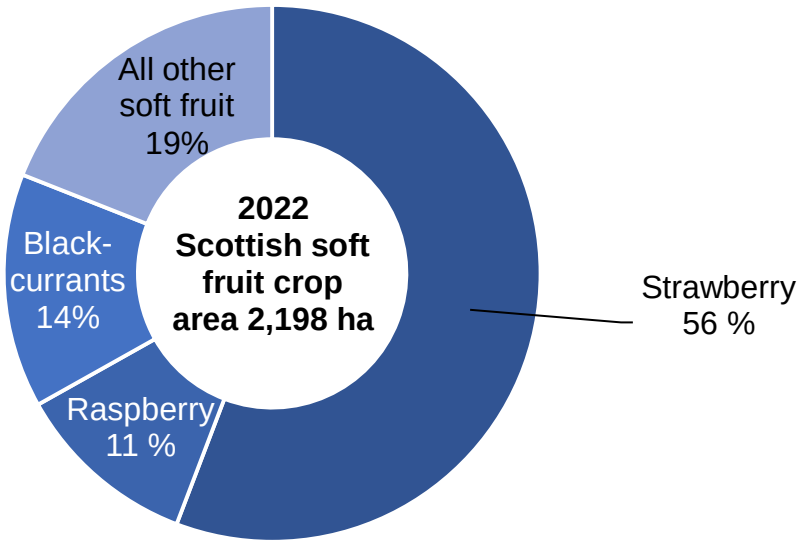
In 2022, strawberries accounted for 56 per cent of the soft fruit area, blackcurrants 14 per cent, raspberries 11 per cent, and other soft fruit crops (blueberries, blackberries, gooseberries, redcurrants and other minor crops) 19 per cent (Figure 2). The same percentages were reported in the 2020 survey[3].

Figure 1 Census area of soft fruit crops grown in Scotland 2018-2022



Note: areas include both non-protected and protected crops. Multi-cropping is not included. 2022 areas are based on the June 2021 Agricultural Census as there was no census in 2022 – see the changes from previous years section for further information.

Figure 2 Soft fruit crop areas 2022 (percentage of total area)



Note: areas include multi-cropping.

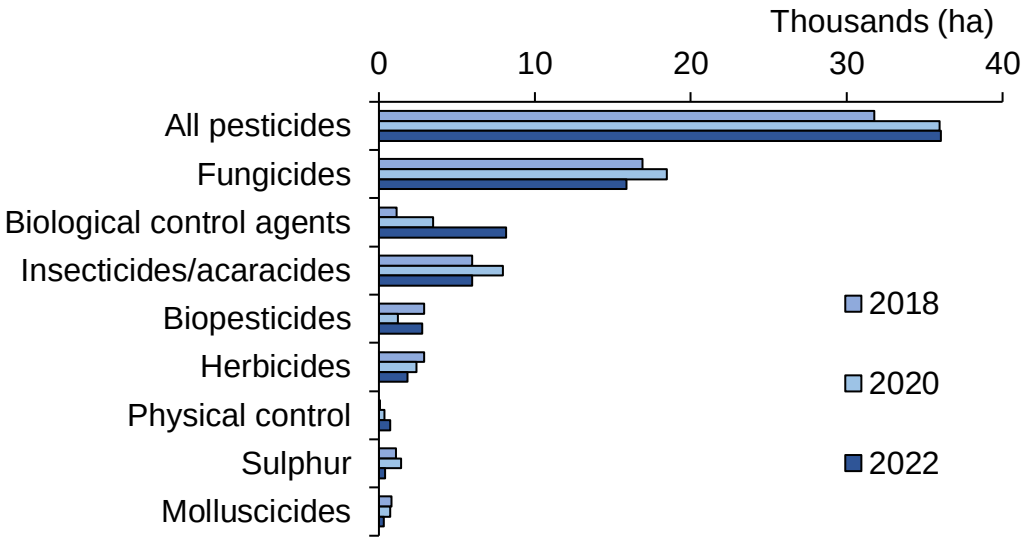
Pesticide usage

This section refers to pesticide usage patterns in overall soft fruit crops. For a description of usage on individual protected and unprotected crops please see the subsequent 2022 Pesticide usage section (pages 13 to 34).

The majority of soft fruit crops (92 per cent) received a pesticide treatment in 2022. Strawberries and blackcurrants had the highest overall proportion of crop treated with a pesticide (100 and 97 per cent respectively, Table 1). Raspberries and other soft fruit crops were estimated to have lower proportions of treated crop (89 and 68 per cent respectively). In relation to the average number of pesticide applications, the treated area of soft fruit crops received on average 14.4 sprays, compared with 12.4 sprays in the previous survey, with the increase being driven by an increased use of biological controls. Strawberries received the highest number of applications with an average of 18.5 sprays. In contrast the "All other soft fruit" category received the lowest number of sprays, 6.7 on average (Table 1).

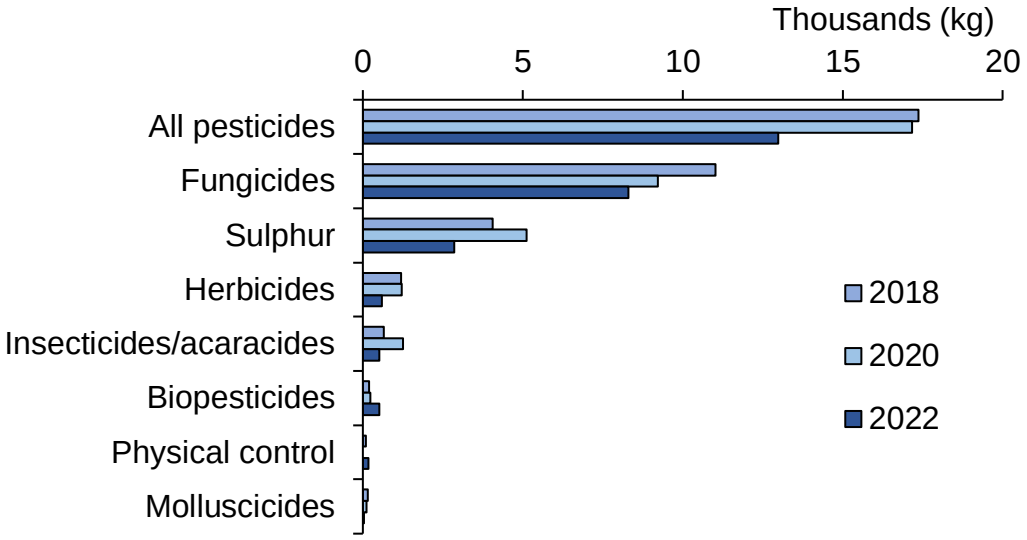
It is estimated that the area of soft fruit crops treated with a pesticide formulation (including biologicals) in 2022 and 2020 was ca. 36,000 hectares compared with ca. 31,800 hectares in 2018 (Table 20, Figure 3). This represents an increase of 13 per cent since 2018 and no change since 2020.

Figure 3 Area of soft fruit crops treated with the major pesticide groups in Scotland 2018-2022



In terms of weight of pesticide applied, ca. 13 tonnes were applied in 2022 compared with ca.17.2 tonnes in 2020 and ca. 17.4 tonnes in 2018 (Figure 4). This represents a decrease of 24 per cent from 2020 and of 25 per cent from 2018.

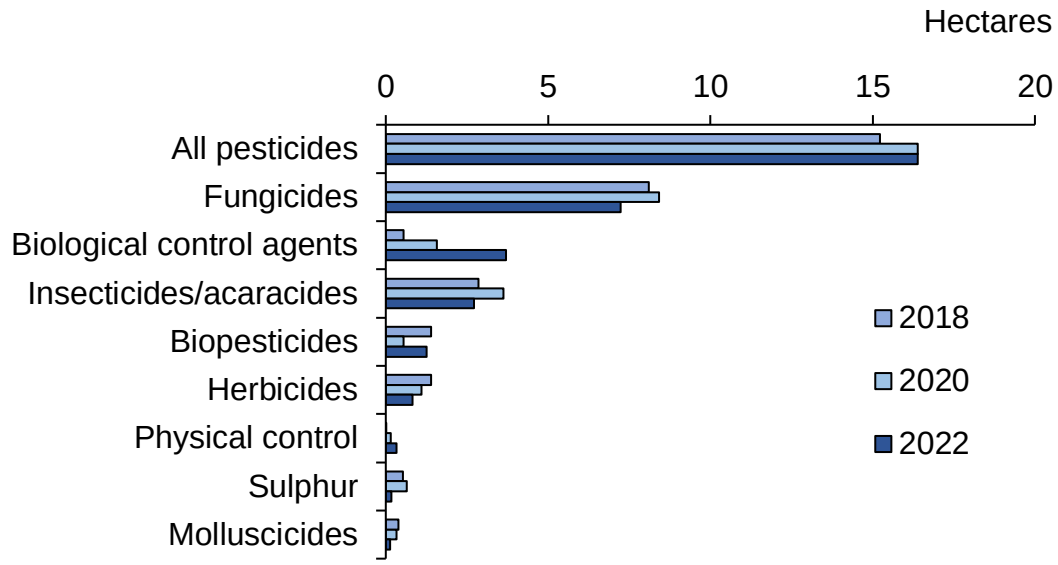
Figure 4 Weight of the major pesticide groups applied to the soft fruit crops in Scotland 2018-2022



Note: invertebrate biological control agents are applied by number of organisms rather than weight therefore data is not presented.

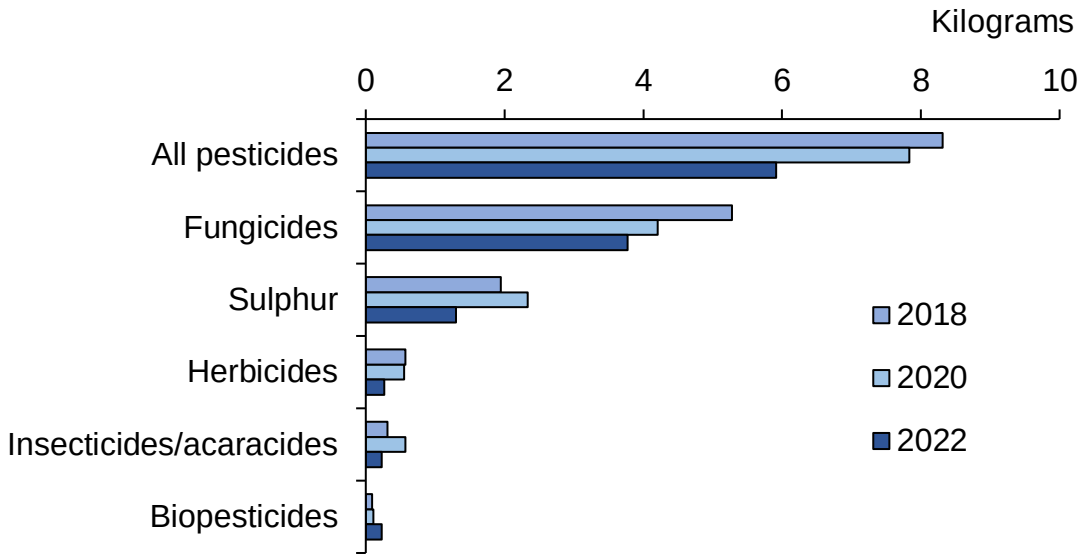
In order to make accurate comparisons between the 2022 data and that reported in previous surveys, it is important to take into account differences in crop areas between years. Therefore, the number of treated hectares per hectare of crop grown and the total weight of pesticide used per hectare of crop grown were calculated. In 2022, for each hectare of crop grown, around 16 treated hectares were recorded (Figure 5). This is unchanged from 2020 but represents an increase of eight per cent since 2018. In 2022, the number of pesticide treated hectares has decreased across all pesticide categories with the exception of biological control agents, biopesticides and physical controls which have more than doubled since the previous 2020 survey.

Figure 5 Number of pesticide treated hectares (formulations) per each hectare of crop grown 2018-2022



The estimated weight of pesticide applied per hectare of crop grown was almost six kilograms (Figure 6). This represents a decrease of 25 per cent from 2020 and 29 per cent from 2018. The unchanged area treated but decrease in weight applied in 2022 compared with 2020 is influenced by a large increase in the use of biological control agents, biopesticides and physical controls (increase of 135, 129 and 108 per cent in treated area respectively from 2020) and play an increasingly important part in growers Integrated Pest Management (IPM) programmes as the availability of active chemical substances become more restricted. As invertebrate biological control agents are applied by number of organisms rather than weight, only the area treated is recorded, which contributes to the reduction in overall weight of pesticides used. Biological (both biological control agents and biopesticides) and physical control products represented ca. 32 per cent of pesticide formulations used in 2022 in comparison to ca. 14 per cent in 2020.

Figure 6 Weight of pesticides applied per each hectare of crop grown 2018-2022



Note: molluscicides and physical control have been excluded as their use represents less than 0.1 kg per hectare of crop grown. Invertebrate biological control agents are applied by number of organisms rather than weight therefore data are not presented.

In 2022, fungicides were the most frequently used pesticides by area treated on soft fruit crops, followed by biological control agents, insecticide/acaricides and biopesticides (Figure 7). Fungicides accounted for 44 per cent of the total pesticide treated area and 64 per cent of the total weight of pesticides applied (Figures 7 and 8). When changes in crop area are taken into account decreases were seen for both area treated and weight applied. The area treated with fungicide formulations decreased by 14 per cent from 2020 to 2022 and by 11 per cent from 2018 to 2022 (Figure 5). Similarly, there was a decrease of 10 per cent in the weight of fungicides used per hectare of crop grown from 2020 to 2022 and a 28 per cent drop from 2018 to 2022 (Figure 6). A cool, dry spring may have reduced disease pressure in 2022. An increased use of biological control agents and biopesticides may also be a factor (discussed later).

Sulphur can be applied as a fungicide but is also used as an insecticide on blackcurrants. Sulphur accounted for one per cent of the total treated area and 22 per cent of the total weight of pesticides applied (Figures 7 and 8). When changes in area grown are taken into account, there was a 73 per cent decrease in the use of sulphur between 2020 and 2022, and a 67 per cent decrease from 2018 to 2022 (Figure 5). The weight of sulphur applied per hectare of crop grown also decreased by 44 per cent from 2020 to 2022 and by 33 per cent from 2018 to 2022 (Figure 6). When crop area is taken into account, the mean applications of sulphur were 1.3 kg/ha in 2022, 2.3 kg/ha in

2020 and 1.9 kg/ha in 2018. Sulphur was primarily applied to control big bud mite on blackcurrants, the vector for blackcurrant reversion virus, and being an essential macronutrient that can be applied as a foliar spray, sulphur helps supports plant functions that can affect yield, quality and marketability.

Figure 7 Use of pesticides on soft fruit crops - 2022 (percentage of total area treated with formulations)

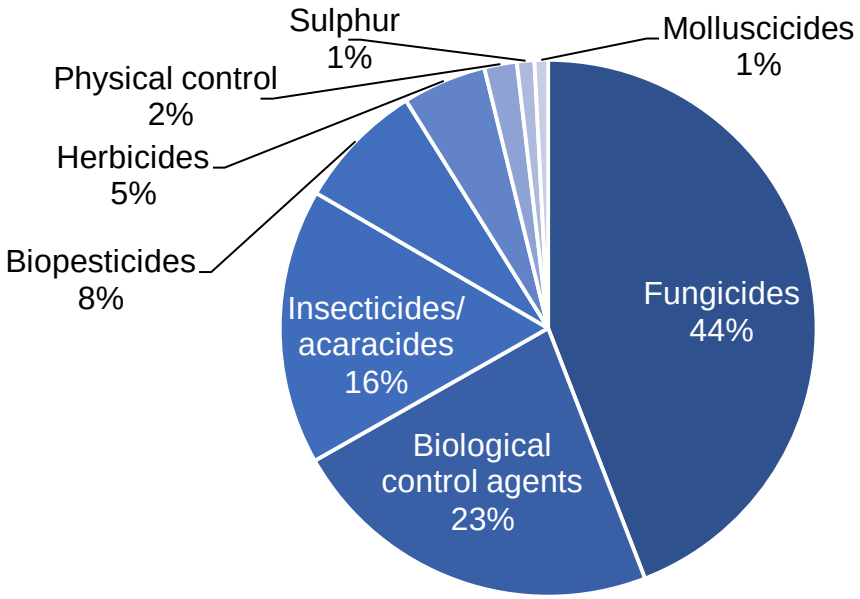
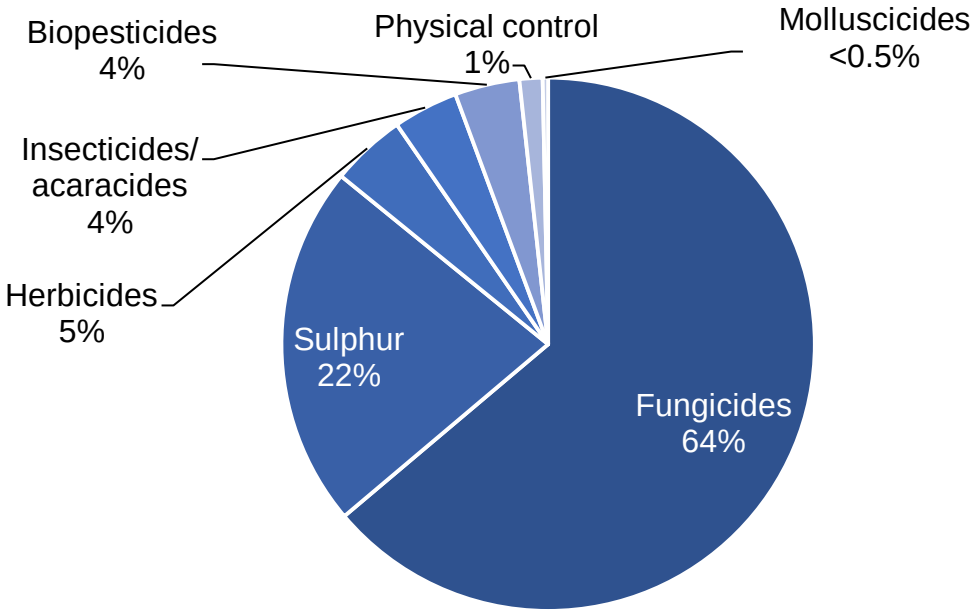


Figure 8 Use of pesticides on soft fruit crops - 2022 (percentage of total weight of pesticides applied)



Note: invertebrate biological control agents are applied by number of organisms rather than weight therefore data are not presented.

In 2022, insecticides and acaricides accounted for 16 per cent of the total pesticide treated area and four per cent of the total weight of pesticides applied (Figures 7 and 8). When changes in crop area are taken into account, there is a 25 per cent decrease from 2020 to 2022 and a five per cent decrease from 2018 to 2022 in the area treated with insecticide/acaricide formulations (Figure 5). In terms of weight of insecticide applied, when area of crop grown is taken into account, there is a 59 per cent decrease from 2020 to 2022 and a 25 per cent decrease from 2018 to 2022 (Figure 6). The decrease in insecticide use in 2022 may have been influenced by a number of factors, such as the withdrawal of active substances and an increased use of biological control agents and biopesticides for managing insect pests and disease in soft fruit crops as part of an IPM system. Thiacloprid was the second most used insecticide in the previous survey in 2020 (applied to ca. 1500 ha), however this was withdrawn from use in February 2021. Use of the pyrethroid lambda-cyhalothrin decreased by 28 per cent; in contrast the use of spirotetramat increased by nine per cent. Unlike pyrethroids, which can have adverse effects on non-target insects, the use of spirotetramat is generally more compatible with IPM programmes.

Herbicides and desiccants accounted for five per cent of both the total pesticide treated area and the total weight of pesticides applied (Figures 7 and 8). When changes in crop area are taken into account, there was a decrease in area treated with herbicide and desiccant formulations of 25 per cent from 2020 and a decrease of 40 per cent from 2018 (Figure 5). In terms of weight of pesticide applied, when area of crop is taken into account, there was a decrease of 52 per cent from 2020 to 2022 and a decrease of 53 per cent from 2018 to 2022 (Figure 6). Dry weather in spring and summer 2022 kept weed pressure low.

In 2022, biopesticides accounted for eight per cent of the total pesticide treated area and four per cent of the total weight of pesticides applied (Figures 7 and 8). When changes in crop area are taken into account, there was an increase of 129 per cent from 2020 to 2022 and a decrease of 10 per cent from 2018 to 2022 in the area treated with biopesticide formulations (Figure 5). In terms of weight of pesticide applied, there is an increase of 117 per cent from 2020 to 2022 and an increase of 145 per cent from 2018 to 2022. Biopesticides were recorded on strawberry, raspberry and on other soft fruit crops. The majority of biopesticides were applied to strawberry crops for the control of botrytis and powdery mildew.

Biological control agents accounted for 23 per cent of the total pesticide treated area (Figure 7). As biological control agents are applied by the number of organisms rather than the weight, no weight data are presented. When changes in crop area are taken into account, there is an increase of 135 per cent from 2020 to 2022 and an increase of 587 per cent from 2018 to 2022 in area treated. Biological control agents were used on semi protected and protected strawberry, raspberry and other soft fruit crops such as blueberry and honeyberry. This demonstrates a continuing trend towards increased use of biological control agents and biopesticides for managing

insect pests and disease in soft fruit crops as part of an integrated pest management system.

In this survey, molluscicides accounted for one per cent of the total pesticide treated area and less than one per cent of the total weight of pesticides applied (Figures 7 and 8). When changes in crop areas between years are taken into account, there is a decrease in molluscicide applications per unit area of 59 per cent between 2020 and 2022 and 66 per cent between 2018 and 2022 (Figure 5). The weight of molluscicides applied per hectare of crop grown decreased by 63 per cent from 2020 to 2022 and by 73 per cent from 2018 to 2022 (Figure 6). Molluscicide use varies significantly from year to year as slug populations are closely linked to climatic conditions. Ferric phosphate is now the only molluscicide active substance available to growers (applied to 294 ha). Metaldehyde was withdrawn from the market with a final use date of March 2022.

Pesticides classified as physical control agents accounted for two per cent of the total pesticide treated area (Figures 7). When changes in crop areas between years are taken into account, there was an increase in physical control agent applications per unit area of 108 per cent between 2020 and 2022 and 1,240 per cent between 2018 and 2022. Physical control agents are substances that have a physical action against insect pests, for example by blocking insect spiracles and causing death by suffocation. Physical control agents were predominately recorded on protected crops for the control of aphids, spider mite, whitefly and thrips.

As well as changes in overall trends in application of pesticide groups since the previous survey, there has been variation in the use of individual active substances. The use of the biological control agents *Neoseiulus cucumeris* and *Phytoseiulus persimilis* have increased by 208 and 199 per cent in terms of area treated between 2020 and 2022. *Neoseiulus cucumeris* was the most used active substance by area treated in 2022 (Table 18). The use of biopesticide *Bacillus subtilis* strain QST 713 increased by 151 per cent in terms of area treated from 2020 to 2022. As noted previously, the trend of increased use of biopesticides may be influenced by the withdrawal of fungicide active substances. Additionally, since 2016, there has a been a focus on the promotion of IPM and the introduction of mandatory completion of IPM plans within some key farm assurance schemes to help growers make the best possible and most sustainable use of all available methods of pest control.

All sixteen new active substances recorded for the first time in the soft fruit survey were biological control agents and biopesticides. The thirteen new biological control agents encountered included *Aphidius ervi, Aphidius colemani, Aphelinus abdominalis, Aphidius matricariae, Praon volucre* and *Ephedrus cerasicola* and the three biopesticides were *Cerevisane (saccharomyces cerevisiae* strain LAS 117*), Gliocladium catenulatum* strain J1446 and *Trichoderma harzianum* (Table 17). This highlights, what appears to be, an increased assurance and capability by growers to use these products to protect high value crops from pests and diseases, coupled with greater availability of biological products to growers.

2022 Pesticide usage

All strawberries (protected and non-protected crops)

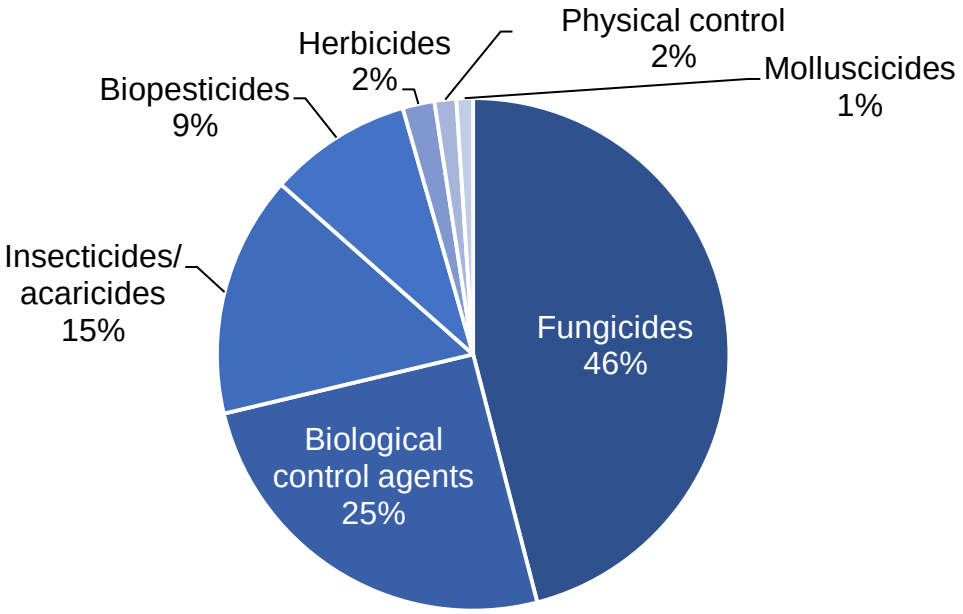
- An estimated 1,226 hectares of strawberries were grown in Scotland in 2022 (based on June 2021 Census areas – see changes from previous years section for further explanation). This consists of 37 ha of non-protected crop and 1,190 ha of protected crop
- Almost all of the crop was treated with a pesticide (see Figure 9 for types of pesticides used)
- Pesticide formulations were applied to 28,001 treated hectares with 7,863 kilograms of pesticide applied in total (see summary table)
- Strawberry crops received on average 18.5 applications (Table 1). These included 9.9 biological applications, 8.7 fungicide applications and 3.5 insecticide applications (applied to 77, 99 and 86 per cent of the crop area). They also received on average 2.4 physical control, 1.3 herbicide/desiccant and 1.2 molluscicide applications (applied to 13, 18 and 20 per cent respectively)
- Ten per cent of strawberries encountered in the sample were under one year old, 77 per cent were between one and two years old, five per cent were over two years old with the remainder unknown
- Sixty-eight per cent of the crop sampled was grown in a raised or table top system. Fifty-eight per cent of the crop sampled was grown in bags, 32 per cent was grown in soil and three per cent in troughs, with the remainder unknown
- Fifty-nine per cent of the crop sampled was grown using a ground mulch or straw
- Ninety-eight per cent of the crop sampled was grown under protection, of this 45 per cent was in permanent tunnels and 53 per cent was in temporary tunnels
- Pollinators were used on 90 per cent of the strawberry crop sampled. Of the area using pollinators, 57 per cent used bumble bees, 11 per cent used honey bees and 22 per cent used both bumble bees and honey bees
- All of the strawberry crops surveyed were harvested in 2022. Ninety-eight per cent were for fresh market, one per cent for pick-your-own and less than one per cent for processing
- The most common varieties encountered were Magnum, Malling Centenary and Murano (accounting for 25, 22 and 18 per cent of the sample area respectively)

Summary of pesticide use on all strawberries:

Pesticide group	Formulation area treated	Weight of pesticides applied	Percentage of crop treated	Most used formulations
	ha	kg	%	ha
Fungicides	12,873	6,771	99	Difenoconazole/ fluxapyroxad (1,639), cyprodinil/fludioxonil (1,343)
Biological control agents	7,086	[z]		*Neoseiulus cucumeris* (2,980)
Insecticides/ acaricides	4,270	323	86	Spirotetramat (1,134), lambda-cyhalothrin (883), spinosad (617)
Biopesticides	2,531	468		*Bacillus subtilis* strain QST 713 (1,618)
Herbicides	563	138	18	Carfentrazone-ethyl (258)
Physical control	384	121	13	Unspecified physical control agents(1) (220), carbonic acid diamide/urea (164)
Molluscicides	294	43	20	Ferric phosphate (294)
All pesticides	**28,001**	**7,863**	**100**	

(1) Refer to Appendix 3 for definitions.
Note: some shorthand is used in this table: [z] = not applicable.

Figure 9 Use of pesticides on all strawberry crops (percentage of total area treated with formulations) - 2022



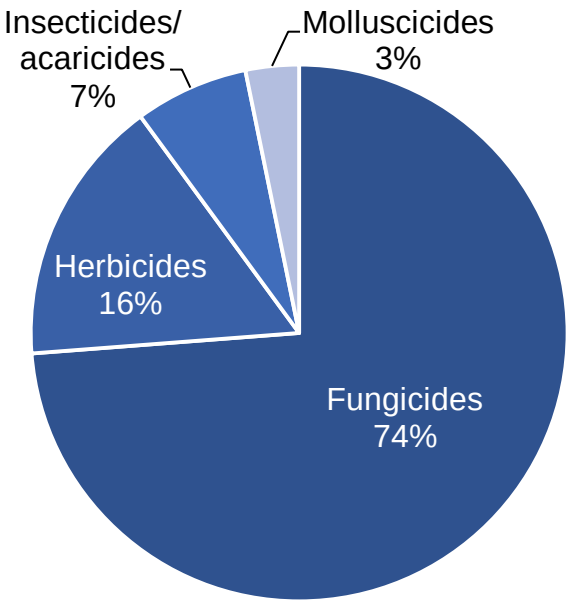
Non-protected strawberries

- An estimated 37 hectares of non-protected strawberry were grown in Scotland in 2022 (based on June 2021 Census areas – see changes from previous years section for further explanation). This included an estimated one hectare recorded in the mixed and other soft fruit section of the census
- Ninety-eight per cent of the crop was treated with a pesticide (see Figure 10 for types of pesticides used)
- Pesticide formulations were applied to 255 treated hectares with 124 kilograms of pesticide applied in total (see summary table below)
- The 98 per cent of non-protected strawberry crop treated with a pesticide received on average 4.9 spray applications (Table 1). These included 3.5 fungicide applications, 2.1 herbicide/desiccant applications and 1.4 insecticide applications (applied to 98, 42 and 35 per cent of the crop respectively). Molluscicides were applied to 22 per cent of the crop averaging one application over the season
- The most common varieties encountered were Symphony and Solero, accounting for 37 and 32 per cent of the sample area respectively

Summary of pesticide use on non-protected strawberries:

Pesticide group	**Formulation area treated**	**Weight of pesticides applied**	**Percentage of crop treated**	**Most used formulations**
	ha	kg	%	ha
Fungicides	188	86	98	Cyprodinil/fludioxonil (41), potassium hydrogen carbonate (34)
Herbicides	41	37	42	Isoxaben (13), pendimethalin (11)
Insecticides/ acaricides	17	<0.5	35	Lambda-cyhalothrin (9)
Molluscicides	8	1	22	Ferric phosphate (8)
All pesticides	**255**	**124**	**98**	

Figure 10 Use of pesticides on non-protected strawberries (percentage of total area treated with formulations) - 2022



Protected strawberries

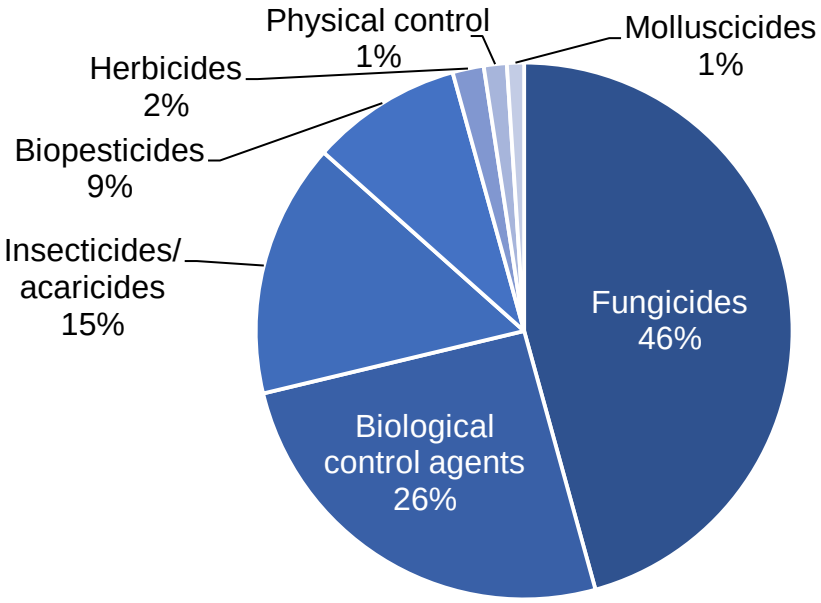
- An estimated 1,190 hectares of protected strawberry were grown in Scotland in 2022 (based on June 2021 Census areas – see changes from previous years section for further explanation), including 39 hectares of multi-cropping
- Based on the ratio encountered in the sample, it is estimated that 50 per cent of the crop was semi-protected (grown under temporary tunnels) and 50 per cent permanently protected (grown in permanent tunnels or glasshouses)
- All of the crop was treated with a pesticide (see Figure 11 for types of pesticides used)
- Pesticide formulations were applied to 27,746 treated hectares with 7,739 kilograms of pesticides applied in total (see summary table below)
- Protected strawberry crops received on average 18.9 pesticide applications (Table 1). These included 9.9 biological applications, 8.8 fungicide applications, 3.5 insecticide applications, 2.4 physical control applications, 1.3 herbicide/desiccant applications and 1.2 molluscicide applications (applied to 80, 99, 88, 13, 17, and 20 per cent of the crop respectively)
- The most common varieties encountered were Magnum and Malling Centenary, accounting for 26 and 22 per cent of the sample area respectively

Summary of pesticide use on protected strawberries:

Pesticide group	Formulation area treated	Weight of pesticides applied	Percentage of crop treated	Most used formulations
	ha	kg	%	ha
Fungicides	12,685	6,685	99	Difenoconazole/ fluxapyroxad (1,630), cyprodinil/fludioxonil (1,302)
Biological control agents	7,086	[z]		*Neoseiulus cucumeris* (2,980)
Insecticides/ acaricides	4,252	323	88	Spirotetramat (1,134), lambda-cyhalothrin (874), spinosad (617)
Biopesticides	2,531	468		*Bacillus subtilis* strain QST 713 (1,618)
Herbicides	522	102	17	Carfentrazone-ethyl (258)
Physical control	384	121	13	Unspecified physical control agents(1) (220), carbonic acid diamide/urea (164)
Molluscicides	286	41	20	Ferric phosphate (286)
All pesticides	**27,746**	**7,739**	**100**	

(1) Refer to Appendix 3 for definitions.
Note: some shorthand is used in this table: [z] = not applicable.

Figure 11 Use of pesticides on protected strawberries (percentage of total area treated with formulations) - 2022



All raspberries (protected and non-protected crops)

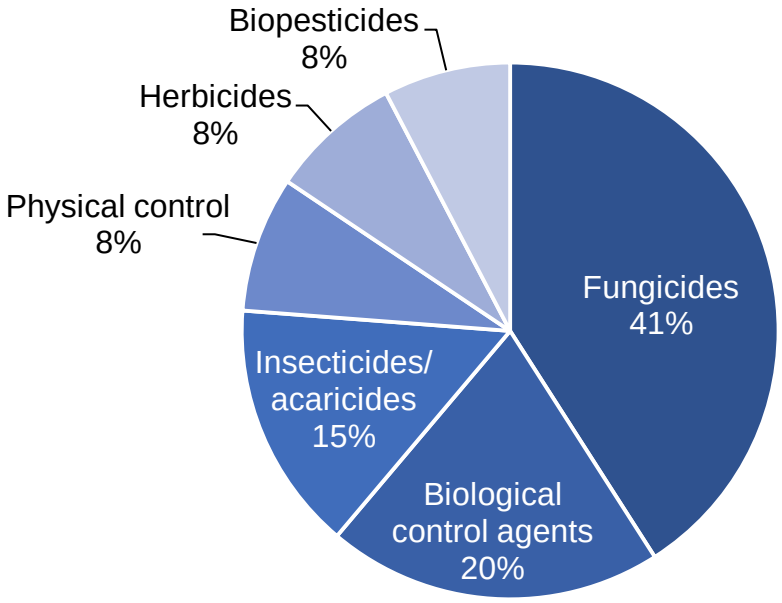
- An estimated 243 hectares of raspberries were grown in Scotland in 2022 (based on June 2021 Census areas – see changes from previous years section for further explanation). This consisted of 92 hectares of non-protected crops and 152 hectares of protected crop
- Eighty-nine per cent of the crop was treated with a pesticide (See Figure 12 for the types of pesticides used)
- Pesticide formulations were applied to 2,192 treated hectares with 742 kilograms of pesticides applied in total (see summary table)
- The 89 per cent of raspberry crop treated with a pesticide received on average 8.9 pesticide sprays (Table 1). These included 5.1 biological applications, 3.8 fungicide applications, 2.2 physical control applications, 1.6 insecticide applications and 1.1 herbicide/desiccant applications (applied to 49, 86, 34, 84 and 53 per cent of the crop respectively)
- Fifty per cent of the raspberries encountered in the sample were under two years old, 23 per cent were between two and five years old and 15 per cent were over five years old. The age of the remainder (12 per cent) was unknown
- Eighty-four per cent of the crop sampled was grown in pots and 16 per cent was grown directly in the soil
- Seventy-seven per cent of the crop encountered was grown using a ground mulch
- Seventeen per cent of the raspberry crop sampled was grown outdoors, 33 per cent were in temporary tunnels and 50 per cent was grown under permanent tunnels
- Pollinators were used on 95 per cent of the raspberry crops surveyed. Of the sample area using pollinators, 50 per cent were bumble bees, 22 per cent were honeybees and 23 per cent used both bumble bees and honey bees
- Ninety-nine per cent of the raspberry crops surveyed were harvested in 2022. Eighty-three per cent were for fresh market, 16 per cent for processing and one per cent for pick-your-own
- The most common variety encountered was Glen Ample, accounting for 35 per cent of the sample area

Summary of pesticide use on all raspberries:

Pesticide group	Formulation area treated	Weight of pesticides applied	Percentage of crop treated	Most used formulations
	ha	kg	%	ha
Fungicides	897	482	86	Boscalid/pyraclostrobin (186)
Biological control agents	443	[z]		*Amblyseius andersoni* (137)
Insecticides/ acaricides	330	101	84	Deltamethrin (182)
Physical control	180	52	34	Unspecified physical control agents(1) (110), carbonic acid diamide/urea (69)
Herbicides	174	86	53	Propyzamide (69)
Biopesticides	168	21		*Bacillus subtilis* strain QST 713 (135)
All pesticides	**2,192**	**742**	**89**	

(1) Refer to Appendix 3 for definitions.
Note: some shorthand is used in this table: [z] = not applicable.

Figure 12 Use of pesticides on all raspberry crops (percentage of total area treated with formulations) - 2022



Non-protected raspberries

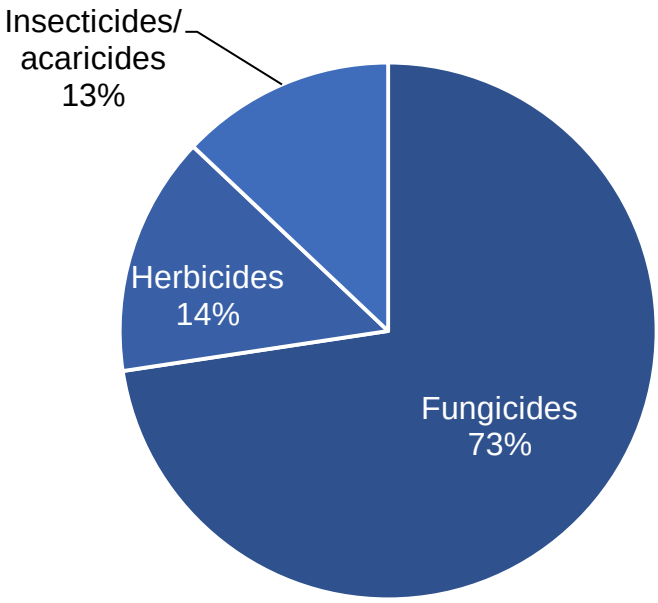
- An estimated 92 hectares of non-protected raspberries were grown in Scotland in 2022 (based on June 2021 Census areas – see changes from previous years section for further explanation). This included an estimated one hectare recorded in the mixed and other crop category in the census
- Seventy-one per cent of the crop was treated with a pesticide (see Figure 13 for types of pesticides used)
- Pesticide formulations were applied to 502 treated hectares with 198 kilograms of pesticide applied in total (see summary table below)
- Glen Ample was the most common named variety encountered, accounting for 93 per cent of the area sampled

Summary of pesticide use on non-protected raspberries:

Pesticide group	**Formulation area treated**	**Weight of pesticides applied**	**Percentage of crop treated**	**Most used formulations**
	ha	kg	%	ha
Fungicides	365	160	70	Boscalid/pyraclostrobin (123)
Herbicides	73	37	68	Propyzamide (62)
Insecticides/ acaricides	65	1	71	Deltamethrin (57)
All pesticides	**502**	**198**	**71**	

(1) Refer to Appendix 3 for definitions.
Note: some shorthand is used in this table: [z] = not applicable.

Figure 13 Use of pesticides on non-protected raspberries (percentage of total area treated with formulations) – 2022



Protected raspberries

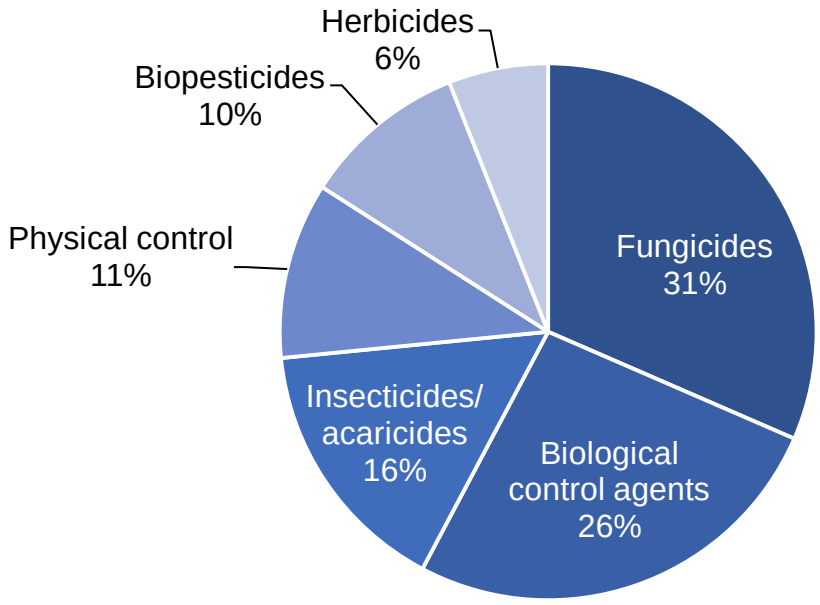
- An estimated 152 hectares of protected raspberries were grown in Scotland in 2020 (based on June 2021 Census areas – see changes from previous years section for further explanation)
- Based on the ratio encountered in the sample, it is estimated that 65 per cent of the crop was semi-protected (grown under temporary tunnels) and 35 per cent was permanently protected (grown in permanent tunnels or glasshouses)
- More than ninety-nine per cent of the crop was treated with a pesticide (see Figure 14 for types of pesticides used)
- Pesticide formulations were applied to 1,690 treated hectares with 545 kilograms of pesticides applied in total (see summary table below)
- The protected raspberry crop received on average 9.8 pesticide applications (Table 1). These included 5.1 biological applications, 3.5 fungicide applications, 2.2 physical control applications, 1.8 insecticide applications, and 1.1 herbicide/desiccant applications (applied to 78, 95, 54, 91 and 43 per cent of the crop respectively)
- The most common varieties encountered were Driscoll's Maravilla and Lagorai (24 per cent each) followed by Glen Ample accounting for 22 per cent of the sample area

Summary of pesticide use on protected raspberries:

Pesticide group	Formulation area treated	Weight of pesticides applied	Percentage of crop treated	Most used formulations
	ha	kg	%	ha
Fungicides	533	323	95	Fenhexamid (169)
Biological control agents	443	[z]		*Amblyseius andersoni* (137)
Insecticides/ acaricides	265	101	91	Deltamethrin (125)
Physical control	180	52	54	Unspecified physical control agents(1) (110), carbonic acid diamide/urea (69)
Biopesticides	168	21		*Bacillus subtilis* strain QST 713 (135)
Herbicides	101	49	43	Carfentrazone-ethyl (42)
All pesticides	**1,690**	**545**	**99**	

(1) Refer to Appendix 3 for definitions.
Note: some shorthand is used in this table: [z] = not applicable.

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



Blackcurrants

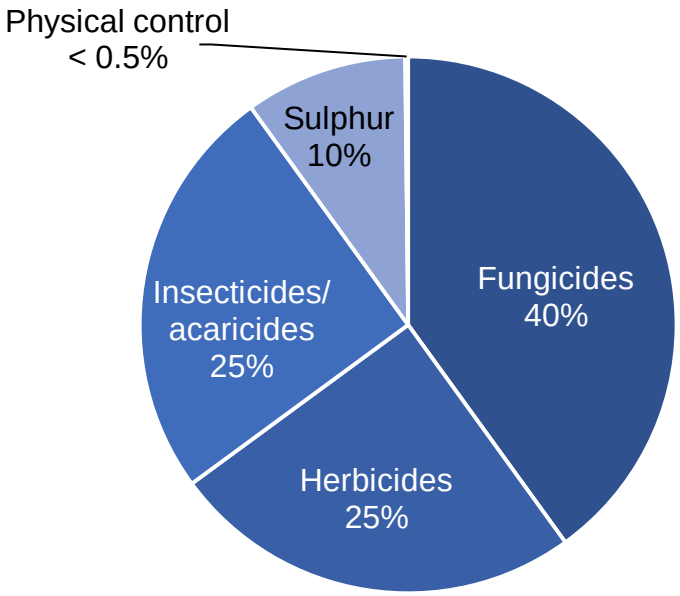
- The total estimated area of blackcurrants grown in Scotland in 2022 was 311 hectares (based on June 2021 Census areas – see changes from previous years section for further explanation). This includes one hectare which was included in the mixed and other soft fruit census category
- Ninety-seven per cent of the cop was treated with a pesticide (see Figure 15 for types of pesticides used)
- Pesticide formulations were applied to 3,807 treated hectares with 3,921 kilograms of pesticide applied in total (see summary table below)
- The blackcurrant crop treated with a pesticide received on average 9.0 pesticide applications (Table 1). These included 6.1 fungicide applications, 3.1 insecticide applications, 1.8 herbicide/desiccant applications and 1.3 sulphur applications (applied to 91, 95, 94 and 91 per cent of the crop respectively)
- The most common variety encountered was Ben Starav, accounting for 33 per cent of the area sampled followed by Ben Klibreck at 29 per cent
- Seventy-three per cent of blackcurrants encountered were five years old or less, eight per cent were between six and 10 years old and below one per cent were older than 10 years with the remainder (19 per cent) unknown
- All blackcurrant crops sampled were grown in soil without protection
- Ninety-seven per cent of the blackcurrant crops surveyed were harvested in 2022
- Over ninety-nine per cent of the blackcurrant crops harvested were for processing, and under one per cent for fresh market and pick-your-own

Summary of pesticide use on blackcurrants:

Pesticide group	Formulation area treated	Weight of pesticides applied	Percentage of crop treated	Most used formulations
	ha	kg	%	ha
Fungicides	1,524	686	91	Boscalid/pyraclostrobin (559)
Herbicides	948	342	94	Glyphosate (289)
Insecticides/ acaricides	956	57	95	Spirotetramat (343)
Sulphur	373	2,838	91	[z]
Physical control	7	[z]	2	Unspecified physical control agents(1) (7)
All pesticides	**3,807**	**3,923**	**97**	

(1) Refer to Appendix 3 for definitions.
Note: some shorthand is used in this table: [z] = not applicable.

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



All other soft fruit crops (protected and non-protected crops)

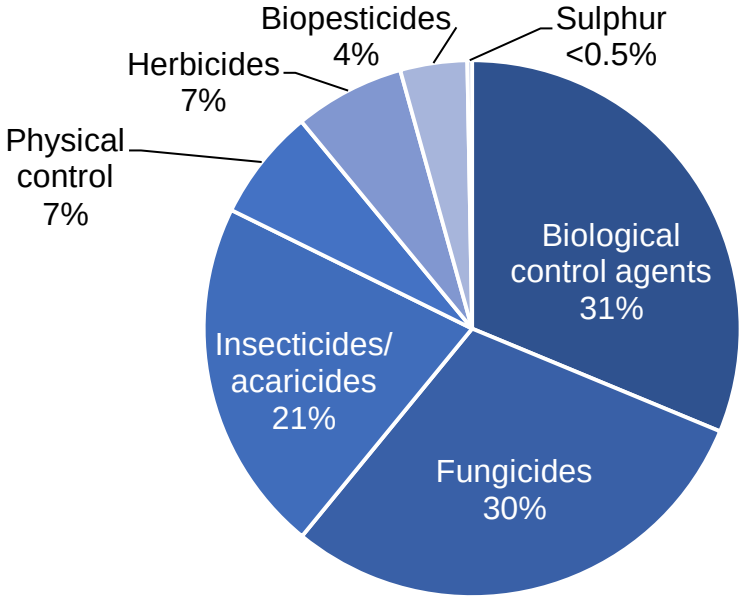
- An estimated 418 hectares of other soft fruit was grown in Scotland in 2022 (based on June 2021 Census areas – see changes from previous years section for further explanation). This consists of 157 hectares of non-protected crop and 261 hectares of protected crop
- The crops encountered in this category were blueberry, blackberry, gooseberry, honeyberry and redcurrant as well as minor crops; elderberry, loganberry, saskatoon and tayberry
- Sixty-eight per cent of the other soft fruit crop was treated with a pesticide (see Figure 16 for types of pesticides used)
- Pesticide formulations were applied to 2,028 treated hectares with 466 kilograms of pesticide applied in total (see summary table below)
- The area of the crop treated with a pesticide received on average 6.7 pesticide applications (Table 1). These included 5.2 biological applications, 3.1 fungicide applications, 1.6 insecticide applications, 1.2 physical control applications and 1.1 herbicide/desiccant applications, (applied to 32, 46, 63, 26 and 28 per cent of the crop respectively)
- Forty-three per cent of other soft fruit crops sampled were five years old or less, 24 per cent were six to 10 years old, six per cent were over 10 years old and 27 per cent of the crop were an unknown age
- Forty per cent of the other soft fruit crops surveyed was grown in the soil and 57 per cent was grown in pots. Three per cent were grown in bags and troughs
- Eighteen per cent of the crop was grown outdoors, 54 per cent was grown under temporary tunnels and 28 per cent was grown under permanent protection
- Eighty-five per cent of the sampled crop was grown using a ground mulch
- Pollinators were used on 87 per cent of the other soft fruit crops sampled and thirteen per cent used no pollinators. Of the sample area using pollinators, 37 per cent were bumble bees, 38 per cent were both bumble bees and honey bees and 12 per cent were honey bees
- Ninety-six per cent of the crops surveyed were harvested in 2022. Of the crops harvested, 92 per cent was for fresh market, seven per cent was for processing and one per cent was for pick-your-own

Summary of pesticide use on all other soft fruits:

Pesticide group	Formulation area treated	Weight of pesticides applied	Percentage of crop treated	Most used formulations
	ha	kg	%	ha
Biological control agents	634	[z]		*Steinernema kraussei* (509)
Fungicides	602	358	46	Fenhexamid (222)
Insecticides/ acaricides	433	31	63	Spinosad (246)
Physical control	137	9	26	Unspecified physical control agents(1) (126), carbonic acid diamide/urea (11)
Herbicides	135	24	28	Carfentrazone-ethyl (97)
Biopesticides	82	21		*Bacillus subtilis* strain QST 713 (40)
Sulphur	6	23	1	[z]
All pesticides	**2,028**	**466**	**68**	

(1) Refer to Appendix 3 for definitions.
Note: some shorthand is used in this table: [z] = not applicable.

Figure 16 Use of pesticides on all other soft fruit crops (percentage of total area treated with formulations) - 2022



Non-protected other soft fruit crops

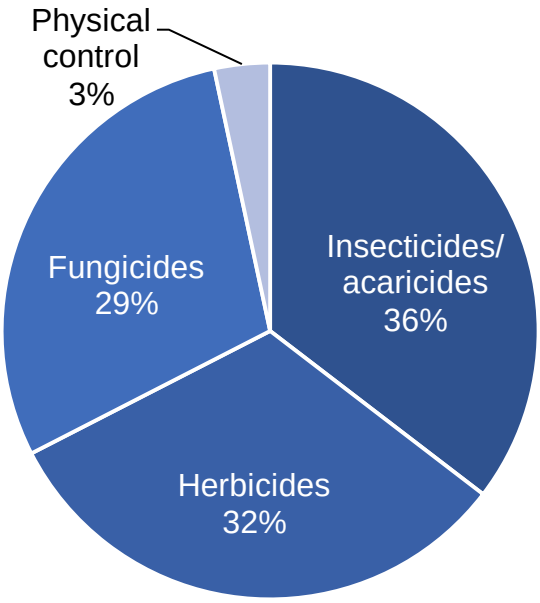
- An estimated area of 157 hectares of non-protected other soft fruit crops were grown in Scotland in 2022 (based on June 2021 Census areas – see changes from previous years section for further explanation)
- The crops encountered in this category were blueberry, gooseberry, honeyberry and redcurrant as well as minor crops; elderberry, loganberry, saskatoon and tayberry
- Twenty-two per cent of the crop was treated with a pesticide (see Figure 17 for the types of pesticides used)
- Pesticide formulations were applied to 89 treated hectares with 29 kilograms of pesticide applied in total (see summary table below)
- The treated area of the non-protected other soft fruit crop received on average 2.2 pesticide applications (Table 1). These applications included 1.4 insecticide applications and 1.3 herbicide/desiccant applications (applied to 14 and 11 per cent of the crop area)

Summary of pesticide use on non-protected other soft fruit:

Pesticide group	**Formulation area treated**	**Weight of pesticides applied**	**Percentage of crop treated**	**Most used formulations**
	ha	kg	%	ha
Insecticides/ acaricides	31	1	14	Lambda-cyhalothrin (25)
Herbicides	28	17	11	Glyphosate (15)
Fungicides	26	12	4	Boscalid/pyraclostrobin (5), cyprodinil/fludioxonil (5), myclobutanil (5)
Physical control	3	[z]	2	Unspecified physical control agents(1) (3)
All pesticides	**89**	**29**	**22**	

(1) Refer to Appendix 3 for definitions.
Note: some shorthand is used in this table: [z] = not applicable.

Figure 17 Use of pesticides on non-protected other soft fruit crops (percentage of total area treated with formulations) - 2022



Protected other soft fruit crops

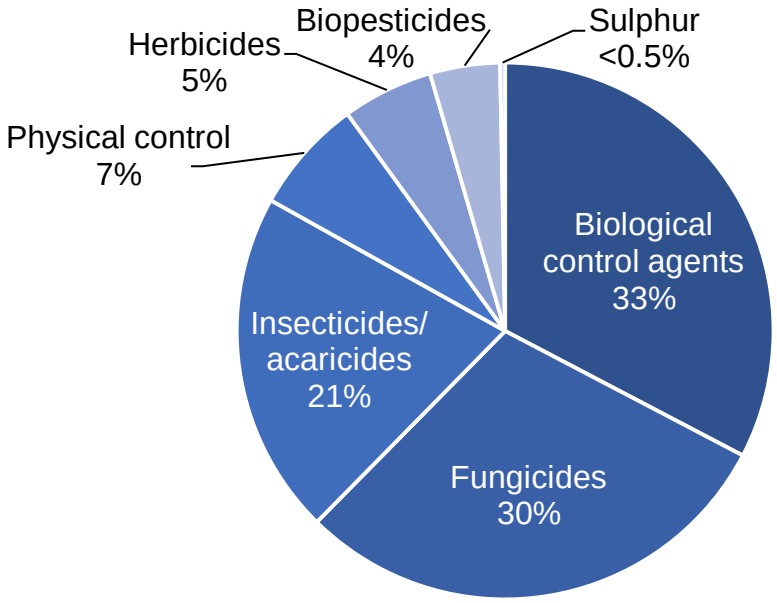
- The total estimated area of protected other soft fruit crops in 2022 was 261 hectares (based on June 2021 Census areas – see changes from previous years section for further explanation). It is estimated that 80 per cent of the crop was semi-protected (grown under temporary tunnels) with 20 per cent grown under permanent tunnels or glasshouses
- The crops encountered in this category were blueberry, blackberry and redcurrants
- Ninety-six per cent of the crop area was treated with a pesticide (see Figure 18 for types of pesticides used)
- Pesticide formulations were applied to 1,939 treated hectares with 437 kilograms of pesticide applied in total (see summary table below)
- The protected other soft fruit crop received on average 7.3 pesticide applications (Table 1). These applications included 5.2 biological applications, 3.1 fungicide applications, 1.6 insecticide applications, 1.2 physical control applications and one application of herbicide/desiccant (applied to 52, 71, 93, 41 and 37 per cent of the crop)

Summary of pesticide use on protected other soft fruits:

Pesticide group	**Formulation area treated**	**Weight of pesticides applied**	**Percentage of crop treated**	**Most used formulations**
	ha	kg	%	ha
Biological control agents	634	[z]		*Steinernema kraussei* (509)
Fungicides	576	346	71	Fenhexamid (220)
Insecticides/ acaricides	402	30	93	Spinosad (242)
Physical control	134	9	41	Unspecified physical control agents(1) (123)
Herbicides	106	7	37	Carfentrazone-ethyl (95)
Biopesticides	82	21		*Bacillus subtilis* strain QST 713 (40)
Sulphur	6	23	2	[z]
All pesticides	**1,939**	**437**	**96**	

(1) Refer to Appendix 3 for definitions.
Note: some shorthand is used in this table: [z] = not applicable.

Figure 18 Use of pesticides on protected other soft fruit crops (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/ desiccants		Insecticides/ acaricides		Molluscicides		Sulphur		Biologicals[1]		Physical control		Any pesticide	
	%	spray apps	%	spray apps	%	spray apps	%	spray apps	%	spray apps	%	spray apps	%	spray apps	%	spray apps
Non-protected strawberry	98	3.5	42	2.1	35	1.4	22	1.0	0	0.0	0	0.0	0	0.0	98	4.9
Protected strawberry	99	8.8	17	1.3	88	3.5	20	1.2	0	0.0	80	9.9	13	2.4	100	18.9
All strawberry	**99**	**8.7**	**18**	**1.3**	**86**	**3.5**	**20**	**1.2**	**0**	**0.0**	**77**	**9.9**	**13**	**2.4**	**100**	**18.5**
Non-protected raspberry	70	4.6	68	1.2	71	1.0	0	0.0	0	0.0	0	0.0	0	0.0	71	6.7
Protected raspberry	95	3.5	43	1.1	91	1.8	0	0.0	0	0.0	78	5.1	54	2.2	99	9.8
All raspberry	**86**	**3.8**	**53**	**1.1**	**84**	**1.6**	**0**	**0.0**	**0**	**0.0**	**49**	**5.1**	**34**	**2.2**	**89**	**8.9**
All blackcurrant	**91**	**6.1**	**94**	**1.8**	**95**	**3.1**	**0**	**0.0**	**91**	**1.3**	**0**	**0.0**	**2**	**1.0**	**97**	**9.0**
Non-protected other soft fruit	4	3.5	11	1.3	14	1.4	0	0.0	0	0.0	0	0.0	2	1.1	22	2.2
Protected other soft fruit	71	3.1	37	1.0	93	1.6	0	0.0	2	1.0	52	5.2	41	1.2	96	7.3
All other soft fruit	**46**	**3.1**	**28**	**1.1**	**63**	**1.6**	**0**	**0.0**	**1**	**1.0**	**32**	**5.2**	**26**	**1.2**	**68**	**6.7**
All soft fruit crops	**86**	**7.0**	**34**	**1.4**	**83**	**2.9**	**11**	**1.2**	**13**	**1.3**	**55**	**8.9**	**16**	**2.0**	**92**	**14.4**

(1) Biologicals include biological control agents and biopesticides.
Note: 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 Strawberry insecticide and acaricide formulations - 2022

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

Insecticides/acaricides	Non-protected strawberry		Protected strawberry		All strawberry 2022		All strawberry 2020[1]	
	ha	%	ha	%	**ha**	**kg**	ha	kg
Abamectin	0	0	18	1	**18**	**<0.5**	75	1
Bifenazate	0	0	604	42	**604**	**59**	787	68
Clofentezine	0	0	418	34	**418**	**79**	444	71
Cyantraniliprole	0	0	128	10	**128**	**9**	19	1
Cyflumetofen	0	0	46	4	**46**	**9**	150	30
Deltamethrin	0	0	202	16	**202**	**1**	93	1
Etoxazole	0	0	172	14	**172**	**6**	271	10
Indoxacarb	0	0	40	3	**40**	**2**	126	6
Lambda-cyhalothrin	9	13	874	59	**883**	**7**	798	7
Spinosad	0	0	617	37	**617**	**42**	428	29
Spirotetramat	0	0	1,134	80	**1,134**	**110**	1265	120
Unspecified insecticide	8	22	1	<0.5	**9**	**[z]**	0	[z]
All insecticides/acaricides	**17**	**35**	**4,252**	**88**	**4,270**	**323**	**5,548**	**1,050**
Area grown	37		1,190		**1,226**		1,221	

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

Table 3 Strawberry biological, molluscicide and physical control formulations - 2022

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

Biological control agents	Non-protected strawberry		Protected strawberry		All strawberry 2022		All strawberry 2020[(1)]	
	ha	%	ha	%	**ha**	**kg**	ha	kg
Amblyseius andersoni	0	0	27	1	**27**	**[z]**	0	[z]
Amblyseius montdorensis	0	0	70	4	**70**	**[z]**	0	[z]
Amblyseius spp.	0	0	4	<0.5	**4**	**[z]**	0	[z]
Aphelinus abdominalis/aphidius colemani/aphidius ervi/aphidius matricariae/ephedrus cerasicola/praon volucre	0	0	588	38	**588**	**[z]**	0	[z]
Aphelinus abdominalis/aphidius colemani/aphidius ervi/aphidius matricariae/praon volucre	0	0	12	1	**12**	**[z]**	0	[z]
Aphidius colemani/aphidius ervi	0	0	12	1	**12**	**[z]**	0	[z]
Aphidius ervi	0	0	12	1	**12**	**[z]**	0	[z]
Aphidoletes aphidimyza	0	0	26	1	**26**	**[z]**	0	[z]
Bacillus amyloliquefaciens strain MBI600	0	0	317	19	**317**	**[z]**	49	[z]
Bacillus pumilus strain QST 2808	0	0	218	9	**218**	**[z]**	428	[z]
Chrysoperla carnea	0	0	120	5	**120**	**[z]**	0	[z]
Eupeodes corollae	0	0	24	1	**24**	**[z]**	0	[z]
Heterorhabditis bacteriophora	0	0	211	16	**211**	**[z]**	14	[z]
Hypoaspis miles	0	0	155	13	**155**	**[z]**	11	[z]
Macrocheles robustulus	0	0	11	1	**11**	**[z]**	0	[z]
Neoseiulus cucumeris	0	0	2,980	34	**2,980**	**[z]**	881	[z]

Cont…

Table 3 Strawberry biological, molluscicide and physical control formulations – 2022 continued

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

Biological control agents	Non-protected strawberry		Protected strawberry		All strawberry 2022		All strawberry 2020[(1)]	
	ha	%	ha	%	**ha**	**kg**	ha	kg
Orius laevigatus	0	0	118	5	**118**	**[z]**	0	[z]
Orius spp.	0	0	554	21	**554**	**[z]**	0	[z]
Phasmarhabditis hermaphrodita	0	0	19	2	**19**	**[z]**	0	[z]
Phytoseiulus persimilis	0	0	1,162	32	**1,162**	**[z]**	370	[z]
Steinernema feltiae	0	0	115	6	**115**	**[z]**	29	[z]
Steinernema kraussei	0	0	221	16	**221**	**[z]**	314	[z]
Stratiolaelaps scimitus	0	0	109	4	**109**	**[z]**	0	[z]
All biological control agents	**0**		**7,086**		**7,086**	**[z]**	**2,153**	**[z]**
Biopesticides								
Ampelomyces quisqualis strain AQ 10	0	0	239	14	**239**	**10**	47	2
Aureobasidium pullulans	0	0	107	8	**107**	**27**	18	4
Bacillus amyloliquefaciens strain D747	0	0	285	20	**285**	**148**	59	34
Bacillus subtilis strain QST 713	0	0	1,618	56	**1,618**	**124**	622	50
Bacillus thuringiensis var. kurstaki	0	0	111	6	**111**	**42**	307	119
Beauveria bassiana ATCC - 74040	0	0	82	3	**82**	**13**	12	3
Cerevisane (saccharomyces cerevisiae strain LAS 117)	0	0	38	1	**38**	**27**	0	0
Gliocladium catenulatum strain J1446	0	0	49	4	**49**	**79**	0	0

Cont…

Table 3 Strawberry biological, molluscicide and physical control formulations – 2022 continued

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

Biopesticides	**Non-protected strawberry**		**Protected strawberry**		**All strawberry 2022**		**All strawberry 2020[1]**	
	ha	%	ha	%	**ha**	**kg**	ha	kg
Trichoderma harzianum	0	0	2	<0.5	**2**	**<0.05**	0	0
All biopesticides	**0**		**2,531**		**2,531**	**468**	**1,065**	**211**
All biologicals	**0**	**0**	**9,617**	**80**	**9,617**	**468**	**3,217**	**211**
Molluscicides								
Ferric phosphate	8	22	286	20	**294**	**43**	388	78
All molluscicides	**8**	**22**	**286**	**20**	**294**	**43**	**706**	**114**
Physical control								
Carbonic acid diamide/urea	0	0	164	7	**164**	**121**	0	0
Unspecified physical control agents[3]	0	0	220	7	**220**	**[z]**	180	[z]
All physical control	**0**	**0**	**384**	**13**	**384**	**121**	**180**	**[z]**
Area grown	37		1,190		**1,226**		1,221	

(1) For a full list of formulations recorded in 2020 please refer to the 2020 report[3].
(2) All biologicals includes biological control agents and biopesticides.
(3) Refer to Appendix 3 for definitions.
Note: invertebrate biological control agents are applied by number of organisms rather than weight therefore weight data are not presented.
Note: some shorthand is used in this table: [z] = not applicable.

Table 4 Strawberry fungicide formulations – 2022

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

Fungicides	Non-protected strawberry		Protected strawberry		All strawberry 2022		All strawberry 2020[1]	
	ha	%	ha	%	**ha**	**kg**	ha	kg
Azoxystrobin	26	59	584	44	**610**	**147**	922	219
Azoxystrobin/difenoconazole	0	0	188	8	**188**	**61**	17	6
Boscalid/pyraclostrobin	19	39	1,174	72	**1,193**	**585**	1,512	749
Bupirimate	0	0	311	23	**311**	**75**	190	45
Cyflufenamid	0	0	978	73	**978**	**14**	1,142	16
Cyprodinil/fludioxonil	41	94	1,302	82	**1,343**	**804**	1,345	781
Difenoconazole/fluxapyroxad	8	22	1,630	85	**1,639**	**117**	754	57
Dimethomorph	5	13	239	20	**243**	**365**	261	384
Fenhexamid	23	38	1,248	66	**1,271**	**815**	1,978	1,302
Fluopyram/trifloxystrobin	0	0	975	64	**975**	**381**	1,766	703
Kresoxim-methyl	0	0	178	13	**178**	**21**	250	31
Mepanipyrim	4	12	504	34	**508**	**188**	337	120
Myclobutanil	11	16	976	58	**987**	**56**	1,310	75
Penconazole	34	52	383	26	**417**	**20**	1,286	62
Potassium hydrogen carbonate	0	0	578	24	**578**	**2,378**	458	2,301
Proquinazid	0	0	501	39	**501**	**18**	497	16
Pyrimethanil	17	46	937	67	**954**	**726**	787	577
All fungicides	**188**	**98**	**12,685**	**99**	**12,873**	**6,771**	**15,465**	**7,784**
Area grown	37		1,190		**1,226**		1,221	

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

Table 5 Strawberry herbicide and desiccant formulations – 2022

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

Herbicides/desiccants	Non-protected strawberry		Protected strawberry		All strawberry 2022		All strawberry 2020[1]	
	ha	%	ha	%	**ha**	**kg**	ha	kg
Carfentrazone-ethyl	0	0	258	17	**258**	**6**	252	3
Clethodim	0	0	154	8	**154**	**13**	52	6
Glyphosate	0	0	10	1	**10**	**11**	179	275
Isoxaben	13	35	16	1	**29**	**6**	229	17
Metamitron	5	13	0	0	**5**	**6**	56	78
Napropamide	8	22	42	4	**50**	**48**	80	90
Pendimethalin	11	30	0	0	**11**	**14**	73	62
Propyzamide	5	13	42	4	**46**	**33**	180	116
All herbicides	**41**	**42**	**522**	**17**	**563**	**138**	**1,314**	**766**
Area grown	37		1,190		**1,226**		1,221	

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

Table 6 Raspberry insecticide and acaricide formulations – 2022

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

Insecticides/acaricides	Non-protected raspberry		Protected raspberry		All raspberry 2022		All raspberry 2020[1]	
	ha	%	ha	%	**ha**	**kg**	ha	kg
Abamectin	0	0	4	3	**4**	**<0.5**	27	0
Cyantraniliprole	0	0	31	6	**31**	**3**	<0.5	<0.5
Deltamethrin	57	62	125	70	**182**	**2**	87	1
Fatty acids C7-C20	0	0	26	17	**26**	**96**	21	69
Lambda-cyhalothrin	8	9	79	38	**87**	**1**	111	1
Total insecticides/acaricides	**65**	**71**	**265**	**91**	**330**	**101**	**418**	**91**
Area grown	92		152		**243**		247	

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

Table 7 Raspberry biological and physical control formulations – 2022

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

Biological control agents	Non-protected raspberry		Protected raspberry		All raspberry 2022		All raspberry 2020[1]	
	ha	%	ha	%	**ha**	**kg**	ha	kg
Amblyseius andersoni	0	0	137	44	**137**	**[z]**	19	[z]
Aphelinus abdominalis/aphidius colemani/aphidius ervi/aphidius matricariae/ephedrus cerasicola/ praon volucre	0	0	115	26	**115**	**[z]**	0	[z]
Aphelinus abdominalis/aphidius colemani/aphidius ervi/aphidius matricariae/praon volucre	0	0	42	13	**42**	**[z]**	0	[z]
Chrysoperla carnea	0	0	13	9	**13**	**[z]**	0	[z]
Heterorhabditis bacteriophora	0	0	11	7	**11**	**[z]**	19	[z]
Neoseiulus cucumeris	0	0	7	1	**7**	**[z]**	33	[z]
Orius spp.	0	0	5	1	**5**	**[z]**	0	[z]
Phytoseiulus persimilis	0	0	114	27	**114**	**[z]**	37	[z]
All biological control agents	**0**		**443**		**443**	**[z]**	**120**	**[z]**
Biopesticides								
Bacillus amyloliquefaciens strain D747	0	0	8	6	**8**	**3**	6	3
Bacillus subtilis strain QST 713	0	0	135	40	**135**	**11**	79	6
Bacillus thuringiensis var. kurstaki	0	0	8	5	**8**	**3**	0	0
Beauveria bassiana ATCC - 74040	0	0	16	10	**16**	**3**	11	2
All biopesticides	**0**		**168**		**168**	**21**	**110**	**14**
All biologicals[2]	**0**	**0**	**611**	**78**	**611**	**21**	**230**	**14**

Cont…

Table 7 Raspberry biological and physical control formulations – 2022 continued

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

Physical control	Non-protected raspberry		Protected raspberry		All raspberry 2022		All raspberry 2020[1]	
	ha	%	ha	%	**ha**	**kg**	ha	kg
Unspecified physical control agents[3]	0	0	110	41	**110**	**[z]**	94	[z]
Carbonic acid diamide/urea	0	0	69	25	**69**	**52**	0	[z]
All physical control	**0**	**0**	**180**	**54**	**180**	**52**	**94**	**[z]**
Area grown	92		152		**243**		247	

(1) For a full list of formulations recorded in 2020 please refer to the 2020 report[3].
(2) All biologicals includes biological control agents and biopesticides.
(3) Refer to Appendix 3 for definitions.
Note: invertebrate biological control agents are applied by number of organisms rather than weight therefore weight data are not presented.
Note: some shorthand is used in this table: [z] = not applicable.

Table 8 Raspberry fungicide formulations – 2022

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

Fungicides	**Non-protected raspberry**		**Protected raspberry**		**All raspberry 2022**		**All raspberry 2020[1]**	
	ha	%	ha	%	**ha**	**kg**	ha	kg
Azoxystrobin	63	69	60	40	**123**	**31**	34	8
Boscalid/pyraclostrobin	123	68	63	36	**186**	**78**	149	61
Cyprodinil/fludioxonil	4	4	66	42	**69**	**43**	104	65
Dimethomorph	114	62	37	25	**152**	**139**	90	97
Fenhexamid	0	0	169	75	**169**	**117**	191	143
Myclobutanil	4	4	0	0	**4**	**<0.5**	9	1
Pyrimethanil	0	0	133	69	**133**	**67**	96	39
Tebuconazole	57	62	4	3	**61**	**7**	15	2
All fungicides	**365**	**70**	**533**	**95**	**897**	**482**	**722**	**427**
Area grown	92		152		**243**		247	

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

Table 9 Raspberry herbicide and desiccant formulations – 2022

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

Herbicides/desiccants	Non-protected raspberry		Protected raspberry		All raspberry 2022		All raspberry 2020[(1)]	
	ha	%	ha	%	**ha**	**kg**	ha	kg
Carfentrazone-ethyl	0	0	42	25	**42**	**1**	107	1
Glyphosate	0	0	22	14	**22**	**11**	6	7
Isoxaben	5	6	0	0	**5**	**1**	27	1
Napropamide	0	0	6	4	**6**	**14**	0	0
Pendimethalin	5	6	25	16	**30**	**21**	27	7
Propyzamide	62	68	6	4	**69**	**39**	6	2
All herbicides	**73**	**68**	**101**	**43**	**174**	**86**	**188**	**19**
Area grown	92		152		**243**		247	

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

Table 10 Blackcurrant insecticide, acaricide and physical control formulations – 2022

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

Insecticides/acaricides	**All blackcurrant 2022**			**All blackcurrant 2020[1]**	
	ha	**%**	**kg**	ha	kg
Deltamethrin	**134**	**43**	**1**	0	0
Lambda-cyhalothrin	**170**	**34**	**1**	538	4
Spinosad	**309**	**80**	**30**	143	7
Spirotetramat	**343**	**91**	**26**	128	10
All insecticides/acaricides	**956**	**95**	**57**	**1,110**	**44**
Physical control					
Unspecified physical control agents[2]	**7**	**2**	**[z]**	3	[z]
All physical control	**7**	**2**	**[z]**	**3**	**[z]**
Area grown	**311**			299	

(1) For a 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 Blackcurrant fungicide and sulphur formulations – 2022

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

Fungicides	**All blackcurrant 2022**			**All blackcurrant 2020[1]**	
	ha	**%**	**kg**	ha	kg
Boscalid/pyraclostrobin	**559**	**91**	**280**	535	268
Bupirimate	**2**	**<0.5**	**<0.5**	<0.5	<0.5
Cyprodinil/fludioxonil	**284**	**91**	**177**	97	60
Fenhexamid	**168**	**54**	**126**	240	144
Kresoxim-methyl	**249**	**80**	**25**	145	15
Myclobutanil	**168**	**54**	**15**	342	26
Pyrimethanil	**94**	**8**	**62**	97	77
All fungicides	**1,524**	**91**	**686**	**1,457**	**591**
Sulphur	**373**	**91**	**2,838**	**742**	**4,465**
Area grown	**311**			299	

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

Table 12 Blackcurrant herbicide and desiccant formulations – 2022

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

Herbicides/desiccants	**All blackcurrant 2022**			**All blackcurrant 2020[1]**	
	ha	**%**	**kg**	ha	kg
Carfentrazone-ethyl	**218**	**70**	**2**	99	1
Flufenacet/metribuzin	**218**	**70**	**67**	242	98
Glyphosate	**289**	**93**	**189**	102	89
Isoxaben	**1**	**<0.5**	**<0.5**	<0.5	<0.5
Pendimethalin	**219**	**71**	**85**	242	125
Propyzamide	**1**	**<0.5**	**<0.5**	2	2
All herbicides	**948**	**94**	**342**	**687**	**315**
Area grown	**311**			299	

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

Table 13 Other soft fruit insecticide and acaricide formulations – 2022

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

Insecticides/acaricides	Non-protected other soft fruit		Protected other soft fruit		All other soft fruit 2022[1]		All other soft fruit 2020[2]	
	ha	%	ha	%	**ha**	**kg**	ha	kg
Abamectin	0	0	3	1	**3**	**<0.5**	10	<0.5
Clofentezine	0	0	3	1	**3**	**1**	0	0
Cyantraniliprole	0	0	5	1	**5**	**<0.5**	11	1
Deltamethrin	0	0	5	2	**5**	**<0.5**	2	<0.5
Indoxacarb	0	0	11	3	**11**	**1**	5	<0.5
Lambda-cyhalothrin	25	14	78	20	**103**	**1**	286	3
Spinosad	4	1	242	83	**246**	**23**	23	2
Spirotetramat	2	1	55	21	**57**	**5**	0	0
All insecticides/acaricides	**31**	**14**	**402**	**93**	**433**	**31**	**865**	**75**
Area grown	157		261		**418**		426	

(1) In 2022 other soft fruit crops included blueberry, blackberry, elderberry, gooseberry, honeyberry, loganberry, redcurrant, saskatoon and tayberry.
(2) For a full list of formulations recorded in 2020 please refer to the 2020 report[3].

Table 14 Other soft fruit biological, molluscicide and physical control formulations – 2022

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

Biological control agents	Non-protected other soft fruit		Protected other soft fruit		All other soft fruit 2022[1]		All other soft fruit 2020[2]	
	ha	%	ha	%	**ha**	**kg**	ha	kg
Amblyseius andersoni	0	0	6	1	**6**	**[z]**	0	[z]
Aphelinus abdominalis/aphidius colemani/aphidius ervi/aphidius matricariae/ephedrus cerasicola/ praon volucre	0	0	<0.5	<0.5	**<0.5**	**[z]**	0	[z]
Aphelinus abdominalis/aphidius colemani/aphidius ervi/aphidius matricariae/praon volucre	0	0	5	1	**5**	**[z]**	0	[z]
Aphidius colemani	0	0	9	2	**9**	**[z]**	0	[z]
Chrysoperla carnea	0	0	3	1	**3**	**[z]**	0	[z]
Heterorhabditis bacteriophora	0	0	84	8	**84**	**[z]**	826	[z]
Neoseiulus cucumeris	0	0	1	<0.5	**1**	**[z]**	56	[z]
Phytoseiulus persimilis	0	0	3	1	**3**	**[z]**	21	[z]
Steinernema carpocapsae	0	0	11	1	**11**	**[z]**	0	[z]
Steinernema kraussei	0	0	509	33	**509**	**[z]**	186	[z]
Stratiolaelaps scimitus	0	0	3	1	**3**	**[z]**	0	[z]
All biological control agents	**0**		**634**		**634**	**[z]**	**1,190**	**[z]**
Biopesticides								
Aureobasidium pullulans	0	0	3	1	**3**	**1**	0	0
Bacillus pumilus strain QST 2808	0	0	1	<0.5	**1**	**6**	0	0
Bacillus subtilis strain QST 713	0	0	40	4	**40**	**3**	14	1

Cont…

Table 14 Other soft fruit biological and physical control formulations – 2022 continued

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

	Non-protected other soft fruit		Protected other soft fruit		All other soft fruit 2022[1]		All other soft fruit 2020[2]	
	ha	%	ha	%	**ha**	**kg**	ha	kg
Bacillus thuringiensis var. kurstaki	0	0	17	7	**17**	**7**	0	0
Beauveria bassiana ATCC - 74040	0	0	21	5	**21**	**4**	15	3
All biopesticides	**0**		**82**		**82**	**21**	**36**	**9**
All biologicals[3]	**0**	**0**	**715**	**52**	**715**	**21**	**1,226**	**9**
Physical control								
Carbonic acid diamide/urea	3	0	123	3	**126**	**9**	0	0
Unspecified physical control agents[4]	0	2	11	40	**11**	**[z]**	61	[z]
All physical control	**3**	**2**	**134**	**41**	**137**	**9**	**61**	**0**
Area grown	157		261		**418**		426	

(1) In 2022 other soft fruit crops included blueberry, blackberry, elderberry, gooseberry, honeyberry, loganberry, redcurrant, saskatoon and tayberry.
(2) For a full list of formulations recorded in 2020 please refer to the 2020 report[3].
(3) All biologicals includes biological control agents and biopesticides.
(4) Refer to Appendix 3 for definitions.
Note: invertebrate biological control agents are applied by number of organisms rather than weight therefore weight data are not presented.
Note: some shorthand is used in this table: [z] = not applicable.

Table 15 Other soft fruit fungicide and sulphur formulations – 2022

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

Fungicides	**Non-protected other soft fruit**		**Protected other soft fruit**		**All other soft fruit 2022[1]**		**All other soft fruit 2020[2]**	
	ha	%	ha	%	**ha**	**kg**	ha	kg
Azoxystrobin	0	0	6	2	**6**	**2**	0	0
Boscalid/pyraclostrobin	5	2	124	43	**129**	**46**	128	46
Bupirimate	4	2	0	0	**4**	**1**	4	1
Cyprodinil/fludioxonil	5	3	141	52	**146**	**75**	221	112
Fenhexamid	2	1	220	45	**222**	**165**	252	189
Myclobutanil	5	2	0	0	**5**	**<0.5**	63	6
Pyrimethanil	4	3	85	30	**89**	**68**	114	73
All fungicides	**26**	**4**	**576**	**71**	**602**	**358**	**811**	**432**
Sulphur	**0**	**0**	**6**	**2**	**6**	**23**	**15**	**60**
Area grown	157		261		**418**		426	

(1) In 2022 other soft fruit crops included blueberry, blackberry, elderberry, gooseberry, honeyberry, loganberry, redcurrant, saskatoon and tayberry.

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

Table 16 Other soft fruit herbicide and desiccant formulations – 2022

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

Herbicides/desiccants	Non-protected other soft fruit		Protected other soft fruit		All other soft fruit 2022[1]		All other soft fruit 2020[2]	
	ha	%	ha	%	**ha**	**kg**	ha	kg
Carfentrazone-ethyl	2	1	95	36	**97**	**2**	20	<0.5
Flufenacet/metribuzin	4	2	7	3	**10**	**4**	46	19
Glyphosate	15	10	<0.5	<0.5	**15**	**12**	30	25
Isoxaben	1	1	0	0	**1**	**<0.5**	9	1
Pendimethalin	4	3	2	1	**7**	**3**	31	16
Propyzamide	3	2	2	1	**5**	**2**	22	16
All herbicides	**28**	**11**	**106**	**37**	**135**	**24**	**221**	**120**
Area grown	157		261		**418**		426	

(1) In 2022 other soft fruit crops included blueberry, blackberry, elderberry, gooseberry, honeyberry, loganberry, redcurrant, saskatoon and tayberry.

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

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

Active substance (includes Biological control agents)	Type[(1)]	Area (ha)	Weight (kg)
Amblyseius montdorensis	B	70	[z]
Aphelinus abdominalis	B	762	[z]
Aphidius colemani	B	783	[z]
Aphidius ervi	B	787	[z]
Aphidius matricariae	B	762	[z]
Cerevisane (saccharomyces cerevisiae strain LAS 117*)*	BP	38	27
Chrysoperla carnea	B	136	[z]
Ephedrus cerasicola	B	703	[z]
Eupeodes corollae	B	24	[z]
Gliocladium catenulatum strain J1446	BP	49	79
Macrocheles robustulus	B	11	[z]
Orius laevigatus	B	118	[z]
Orius spp.	B	558	[z]
Praon volucre	B	762	[z]
Steinernema carpocapsae	B	11	[z]
Trichoderma harzianum	BP	2	<0.05

(1) Pesticide type = B: Biological control agent, BP: Biopesticide.
Note: some shorthand is used in this table: [z] = not applicable.

Table 18 Principal active substances by area treated

Area treated (ha) of the 20 most used active substances on all soft fruit crops surveyed

	Active substance	Type[(1)]	2022	2020	% change
1	*Neoseiulus cucumeris*	B	2,988	970	208
2	Pyraclostrobin	F	2,067	2,324	-11
3	Boscalid	F	2,067	2,324	-11
4	Cyprodinil	F	1,842	1,767	4
5	Fludioxonil	F	1,842	1,767	4
6	Fenhexamid	F	1,830	2,661	-31
7	Difenoconazole	F	1,827	771	137
8	*Bacillus subtilis* strain QST 713	BP	1,794	714	151
9	Fluxapyroxad	F	1,639	754	117
10	Spirotetramat	I	1,533	1,402	9
11	*Phytoseiulus persimilis*	B	1,279	428	199
12	Pyrimethanil	F	1,271	1,094	16
13	Lambda-cyhalothrin	I	1,243	1,732	-28
14	Spinosad	I	1,172	617	90
15	Myclobutanil	F	1,164	1,724	-32
16	Cyflufenamid	F	978	1,142	-14
17	Trifloxystrobin	F	975	1,766	-45
18	Fluopyram	F	975	1,766	-45
19	Azoxystrobin	F	927	973	-5
20	*Aphidius ervi*	B	787	0	[z]

(1) Pesticide type = B: Biological, BP: Biopesticide, F: Fungicide, H: Herbicide, I: Insecticide/ acaricide, PC: Physical Control, SU: Sulphur.
Note: some shorthand is used in this table: [z] = not applicable.

Table 19 Principal active substances by weight

Weight (kg) of the 20 most used active substances on all soft fruit crops surveyed

	Active substance	Type[(1)]	2022	2020	% change
1	Sulphur	SU	2,861	5,112	-44
2	Potassium hydrogen carbonate	F	2,378	2,301	3
3	Fenhexamid	F	1,223	1,779	-31
4	Pyrimethanil	F	922	766	20
5	Boscalid	F	791	899	-12
6	Cyprodinil	F	660	611	8
7	Dimethomorph	F	504	483	4
8	Fludioxonil	F	440	407	8
9	Glyphosate	H	222	397	-44
10	Azoxystrobin	F	217	231	-6
11	Pyraclostrobin	F	199	226	-12
12	Trifloxystrobin	F	190	352	-46
13	Fluopyram	F	190	352	-46
14	Mepanipyrim	F	188	120	57
15	Carbonic acid diamide/urea	PC	182	0	[z]
16	Spirotetramat	I	151	131	15
17	*Bacillus amyloliquefaciens* strain D747	BP	141	42	235
18	*Bacillus subtilis* strain QST 713	BP	138	57	142
19	Pendimethalin	H	123	266	-54
20	Fatty acids C7-C20	I	96	682	-86

Table 20 Total soft fruit 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/ acaracides	5,973	5,973	645	7,941	7,896	1,260	**5,989**	**5,989**	**513**
Molluscicides	823	823	150	712	712	115	**294**	**294**	**43**
Fungicides	16,911	22,291	11,017	18,454	25,098	9,233	**15,896**	**22,607**	**8,296**
Sulphur	1,085	1,085	4,058	1,418	1,418	5,112	**379**	**379**	**2,861**
Herbicides	2,894	3,098	1,199	2,411	2,819	1,220	**1,820**	**2,048**	**590**
Biological control agents(1)	1,129	1,129	[z]	3,463	3,463	[z]	**8,163**	**11,928**	**[z]**
Biopesticides	2,921	2,921	198	1,211	1,211	235	**2,781**	**2,781**	**510**
Physical control	50	50	97	339	336	[z]	**707**	**707**	**182**
All pesticides	**31,786**	**37,371**	**17,363**	**35,948**	**42,953**	**17,175**	**36,028**	**46,732**	**12,995**
Area of all soft fruit crops (ha)(2)	2,088			2,193			**2,198**		

(1) Invertebrate biological control agents are applied by number of organisms rather than weight therefore weight data are not presented.
(2) Area grown includes multi-cropping.
Note: some shorthand is used in this table: [z] = not applicable.

Appendix 2 – Survey statistics

Census and sample information

Table 21 Census crop areas 2021 (there was no census in 2022)

Census area (ha) of soft fruit crops grown in Scotland

Crop	Scotland 2021	Scotland 2020	Percentage change
Strawberry	1,187	1,194	-1
Raspberry	243	241	1
Blackcurrant	320	297	8
Blueberry	253	265	-4
Mixed and other soft fruits	157	172	-9
All soft fruit	**2,159**	**2,168**	**<0.5**

Note: data taken from the 2021 and 2020 June Agricultural Census. There was no census in 2022, see changes from previous years section for full details.
All areas exclude multi-cropping.
It was estimated from the crops encountered in the 2022 sample, that 11 ha of the mixed and other soft fruit categories in the census were raspberry, strawberry, blueberry or blackcurrant.

Table 22 Distribution of soft fruit sample - 2022

Number of holdings surveyed in each region and size group

Size[(1)] (ha)	North	Angus	South	Scotland
0.01 - 4.99	20	11	5	**36**
5.00 - 9.99	1	7	3	**11**
10.00 - 19.99	1	11	1	**13**
20 +	0	17	4	**21**
All sizes	**22**	**46**	**13**	**81**

(1) Refers to the total area of soft fruit crops grown on the holding, including those grown in the open and those grown under glasshouse or walk-in plastic structures.

Table 23 Non-protected soft fruit sample areas - 2022

Area (ha) of non-protected soft fruit crops in sample

Size[1] (ha)	Scotland[2]
0.01 - 4.99	35
5.00 - 9.99	27
10.00 - 19.99	57
20 +	244
All sizes	**363**

Table 24 Non-protected soft fruit census areas - 2021 (there was no census in 2022)

Area (ha) of soft fruit grown in the open in Scotland

Size[1] (ha)	Scotland[2]
0.01 - 4.99	117
5.00 - 9.99	44
10.00 - 19.99	85
20 +	349
All sizes	**596**

(1) Refers to the total area of soft fruit crops grown on the holding, including those grown in the open and those grown under glasshouse or walk-in plastic structures.
(2) Regional data have not been provided in order to prevent disclosure of information relating to fewer than five holdings.
Note: there was no June 2022 Agricultural Census, therefore data was taken from the June 2021 Census – see changes from previous years section for further details.

Table 25 Protected soft fruit sample areas - 2022

Area (ha) of protected soft fruit crops in sample

Size[1] (ha)	Scotland[2]
0.01 - 4.99	8
5.00 - 9.99	52
10.00 - 19.99	106
20 +	782
All sizes	**948**

Table 26 Protected soft fruit census areas - 2021 (there was no census in 2022)

Area (ha) of soft fruit grown under protection in Scotland

Size[1] (ha)	Scotland[2]
0.01 - 4.99	39
5.00 - 9.99	75
10.00 - 19.99	224
20 +	1,225
All sizes	**1,563**

(1) Refers to the total area of soft fruit crops grown on the holding, including those grown in the open and those grown under glasshouse or walk-in plastic structures.
(2) Regional data have not been provided in order to prevent disclosure of information relating to fewer than five holdings.
Note: there was no June 2022 Agricultural Census, therefore data was taken from the June 2021 Census – see changes from previous years section for further details.

Table 27 Non-protected soft fruit raising factors - 2022

Size[1] (ha)	North	Angus	South
0.01 - 9.99	3.1524	2.1810	2.8119
10.00 - 19.99		1.3109	
20 +		1.2815	47.5417

Table 28 Protected soft fruit raising factors - 2022

Size[1] (ha)	Angus	North & South
0.01 - 4.99	6.0857	4.2630
5.00 - 9.99	1.3356	1.8307
10.00 - 19.99	2.1645	1.9154
20 +	1.3253	2.8837

(1) Refers to the total area of soft fruit crops grown on the holding, including those grown in the open and those grown under glasshouse or walk-in plastic structures.
Note: raising factors are calculated by comparing the sampled crop area to the census crop area.

Table 29 Non-protected soft fruit first and second adjustment factors - 2022

Crop	North Adj. 1	Angus Adj. 1	South Adj. 1	Adj 2
Strawberry	0.8671	3.2376	0.6859	1.0000
Raspberry	6.5422	2.9656	4.2511	1.0000
Blackcurrant	6.1809	0.7722	1.2296	1.0000
Other soft fruit	1.0993	1.7985	1.0067	1.0000

Table 30 Protected soft fruit first and second adjustment factors - 2022

Crop	Angus Adj. 1	North & South Adj. 1	Adj 2
Strawberry	1.0087	1.0489	1.0000
Raspberry	1.2408	0.6449	1.0000
Other soft fruit	0.8813	0.9630	1.0000

Response rates

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

Table 31 Response rate

	2022	Percentage total
Target sample	82	100
Total achieved	**81**	**99**
Total number of refusals/non-contact	24	
Total number of farms approached	**105**	

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, where possible.

To determine the total burden that the 2022 Soft Fruit Crop Survey placed on those providing the information, the surveyors recorded the time that respondents spent providing the data during the surveys. This sample represents 100 per cent of growers surveyed. The median time taken to provide the information was 15 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)[5]

The total financial burden to all growers resulting from participation in the 2022 Soft Fruit Crop survey was calculated to be £337.97.

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, 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) **Biological control** is use of a micro-organism, such as a bacteria or virus, or, macro-organisms, such as insect predators or nematodes that are used to control insect pests, weeds and diseases. In this report biologicals which do not require to be authorised are referred to as **biological control agents**. These are generally macro-organisms such as parasites or predators. Biologicals which do require to be authorised like other pesticides are referred to as **biopesticides**. Biopesticides are pesticides that are derived from natural materials and include micro-organisms (bacteria, fungus, virus or protozoa) to control pest populations or compounds such as semio-chemicals that cause behavioural changes in the target pest. In previous surveys (before 2015) biopesticides were included in the biological control agent category.

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

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

7) An **insecticide** is a pesticide used to control unwanted insects. An **acaricide** is a pesticide used to control unwanted mites. As some products are approved for use against both insects and mites, insecticide and acaricide use has been combined in this report.

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

9) A **physical control agent** is a substance that is used to control pests with a mode of action that is physical. For example, by blocking insect spiracles and causing death by suffocation.

10) **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.

11) **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 gets sprayed with the same fungicide twice, the basic area is five hectares, and the treated area is 10 hectares.

12) **Non-protected crops** are crops grown outdoors without any protection during their production cycle.

13) **Protected crops** are grown under both permanent protection and semi-permanent protection. **Permanent protection** refers to crops grown in glasshouses or polythene tunnels for the entire duration of their production cycle. **Semi-permanent protection** refers to crops grown outdoors which are covered with polythene tunnels at some stage during production.

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 the ground beneath crops grown on table tops or the pathways between the crops.

17) The **June Agricultural Census**[6] 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.
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) The areas of crop grown include successional sowings during the same season; therefore the areas of crops grown can be larger than the total area of glasshouses and polythene tunnels. This is referred to throughout the report as **multi-cropping**.

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. It should be noted that growers do not always provide reasons; therefore those presented only reflect those specified and may not reflect overall reasons for use.

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

22) Data from the 2020[(3)] and 2018[(4)] 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 ten 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) **Table top systems** are used where crops are grown on a structure built on stilts, straw bales or polystyrene blocks. This system reduces pest pressure and allows the fruit to be grown at a height which is easier for picking.

25) **Ground mulch** is a layer of material spread over the surface of the soil prior to planting in order to advance the crop by retaining heat. The mulch can be made of a material such as plastic or a biodegradable mesh. Natural materials such as grass cuttings or wood chippings are used too. If the mulch is opaque, it can also be used to suppress weed growth. Pots and bags can be placed on top of the mulch.

26) To aid **pollination**, some growers introduce pollinators to the tunnels to improve fruit set as naturally occurring pollinators are unable to access tunnels.

27) The **age** of crops are reported as soft fruit farms may have plants which are a range of ages in order to allow time for maturation of the crop allowing for a continuous supply of fruit.

28) The term **harvested** refers to plants that were harvested during 2022. This can include perennial crops planted the previous year and plants such as strawberries planted in early 2022. Some plants which are not harvested can include young plants such as raspberries which are normally harvested in their second year.

29) **Fresh market** refers to crops which are picked and sold to consumers without processing. This can include sales direct to the public or to supermarkets for resale.

30) **Processing** refers to crops normally grown under contract or sold for jam, pulp, juice, canning or freezing.

31) **Pick-your-own** refers to farms which operate a pick-your-own business on their soft fruit crops.

32) 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.

Appendix 4 – Survey methodology

Sampling and data collection

Using the May 2022 Single Application Form (SAF) data, two samples were representing soft fruit cultivation in Scotland. The first sample was selected from holdings growing soft fruit crops grown in the open (non-protected crops) and the second from holdings growing soft fruit crops in glasshouses or under walk-in plastic structures (protected crops). Protected and non-protected crops are recorded separately in the SAF and Agricultural Census. Separate samples were drawn to ensure non-protected crops were not under-represented in the sample; however, pesticide information was collected for all soft fruit crops grown on all holdings.

The country was divided into 11 land-use regions (Figure 19). 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 soft fruit 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.

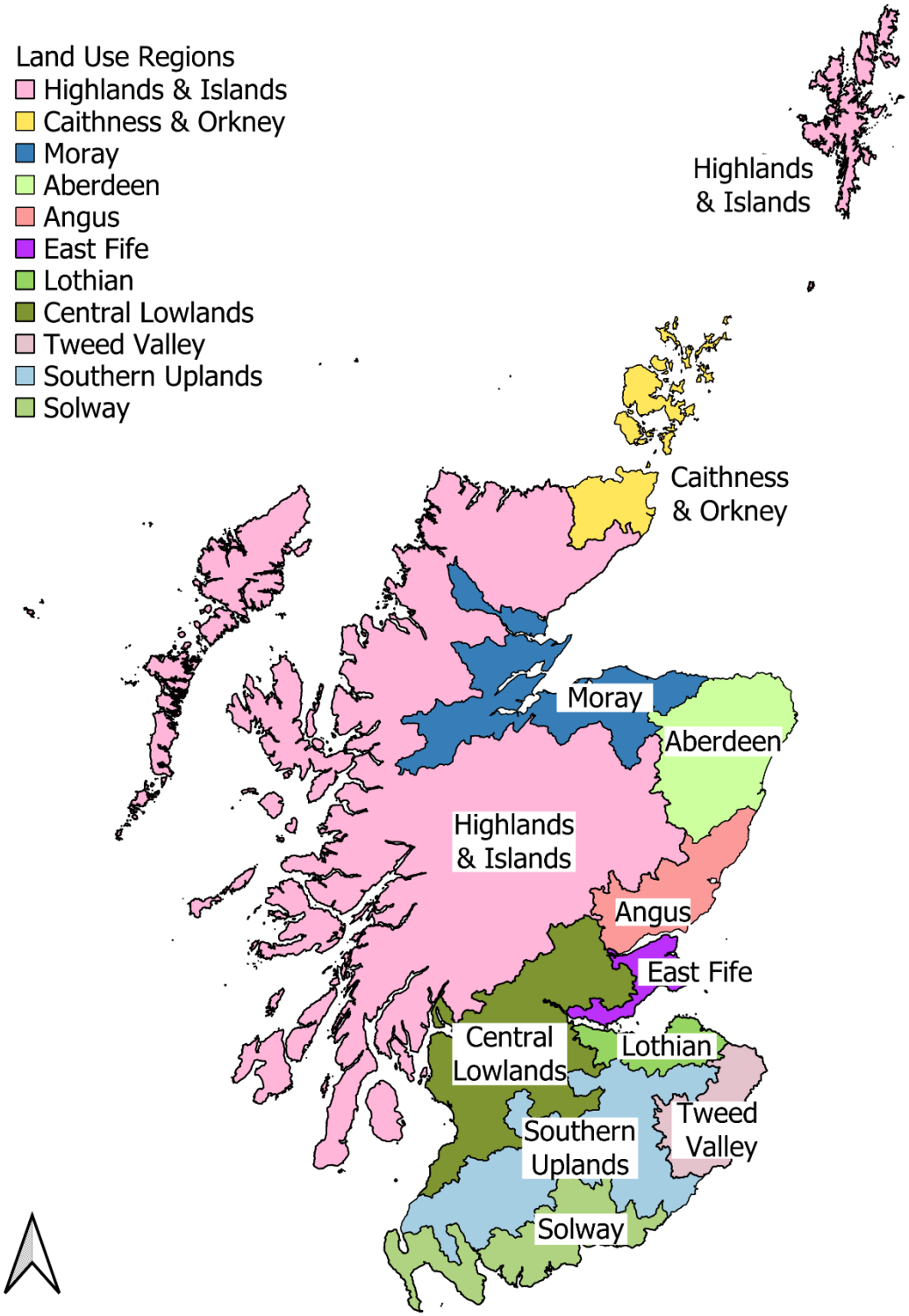
The survey covered pesticide applications to soft fruit crops where all or the majority of the growing season was in 2022. As well as recording treatments applied directly to the crop, data was also collected on land preparation treatments prior to sowing or planting the crop.

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 81 holdings growing soft fruit crops (Table 22). These holdings represent 61 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 (Table 27 and 28). These factors were calculated by comparing the sample area in each of the two samples to the areas recorded in the June 2021 Agricultural Census within each region and size group (please see changes from previous years section for further detail). An adjustment (Table 29 and 30) 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 census 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 is applied if crops which are present in the population are not encountered in the sample in some strata. Due to the distribution of soft fruit crops in Scotland the land use regions were amalgamated into three areas before raising; the North (Highlands & Islands, Caithness & Orkney, Moray and Aberdeen), Angus (the main fruit growing region in Scotland) and the South (East Fife, Lothian, Central Lowlands, Tweed Valley, Southern Uplands and Solway).

Figure 19 Land use regions of Scotland[7]



Changes from previous surveys

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[9], 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. SAF data does not account for the majority of land area for soft fruit crops (smaller holdings are often excluded). The sample drawn is based on area of crop grown, rather than number of holdings. Therefore, to provide better pesticide usage estimates, the 2022 sample data was raised to the June 2021 Agricultural Census data rather than to SAF data. Using SAF data during the raising process would have underestimated total areas grown and therefore pesticide usage estimates. However, using 2021 census data during the raising process will also have impacted pesticide use estimates, though the magnitude of impact is unclear. The June Agricultural Census has been paused only for one year therefore up to date census areas will be available for future surveys.

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

The previous 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 undergoes 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 0 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 soft fruit crops (protected and non-protected) was 12 per cent for area and 17 per cent for quantity, comparable to the 12 and 13 per cent, respectively, in 2020 (Table 32).

Table 32 Relative standard errors for total soft fruit - 2022

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

Crops	Area SE (%)	Weight SE (%)
Raspberry(1)	16	13
Strawberry	13	20
Blackcurrant(1)	3	4
Other soft fruit	13	17
All soft fruit crops	**12**	**17**

(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.

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