Scottish Government
Riaghaltas na h-Alba
gov.scot

# Pesticide Usage in Scotland


A National Statistics Publication for Scotland

# Arable crops and Potato stores 2020

# Pesticide Usage in Scotland

# Arable Crops 2020

**C. Davis, J. Wardlaw, C. Monie and C. MacLeod**

SASA

Roddinglaw Road, Edinburgh, Scotland, EH12 9FJ

psu@sasa.gov.scot

www.sasa.gov.uk/pesticides

## Contents

## List of figures and tables

## Potato Store Contents

## List of figures and tables

# Executive summary

This report presents information from a survey of pesticide use on arable crops grown in Scotland. The survey period covers the 2020 growing season, from post-harvest pesticide applications in 2019 through to harvest in 2020. The crop groups surveyed included cereals, oilseed rape, potatoes and legumes.

The estimated area of arable crops grown in Scotland in 2020 was ca. 496,600 hectares. Spring barley accounted for 52 per cent of the arable crop area, wheat 19 per cent, winter barley nine per cent, oilseed rape and potatoes six per cent and spring oats five per cent. Legumes, winter oats and winter rye together accounted for the remaining three per cent.

Data were collected from a total of 312 holdings, representing eight per cent of the total arable crop area grown in Scotland. Ratio raising was used to produce estimates of national pesticide use from the sampled data.

The estimated total area of arable crops treated with a pesticide formulation was ca. 4,793,000 hectares (± three per cent Relative Standard Error, RSE) with a combined weight of ca. 1,370 tonnes (± four per cent RSE). Overall, pesticides were applied to 99 per cent of the arable crop area. Herbicides/ desiccants were applied to 98 per cent of the crop area, fungicides to 96 per cent, growth regulators to 52 per cent, insecticides to 20 per cent and molluscicides to nine per cent. Pesticide treatments were applied to 90 per cent of seed in this survey.

Overall, use of pesticides in 2020 has remained broadly similar to the previous two arable surveys. Taking into account changes in crop area, the 2020 total pesticide treated area was two per cent higher than that reported in 2018 and two per cent lower than 2016. The weight of pesticide applied to arable crops in 2020 was three per cent higher than in 2018 and eight per cent lower than 2016.

Fungicide and herbicide/desiccant use by both area treated and weight applied remained similar to 2018 levels. The area treated with insecticides/nematicides decreased by three per cent from 2018, while the weight applied increased by 17 per cent. Molluscicide use increased 16 and four per cent by area treated and by weight respectively when compared to 2018. While seed treatment use increased six per cent by area treated, the weight applied decreased twenty-six per cent from 2018. The area treated in 2020 with growth regulators increased 10 per cent while there was no change in the weight applied from 2018 levels.

In terms of area treated, the most commonly used foliar fungicide active substance and the most used seed treatment was prothioconazole. The most used herbicide and insecticide was thifensulfuron-methyl and lambda-cyhalothrin respectively. The herbicide aclonifen, the fungicide mefentrifluconazole, the insecticide spirotetramat and seed treatments *Bacillus amyloliquefaciens* strain MBI600 and penflufen were recorded for the first time in this survey.

Data collected from growers about their Integrated Pest Management (IPM) activities showed that growers were using a variety of IPM methods in relation to risk management, pest monitoring and pest control.  This dataset is the second in this series of surveys of IPM measures on arable crops, allowing the adoption of IPM techniques to be monitored.

## 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. Also available at:

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

The Scottish Pesticide Usage reports have been designated as Official Statistics since August 2012 and as National Statistics since October 2014. The Chief Statistician (Roger Halliday) acts as the statistics Head of Profession for the Scottish Government and has overall responsibility for the quality, format, content and timing of all Scottish Government national statistics publications, including the pesticide usage reports. 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 the survey unit webpage:

http://www.sasa.gov.uk/pesticides/pesticide-usage

### Structure of report and how to use these statistics

This report is intended to provide data in a useful format to a wide variety of data users. The general trends section provides commentary on recent changes in survey data and longer-term trends. The pesticide usage section summarises usage on all arable crops in 2020. Appendix 1 presents all estimated pesticide usage in three formats, area and weight of formulations by crop and area and weight of active substances grouped by their mode of action. 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.

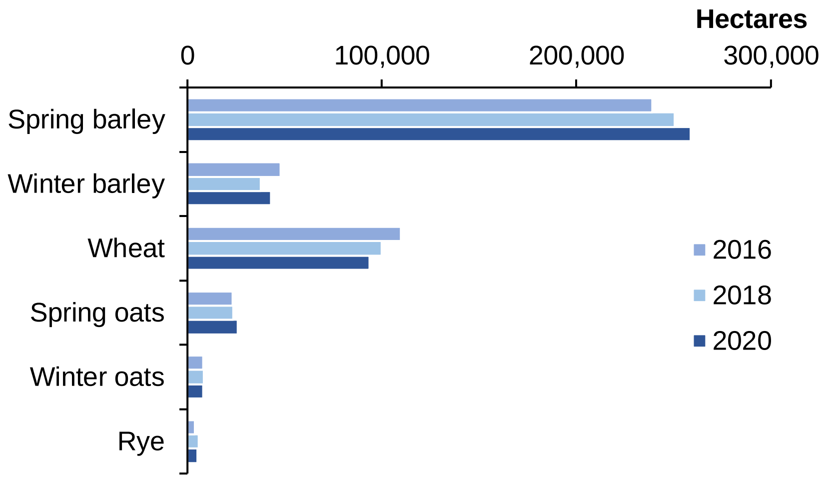
## General trends

### Crop area

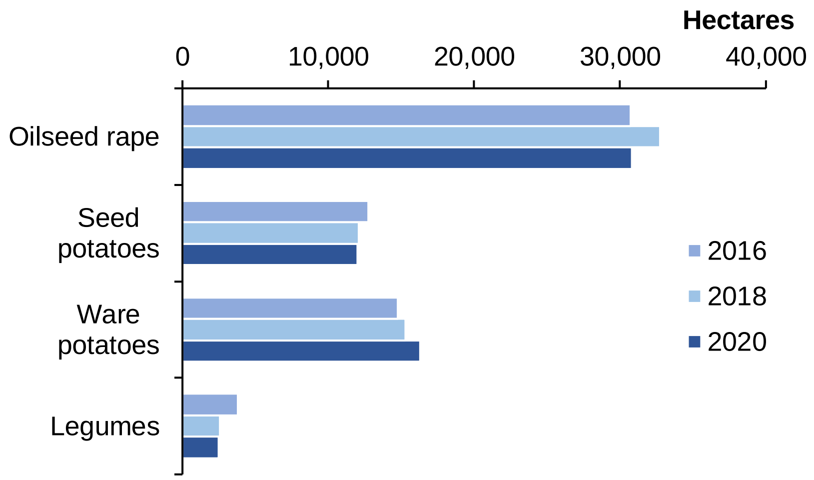
The census area of arable crops grown in 2020 was 496,631 hectares (Table 28). This represents a one per cent increase from 2018[(3)] and no change from 2016[(4)]. Since the last survey, areas of winter barley, spring barley, spring oats and ware potatoes increased (15, three, 10 and seven per cent respectively), while wheat, winter oats, winter rye, oilseed rape, seed potatoes and legumes have decreased (six, five, 11, six, one, three per cent respectively) (Table 28, Figures 1 and 2).

In 2020, cereals accounted for 88 per cent of the arable area (52 per cent spring barley, 19 per cent wheat, nine per cent winter barley, two per cent spring oats, two per cent winter oats and one per cent rye). The remaining area consisted of oilseed rape, potatoes and legumes (accounting for six, six and <0.5 per cent respectively, Figure 3). The largest area of arable crops was in the Aberdeen region, followed by Angus, the Tweed Valley and Moray Firth (Figure 4).

## Figure 1 Area of cereal crops grown in Scotland 2016-2020

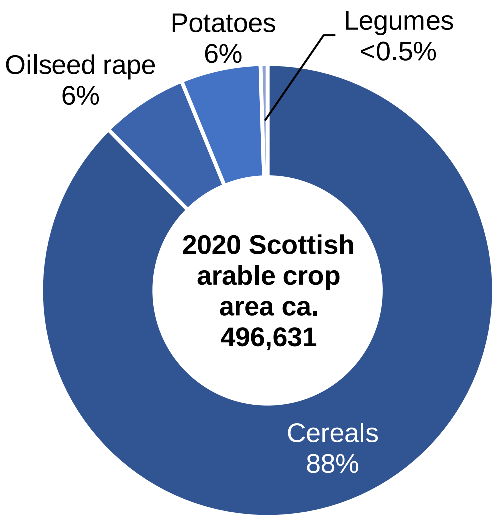



## Figure 2 Area of oilseed rape, potatoes and legumes grown in Scotland 2016-2020



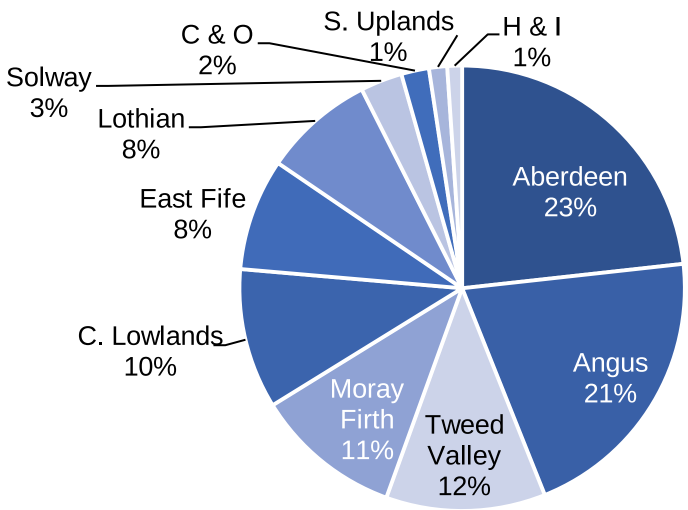

Note: oilseed rape includes winter and spring oilseed rape, legumes includes field beans and dry harvest peas

## Figure 3 Arable crop areas 2020 (percentage of total area)




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

## Figure 4 Regional distribution of arable crops in Scotland 2020




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

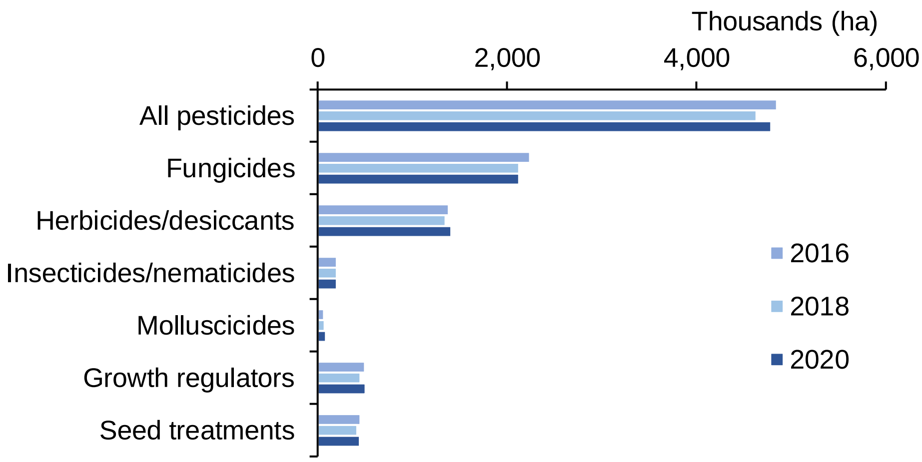
## Pesticide usage

In 2020, as in 2018, the majority of arable crops (99 per cent) received a pesticide treatment.

Winter and spring barley, winter and spring wheat, winter rye, oilseeds, seed and ware potatoes had the highest overall proportion of crop treated with a pesticide (99 per cent of spring barley crop and 100 per cent of the other crops, Table 1). Winter oats, spring oats and legumes had lower proportions of treated crop area (89, 93 and 89 per cent respectively). The average number of sprays applied to treated arable land, excluding seed treatments was 4.1, very similar to that recorded in 2018 (average 3.9 sprays). Ware potatoes and seed potatoes received the highest average number of sprays (13.8 and 10.8 respectively), while legumes, spring barley and spring wheat received the lowest (2.5, 2.7 and 2.8 respectively, Table 1). These figures only apply to the treated area of crops.

It is estimated that the area of arable crops treated with a pesticide formulation in 2020 was ca. 4,793,000 hectares compared with ca. 4,632,000 hectares in 2018 and ca. 4,852,000 hectares in 2016 (Table 24, Figure 5). This represents an increase of three per cent since 2018 and a decrease of one per cent since 2016.

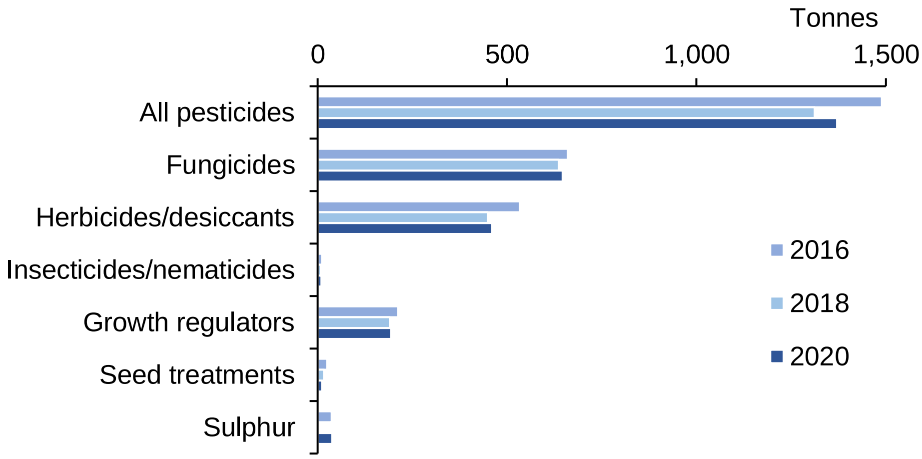
**Figure 5 Area of arable crops treated with major pesticide groups in Scotland 2016-2020**




Note: sulphur is not shown as it represents <2 per cent of the treated area

In terms of weight of pesticide applied, it is estimated ca. 1,370 tonnes were applied in 2020, representing an increase of five per cent from 2018 and a decrease of eight per cent from 2016 (Table 24, Figure 6).

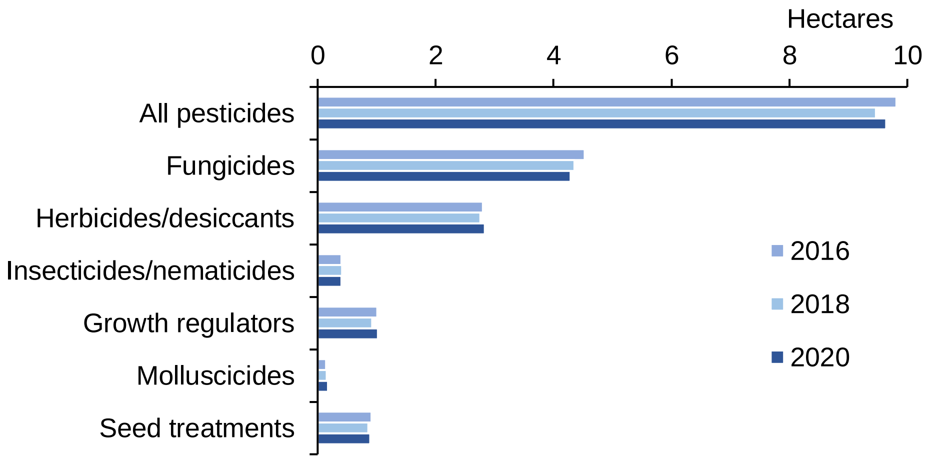
**Figure 6 Quantity of major pesticide groups applied to arable crops in Scotland 2016-2020**




Note: molluscicides are not shown as their use represents under 10 tonnes.

In order to make accurate comparisons between the 2020 data and the data collected in previous surveys, it is important to take into account the differences in crop area between survey years. Therefore, the number of treated hectares per hectare of crop grown and the total weight of pesticide used per hectare of crop grown were calculated. Once crop area is taken into account, there was a two per cent increase from 2018 to 2020 and a two per cent decrease from 2016 to 2020 in terms of the total pesticide treated area per area of crop grown (Figure 7).

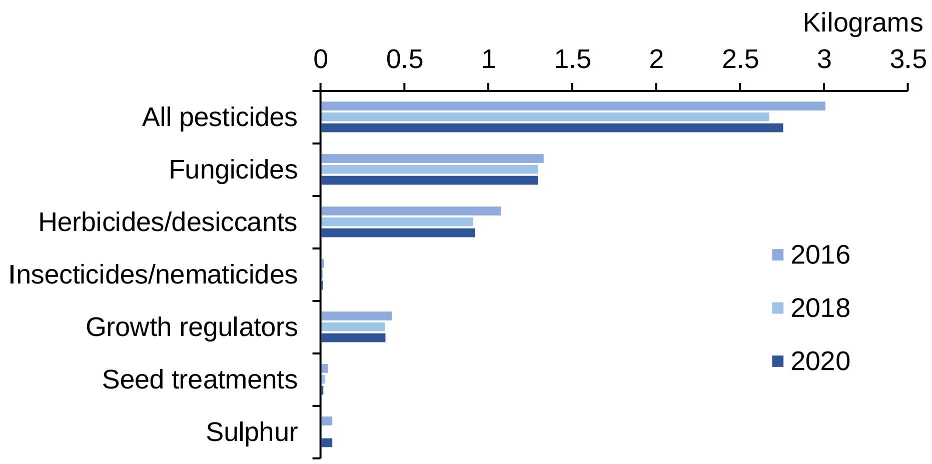
**Figure 7 Number of pesticide treated hectares (formulations) per hectare of crop grown in Scotland 2016-2020**




Note: sulphur is not shown as it represents <0.1 treated hectares per hectare of crop grown.

In terms of quantity of pesticides used per hectare of crop grown, there was an increase of three per cent from 2018 to 2020 and a decrease of eight per cent from 2016 to 2020 (Figure 8).

**Figure 8 Weight of pesticide applied per hectare of crop grown in Scotland 2016-2020**

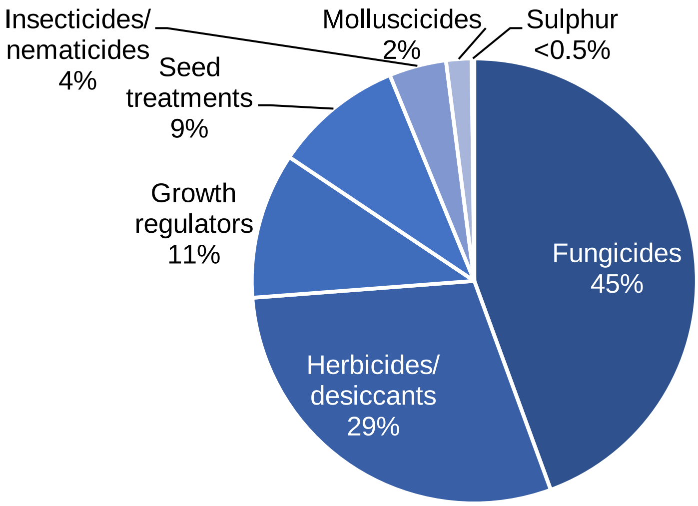



Note: Molluscicides are not shown as it represents <0.02 kg per hectare of crop grown.

As in previous surveys in this series, fungicides were the most frequently used pesticides on arable crops, followed by herbicides/desiccants (Figure 5). In 2020, fungicides accounted for 45 per cent of the total pesticide treated area and 47 per cent of the total weight of active substances applied (Figures 9 and 10). When changes in crop area are taken into account, there was a one per cent decrease in area treated with fungicides from 2018 to 2020 and a five per cent decrease in area treated from 2016 to 2020 (Figure 7). The weight of fungicides applied per hectare was unchanged from 2018 to 2020 and decreased three per cent from 2016 (Figure 8).

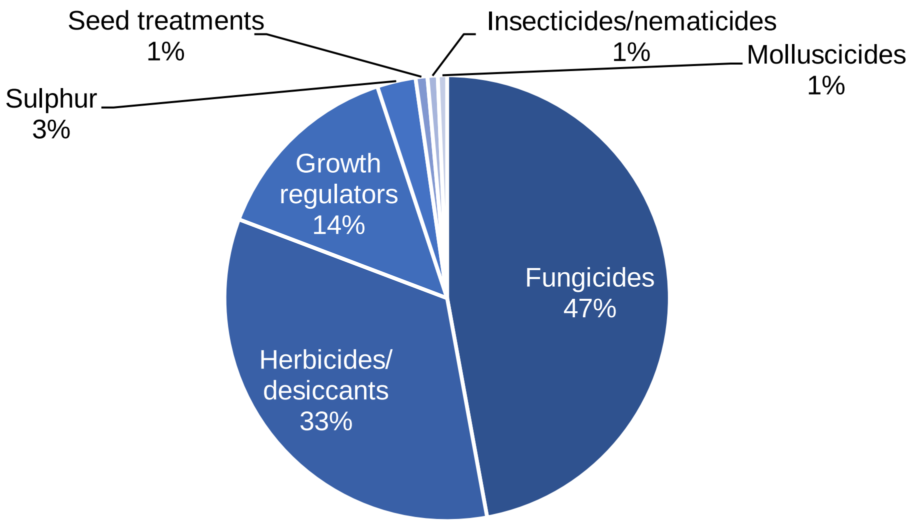
In 2020, herbicides/desiccants accounted for 29 per cent of the total pesticide treated area and 33 per cent of the total weight of active substances applied (Figures 9 and 10). When changes in crop area are taken into account, there was a three per cent increase in the area treated with herbicides/desiccants from 2018 to 2020 and a one per cent increase from 2016 to 2020. The weight of herbicides/desiccants applied increased one per cent from 2018 to 2020 and decreased 14 per cent from 2016 to 2020 (Figures 7 and 8).

**Figure 9 Use of pesticide on arable crops (percentage of total area treated with formulations) – 2020**




As was the case in 2018, insecticides/nematicides accounted for four per cent of the total pesticide treated area and one per cent of the total weight of active substances applied (Figures 9 and 10). As in 2018, pyrethroids accounted for the largest area treated with an insecticide (83 per cent, Table 19). When changes in crop area are taken into account, there was a three per cent decrease in area treated with insecticide from 2018 to 2020 and no change from 2016 to 2020 (Figure 7). The weight of insecticides applied per hectare of crop grown increased 17 per cent from 2018 to 2020 and decreased 18 per cent from 2016 to 2020 (Figure 8). This decrease in weight of insecticides applied since 2016 is influenced by the loss of the active substance chlorpyrifos in 2016 which was applied at high rates for the control of leatherjackets and wheat bulb fly in cereal crops. The increase in weight of insecticides applied since 2018 appears to have been driven by an increase in use on oilseed rape. When changes in crop area are taken into account, insecticide use on oilseed rape in 2020 increased by 54 per cent in terms of weight applied since 2018. A very wet autumn which delayed sowing may have resulted in some poorer crops that were more susceptible to pest attack in early growth stages, necessitating increased usage. With the loss of neonicotinoid seed treatments, growers are now reliant on foliar insecticides for insect control during the autumn crop establishment period.

**Figure 10 Use of pesticides on arable crops (percentage of total quantity of active substances applied) – 2020**




Molluscicides accounted for two per cent of the total pesticide treated area and one per cent of the total weight of active substances applied (Figures 9 and 10). When changes in crop area are taken into account, there was a 16 per cent increase in area treated from 2018 to 2020 and a 28 per cent increase from 2016 to 2020 (Figure 7). The weight of molluscicides applied per hectare of crop grown increased by four per cent from 2018 to 2020 and by 17 per cent from 2016 to 2020 (Figure 8). Heavy rainfall in autumn 2019 favoured slugs and growers were reliant on slug pellets for slug management in oilseed rape and wheat during the autumn[(5,6)]. Also, when changes in crop area are taken into account the weight of molluscicides applied to potato crops increased by 62 per cent. Wet weather during the summer months increased slug pressure on potato crops[(7)].

Growth regulators accounted for 11 per cent of the total pesticide treated area and 14 per cent of the total weight of active substances applied (Figures 9 and 10). When changes in crop area are taken into account, the area treated increased by 10 per cent from 2018 to 2020 and by two per cent from 2016 to 2020 (Figure 7). The weight of growth regulators applied per hectare of crop grown did not change from 2018 to 2020 and decreased nine per cent from 2016 to 2020 (Figure 8).

Seed treatments accounted for nine per cent of the total pesticide treated area and one per cent of the total weight of active substances applied (Figures 9 and 10). When changes in crop area are taken into account, there was a six per cent increase in area treated between 2018 and 2020 and a one per cent decrease between 2016 and 2020 (Figure 7). The weight of seed treatments applied per hectare decreased 26 per cent from 2018 and by 52 per cent since 2016 (Figure 8). The decrease in the weight of seed treatments applied may relate to the withdrawal of some seed treatment formulations since the previous survey including prochloraz/thiram which was the principal seed treatment on winter oilseed rape in 2018 (final use January 2019) and pencycuron which was the main seed treatment on potatoes in 2018 (final use March 2020). The use of imazalil/ipconazole, the main seed treatment on cereals in 2018, has decreased by 54 per cent in terms of treated area (particularly on spring barley). This was likely influenced by a temporary restriction on the use of this product in 2019 when use was limited to autumn use only. The constraint was lifted in early 2020 which meant the seed treatment could be applied throughout the year to combat a range of soil borne diseases in both wheat and barley.

Sulphur accounted for less than 0.5 per cent of the total pesticide treated area and three per cent of the total weight of active substances applied (Figures 9 and 10). When changes in crop area are taken into account, there was a 480 per cent increase in area treated from 2018 to 2020 and a 23 per cent decrease from 2016 to 2020 (Figure 7). The quantity of sulphur applied per hectare of crop grown increased by 1,322 per cent from 2018 to 2020 and increased two per cent from 2016 to 2020 (Figure 8). Spring barley accounted for 96 per cent of the sulphur treated area and 97 per cent of weight applied in 2020; no sulphur was recorded on spring barley in 2018.

Five active substances were recorded for the first time in the 2020 arable survey (Table 18). These included the herbicide aclonifen (for general weed control in potato crops) and the fungicide mefentrifluconazole (for disease control and precaution in cereals) and spirotetramat (used for aphids in seed potatoes). There were also two new fungicidal seed treatments encountered for the first time in this survey, *Bacillus amyloliquefaciens* strain MBI600 (used as a biological fungicide on winter OSR) and penflufen used on potatoes.

Whilst overall use of pesticides in 2020 has remained broadly similar to the previous two arable surveys, some individual active substances have exhibited considerable change. For example, the withdrawal of the multi-site fungicide chlorothalonil in May 2020 led to a 64 per cent decrease of area treated from 2018 and decreased 61 per cent by weight. This is likely to be correlated with the substantial increased use of the multi-site fungicide folpet (993 per cent increase by area treated and 1,039 per cent by weight) on wheat and barley (Table 22).

The area treated with fungicides fenpropimorph and epoxiconazole decreased 82 and 50 per cent respectively from 2018 and the weight applied decreased 82 and 52 per cent respectively. The authorisations for fenpropimorph and epoxiconazole have now been withdrawn (final use dates Oct 2020 and October 2021 respectively). In contrast, the area treated and weight applied of the fungicide and growth regulator metconazole increased 305 and 50 per cent respectively from 2018. The increase in use of metconazole may have been influenced by the reduced availability of epoxiconazole products prior to its withdrawal.

The herbicide treated area with pyraflufen-ethyl in 2020 increased by 345 per cent while the weight applied increased 324 per cent from 2018. Pyraflufen-ethyl is applied as a desiccant to potatoes. This increase in use is likely to be a consequence of the withdrawal of the main potato desiccant, diquat, in February 2020.

The largest increased use of a growth regulator was maleic hydrazide. The treated area increased by 295 per cent and the quantity used increased by 394 per cent. Maleic hydrazide is applied as a field treatment to ware potatoes to prevent sprouting during storage. The increase in the use of maleic hydrazide may have been influenced by the withdrawal of the main growth regulator, chlorpropham, in October 2020. Please refer to the potato storage report for further information.

In 2020, the area treated with the nematicide fosthiazate (organophosphorus) and insecticide acetamiprid (neonicotinoid) increased from 2018 by 589 and 1,065 per cent respectively, while weight applied increased by 1,058 and 996 per cent respectively. The increase in use of fosthiazate was the result of it being one of the few alternatives to oxamyl, which was the principal nematicide in 2018. Growers may have switched to using fosthiazate in 2020 in preparation for the loss of oxamyl which had a final use date 31 December 2020. Acetamiprid was used primarily on potatoes, with a small quantity used on winter oilseed rape. Acetamiprid plays an important part in aphid management programmes as it has no known resistance to peach-potato aphids, unlike pyrethroids.

Use of the molluscicide active substance metaldehyde in 2020 decreased 68 and 79 per cent by area treated and weight applied respectively from 2018. In contrast, the only other chemical alternative for slug control, ferric phosphate, increased by 163 and 135 per cent by area treated and weight applied respectively (Tables 22 and 23) as growers prepare for the loss of metaldehyde in March 2022. Molluscicide use has been influenced in recent years by changes in authorisation of products containing metaldehyde[(8)].

## Integrated pest management

Information about the uptake of IPM measures by Scottish growers was collected alongside the 2020 arable crops pesticide usage survey. This 2020 IPM survey represents the second in the series of surveys of IPM measures on arable crops, allowing the adoption of IPM techniques to be monitored.

This is a summary of the data; please refer to Appendix 6 for the full dataset. Growers were asked a series of questions about the IPM activities that they implemented for arable crop production. Unlike the other statistics in this report, the figures relating to IPM are not raised to produce national estimates but represent only the responses of those surveyed.

In total, IPM data was collected from 242 growers, collectively representing 248 holdings and six per cent of Scotland's 2020 arable crop area. Of these growers, 72 per cent had an IPM plan (45 per cent completed their own IPM plan and 27 per cent had a plan completed by their agronomist) (Figure 32). There was very strong evidence for an increase in the use of IPM plans from the 2016 survey where 24 per cent of growers had an IPM plan (p-value < 0.001). Since 2015, there has been a focus on the promotion of IPM and the introduction of mandatory completion of IPM plans within some key QA schemes to help growers make the best possible and most sustainable use of all available methods of pest control. Growers were asked about their IPM activities is relation to three categories; risk management, pest monitoring and pest control.

In both 2020 and 2016, all growers sampled reported that they implemented at least one measure associated with an IPM risk management approach (Table 36). There was strong evidence for an increase in the proportion of positive responses to soil testing techniques (p-value = 0.003) and to cultivation at sowing techniques (p-value < 0.001). Although not statistically significant, there were also increases in uptake in other risk management activities from 2016.

In terms of the uptake of pest monitoring activities, there was very little change seen between 2016 and 2020. In both years, all the growers sampled reported they implemented at least one pest monitoring measure (Table 37).

All of the growers sampled in 2020 adopted at least one IPM pest control activity, the same as in 2016. There was evidence for an increase in the proportion of positive responses to targeted pesticide application techniques (p-value = 0.005) and strong evidence for an increase in the use of anti-resistance strategies (p-value < 0.001) (Table 38). There were increases in the use of targeted pesticide applications to reduce pesticide use (73 per cent in 2016 to 85 per cent in 2020) and anti-resistance strategies (73 per cent in 2016 to 91 per cent in 2020). Finally, in 2020 a similar proportion of respondents stated that they regularly monitored the success of their crop protection measures (100 per cent in 2016 and 98 per cent in 2020).

## 2020 Pesticide usage

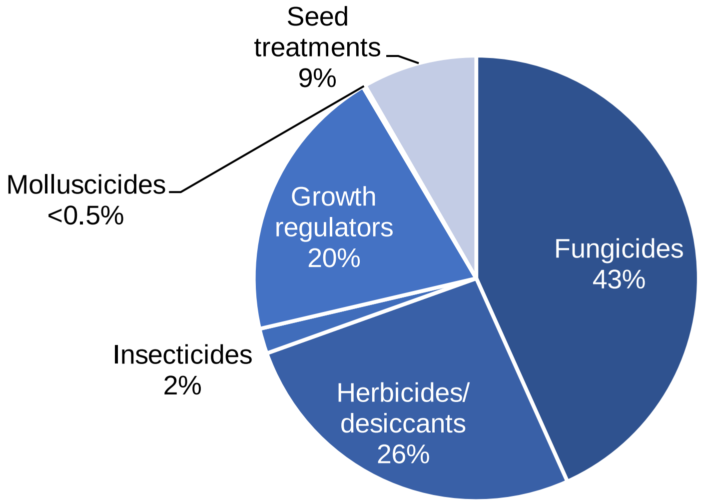
### Winter barley

- An estimated 43,089 hectares of winter barley were grown in Scotland in 2020, an increase of 15 per cent since 2018.
- One hundred per cent of the crop was treated with a pesticide (see Figure 11 for types of pesticides used)
- Pesticides were applied to 453,417 treated hectares
- There were 133,451 kilograms of pesticide applied in total (see summary table)
- Winter barley received on average 4.1 pesticide sprays (Table 1). These sprays included 2.6 fungicide applications and 2.1 herbicide/desiccant applications (applied to 96 per cent of the crop area for both groups), 1.9 applications of growth regulators (applied to 89 per cent) and one application of insecticide (applied to 19 per cent)
- Timings of pesticide applications are shown in Figure 12
- Where reasons were given (51 per cent), 66 per cent of fungicide use was for disease control/precaution. Where the disease was specified *Rynchosporium* was the most commonly reported (13 per cent) followed by mildew (seven per cent), *Ramularia* (six per cent), net blotch (four per cent), *Fusarium* (two per cent) with abiotic spotting, rust and ear diseases all under one per cent
- Reasons for herbicide/desiccant use were given for 68 per cent of the area. Thirty-one per cent was for annual broad-leaved weeds, 27 per cent for general weed control and 17 per cent for annual meadow grass. The remaining reasons were desiccation/harvest aid (13 per cent), wild oats and annual grass weeds (both three per cent), groundsel (two per cent) and couch (one per cent). All other reasons (cleavers, brome, field pansy, volunteer oats, sterile brome, fumitory, ryegrass, speedwell, docks and black grass) were below one per cent
- Where specified (39 per cent) all insecticide use was for aphids
- The most common varieties encountered were KWS Orwell (20 per cent) and KWS Tower (19 per cent)
- The average reported yield was 8.0 t/ha

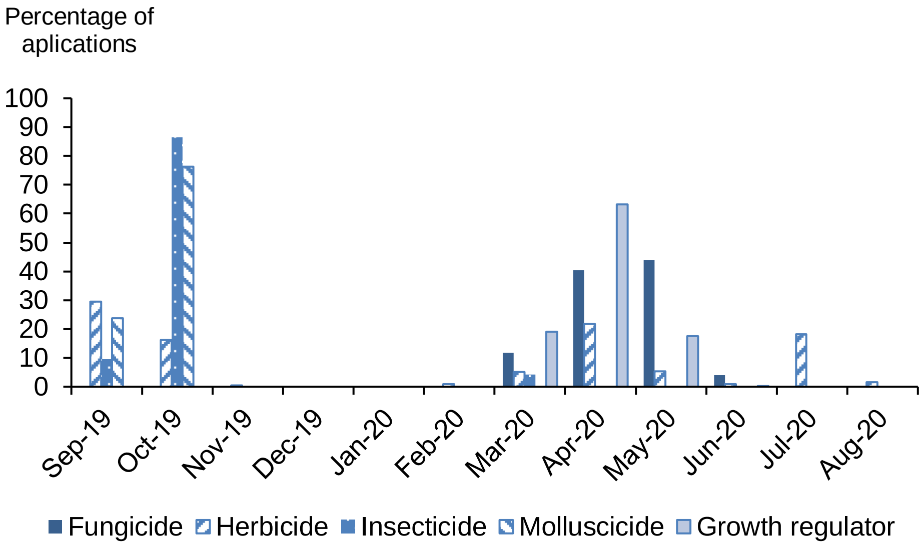
Summary of pesticide use on winter barley:

| Pesticide group | Formulation area treated | Weight of pesticides applied | Percentage of crop treated | Most used formulations |
|---|---|---|---|---|
| | ha | kg | % | ha |
| Fungicides | 196,180 | 45,444 | 96 | Chlorothalonil (37,730) |
| Herbicides/ desiccants | 118,957 | 53,729 | 96 | Glyphosate (25,163) |
| Insecticides | 8,272 | 39 | 19 | Lambda-cyhalothrin (5,810) |
| Growth regulators | 91,230 | 33,607 | 89 | Chlormequat (35,880) |
| Molluscicides | 828 | 51 | 2 | Metaldehyde (592) |
| Seed treatments | 37,949 | 581 | 88 | Imazalil/ipconazole (14,628) |
| **All pesticides** | **453,417** | **133,451** | **100** | |

## Figure 11 Use of pesticides on winter barley (percentage of total area treated with formulations) – 2020



## Figure 12 Timing of pesticide applications on winter barley – 2020




Note: herbicides include desiccants.

## Spring barley

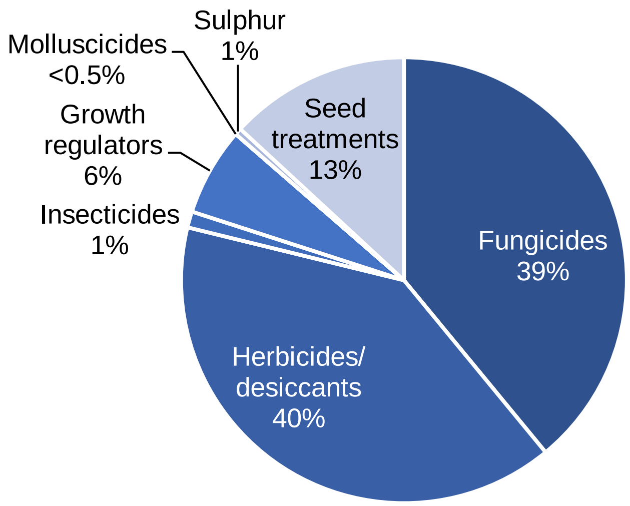
- An estimated 258,702 hectares of spring barley were grown in Scotland in 2018, representing an increase of three per cent since 2020
- Ninety-nine per cent of the crop was treated with a pesticide (see Figure 13 for types of pesticide used)
- Pesticides were applied to 1,802,458 treated hectares
- There were 415,027 kilograms of pesticide used in total on the crop (see summary table)
- The spring barley crop received on average 2.7 pesticide applications (Table 1). These included 1.8 fungicide applications and 1.8 herbicide/desiccant applications (applied to 95 per cent and 99 per cent of the crop area respectively) and 1.2 applications of growth regulators (applied to 35 per cent)
- Timings of pesticide applications are shown in Figure 14
- Reasons were given for 59 per cent of total fungicide use with 67 per cent being for disease control/precaution. Where the disease was specified, *Rhynchosporium* and mildew were most commonly reported (11 per cent each), followed by *Ramularia* (six per cent), net blotch (three per cent) and rust (one per cent). Four other reasons for fungicide use, each less than one per cent, account for the remainder
- Reasons were supplied for 70 per cent of herbicide/desiccant use; 49 per cent was for general weed control, 21 per cent for annual broad-leaved weeds, seven per cent desiccation/harvest aid, five per cent for both annual meadow grass and wild oats and two per cent for couch. Chickweed, fumitory, volunteer rape, knotgrass, annual grass weeds and volunteer potatoes were all listed at one per cent, and 14 other herbicide reasons were recorded at less than one per cent
- Reasons were supplied for 48 per cent of total insecticide use. 63 per cent was for aphids, 29 per cent was for cereal leaf beetle and eight per cent for general pests
- Laureate was the most common variety, accounting for 64 per cent of the sample area, followed by LG Diablo at 12 per cent
- The average reported yield was 7.1 t/ha

Summary of pesticide use on spring barley:

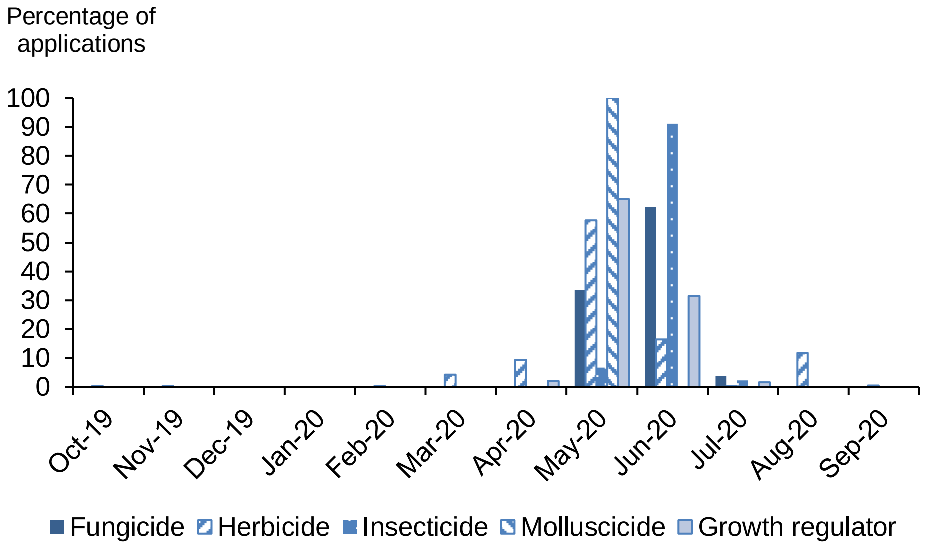
| Pesticide group | Formulation area treated | Weight of pesticides applied | Percentage of crop treated | Most used formulations |
|---|---|---|---|---|
| | ha | kg | % | ha |
| Fungicides | 702,401 | 155,137 | 95 | Folpet (145,294) |
| Herbicides/ desiccants | 715,836 | 187,703 | 99 | Metsulfuron-methyl/ thifensulfuron-methyl (114,027) |
| Insecticides | 20,985 | 98 | 8 | Lambda-cyhalothrin (17,502) |
| Growth regulators | 115,117 | 30,683 | 35 | Chlormequat (41,806) |
| Molluscicides | 34 | 3 | <0.5 | Metaldehyde (34) |
| Sulphur | 8,841 | 37,086 | 3 | N/A |
| Seed treatments | 239,243 | 4,318 | 92 | Prothioconazole/tebuconazole (142,480) |
| **All pesticides** | **1,802,458** | **415,027** | **99** | |

N/A = not applicable

## Figure 13 Use of pesticides on spring barley (percentage of total area treated with formulations) – 2020



## Figure 14 Timing of pesticide applications on spring barley – 2020




Note: herbicides include desiccants.

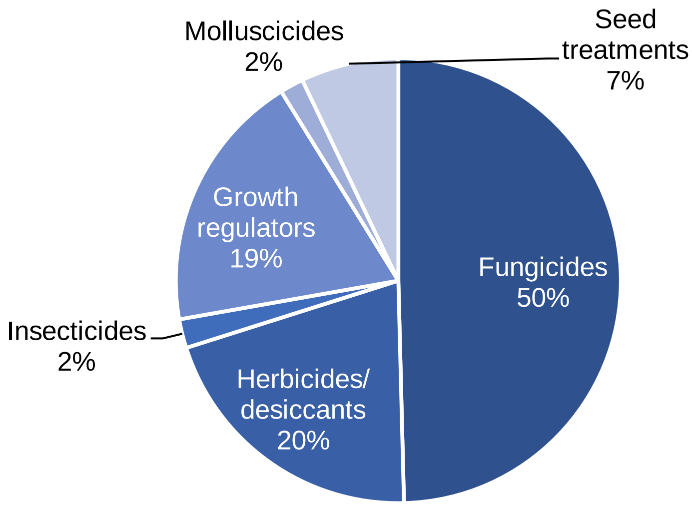
### Winter wheat

- An estimated 91,249 hectares of winter wheat were grown in Scotland in 2020, representing a decrease of three per cent since 2018
- One hundred per cent of the crop was treated with a pesticide (see Figure 15 for types of pesticide used)
- Pesticides were applied to 1,270,846 treated hectares
- There were 369,912 kilograms of pesticide used in total on the crop (see summary table)
- The winter wheat crop received on average 5.1 pesticide applications (Table 1). These included 3.5 fungicide applications and 2.1 herbicide/desiccant applications (applied to 100 per cent and 97 per cent of the crop area respectively), 1.9 applications of growth regulators (applied to 96 per cent); molluscicides and insecticides received 1.3 and 1.2 applications applied to 18 and 24 per cent of the area respectively)
- Timings of pesticide applications are shown in Figure 16
- Reasons were given for 59 per cent of total fungicide use with 47 per cent being for disease control/precaution. Where the disease was specified *Septoria* was most commonly reported (21 per cent) followed by rust (nine per cent), yellow rust (seven per cent), *Fusarium* (five per cent), mildew (four per cent), eyespot (three per cent) and sooty mould (two per cent). Six other reasons for fungicide use were all recorded at below one per cent
- Reasons were supplied for 66 per cent of herbicide/desiccant use; 32 per cent was for general weed control, 19 per cent for annual broad-leaved weeds and 15 per cent for annual meadow grass. Five per cent of use was for harvest aid and four per cent for annual grass weeds. Three per cent listed brome, wild oats and volunteer rape. Two per cent listed fumitory, ryegrass and mayweed. One per cent listed cleavers, volunteer oats, sterile brome, volunteer beans, speedwell, black grass, black bindweed, chickweed and groundsel. Twelve other reasons for herbicide use were all recorded at below one per cent to give two per cent of all reasons given
- Reasons were supplied for 79 per cent of total insecticide use, all of which was for aphids
- KWS Barrel was the most common variety, accounting for 25 per cent of the sample area, followed by LG Skyscraper at 15 per cent
- The average reported yield was 9.1 t/ha

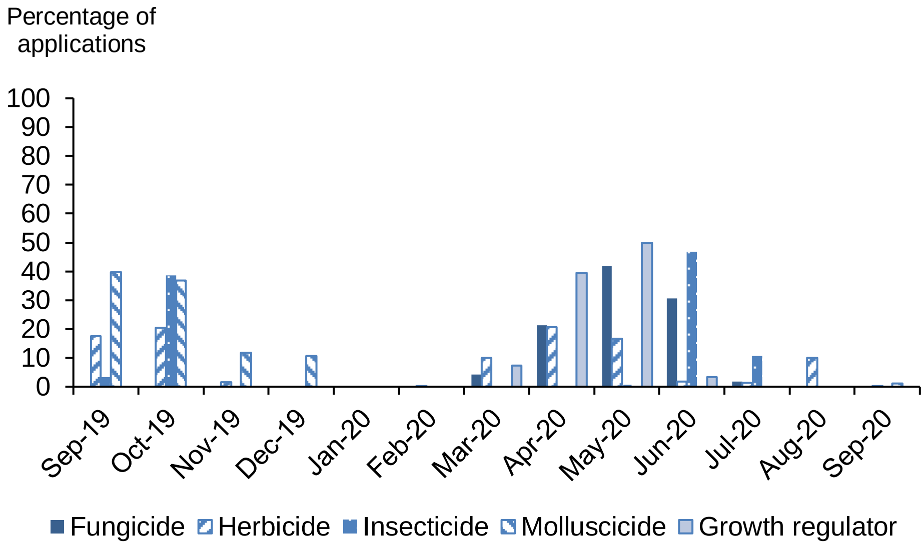
Summary of pesticide use on winter wheat:

| Pesticide group | Formulation area treated | Weight of pesticides applied | Percentage of crop treated | Most used formulations |
|---|---|---|---|---|
| | ha | kg | % | ha |
| Fungicides | 630,257 | 178,034 | 100 | Chlorothalonil (103,788) |
| Herbicides/ desiccants | 260,752 | 89,757 | 97 | Glyphosate (34,446) |
| Insecticides | 26,692 | 118 | 24 | Lambda-cyhalothrin (21,240) |
| Growth regulators | 241,015 | 98,175 | 96 | Chlormequat (108,909) |
| Molluscicides | 21,746 | 2,087 | 18 | Ferric phosphate (16,394) |
| Seed treatments | 90,385 | 1,741 | 94 | Fludioxonil (41,449) |
| **All pesticides** | **1,270,846** | **369,912** | **100** | |

## Figure 15 Use of pesticides on winter wheat (percentage of total area treated with formulations) – 2020



## Figure 16 Timing of pesticide applications on winter wheat – 2020




Note: there were small amounts (<0.5%) of herbicide applications on winter wheat in August 2020 which are not visible on this figure. Herbicides include desiccants

## Spring wheat

This crop was not recorded separately in the Agricultural Census. Based upon the proportions of spring and winter wheat encountered in the survey it was estimated that 2,282 hectares of spring wheat were grown in Scotland in 2020, representing a decrease of 59 per cent since 2018.

- One hundred per cent of the crop was treated with a pesticide (see Figure 17 for types of pesticides used)
- Pesticides were applied to 17,197 treated hectares
- There were 3,241 kilograms of pesticide used in total on the crop (see summary table below)
- The spring wheat crop received on average 2.8 pesticide applications (Table 1). These included 1.9 fungicide applications and 1.6 herbicide/desiccant applications (applied to 100 per cent of the crop area for both groups) and 1.0 applications of growth regulators (applied to 79 per cent). There were no insecticide applications.
- Timings of pesticide applications are shown in Figure 18
- Reasons were given for 79 per cent of total fungicide use with over 73 per cent being for disease control. Specified diseases included mildew (10 per cent), *Septoria* and yellow rust (both nine per cent)
- Reasons were supplied for 92 per cent of herbicide/desiccant use; 53 per cent was for general weed control, 30 per cent for annual broad-leaved weeds, eight per cent for couch, six per cent for desiccation and three per cent for wild oats. Fumitory was listed at under one per cent of area
- The most common variety grown, accounting for 45 per cent of the sample area, was Tybalt followed by Belepi at 37 per cent
- The average reported yield was 6.1 t/ha

Summary of pesticide use on spring wheat:

| Pesticide group | Formulation area treated | Weight of pesticides applied | Percentage of crop treated | Most used formulations |
|---|---|---|---|---|
| | ha | kg | % | ha |
| Fungicides | 6,894 | 1,455 | 100 | Prothioconazole/ tebuconazole (1,003) |
| Herbicides/ desiccants | 6,175 | 1,122 | 100 | Metsulfuron-methyl/ thifensulfuron-methyl (1,759) |
| Growth regulators | 2,335 | 643 | 79 | Trinexapac-ethyl (1,813) |
| Seed treatments | 1,792 | 20 | 79 | Fludioxonil/Tebuconazole (1,039) |
| **All pesticides** | **17,197** | **3,241** | **100** | |

**Figure 17 Use of pesticides on spring wheat (percentage of total area treated with formulations) – 2020**

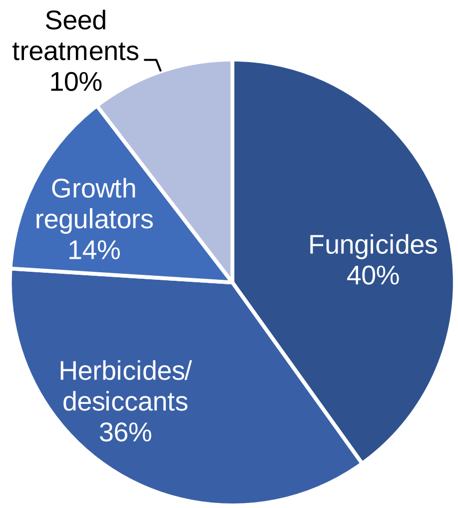
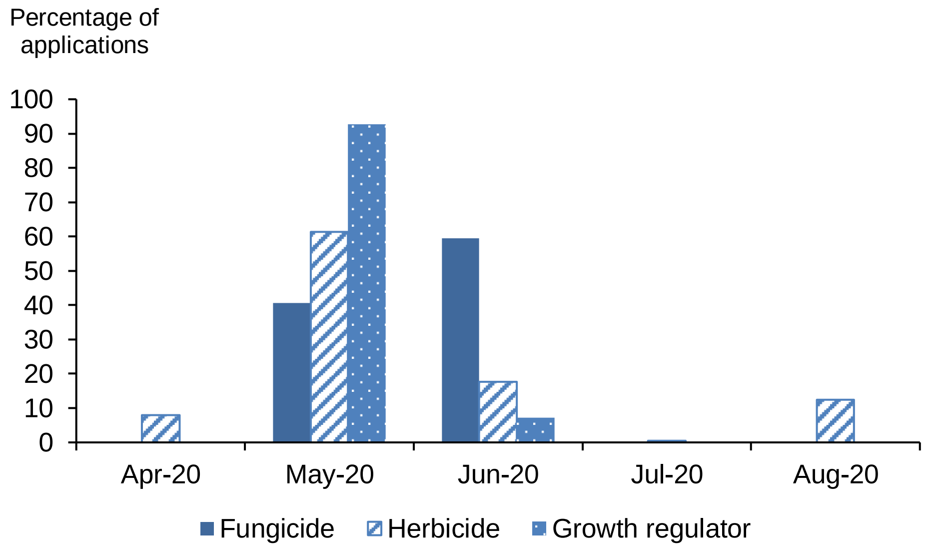



**Figure 18 Timing of pesticide applications on spring wheat – 2020**




Note: Herbicides include desiccants.

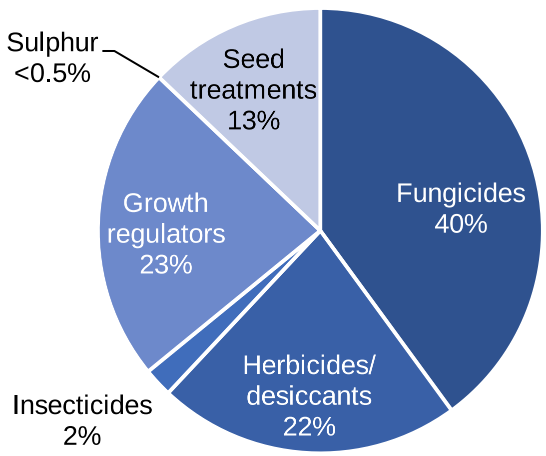
## Winter oats

- An estimated 7,984 hectares of winter oats were gown in Scotland in 2020, a decrease of five per cent since 2018.
- Eighty-nine per cent of the crop was treated with a pesticide (see Figure 19 for types of pesticides used)
- Pesticides were applied to 52,111 treated hectares
- There were 10,202 kilograms of pesticide applied in total (see summary table)
- Winter oats received on average 3.3 pesticide sprays (Table 1). These sprays included 2.4 fungicide applications and 1.5 herbicide/desiccant applications (applied to 74 per cent and 82 per cent of the crop area respectively), 1.5 applications of growth regulators (applied to 80 per cent) and 1.0 applications of insecticides (applied to 14 per cent)
- Timings of pesticide applications are shown in Figure 20
- Where reasons were given (73 per cent of area treated), 38 per cent of fungicide use was for mildew, 24 per cent for disease control, 14 per cent for crown rust and six per cent for rust. Six other reasons for fungicide use were all recorded at below three per cent.
- Reasons for herbicide/desiccant use were given for 81 per cent of the area, 35 per cent was for general weed control, 29 per cent for annual broad-leaved weeds, 11 per cent for annual meadow grass, seven per cent for both harvest aid and mayweed, three per cent for volunteer beans, groundsel and volunteer rape, one per cent each for chickweed, cleavers and fumitory
- Where specified (100 per cent), 73 per cent of insecticide use was for aphids and 27 per cent for cereal leaf beetle
- The most common variety encountered was Gerald accounting for 35 per cent of the sample area followed by Dalguise at 34 per cent
- The average reported yield was 7.7 t/ha

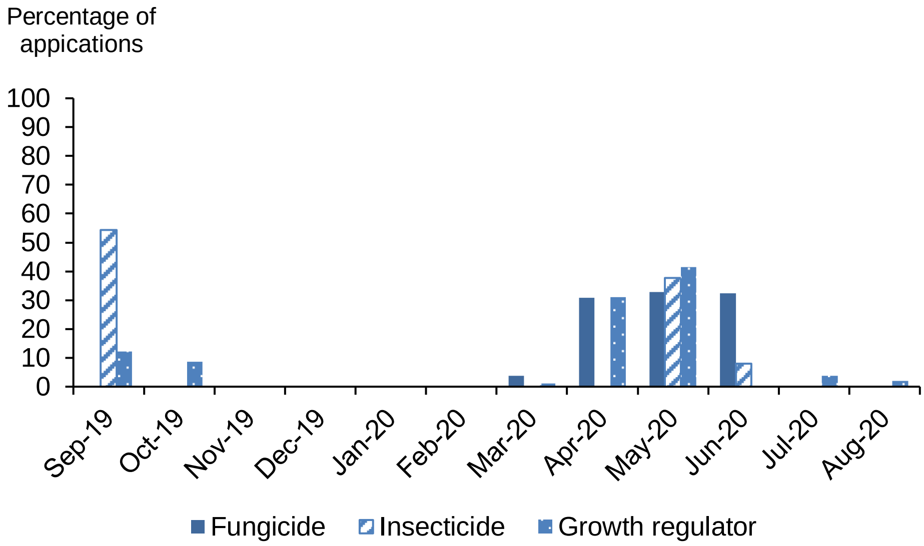
Summary of pesticide use on winter oats:

| Pesticide group | Formulation area treated | Weight of pesticides applied | Percentage of crop treated | Most used formulations |
|---|---|---|---|---|
| | ha | kg | % | ha |
| Fungicides | 20,818 | 2,456 | 74 | Cyflufenamid (4,460) |
| Herbicides/ desiccants | 11,488 | 2,386 | 82 | Diflufenican/ flufenacet (4,335) |
| Insecticides | 1,095 | 5 | 14 | Lambda-cyhalothrin (1,095) |
| Growth regulators | 11,983 | 5,266 | 80 | Trinexapac-ethyl (6,095) |
| Seed treatments | 6,727 | 88 | 84 | Fludioxonil (3,223) |
| **All pesticides** | **52,111** | **10,202** | **89** | |

## Figure 19 Use of pesticides on winter oats (percentage of total area treated with formulations) – 2020



## Figure 20 Timing of pesticide applications on winter oats – 2020




Note: Herbicides include desiccants.

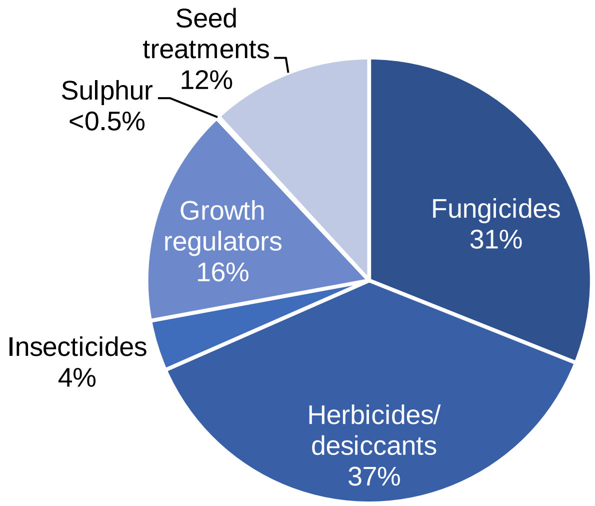
## Spring oats

- An estimated 25,999 hectares of spring oats were grown in Scotland in 2020, an increase of ten per cent since 2018
- Ninety-three per cent of the crop was treated with a pesticide (see Figure 21 for types of pesticides used)
- Pesticides were applied to 170,500 treated hectares
- There were 40,535 kilograms of pesticide applied in total (see summary table)
- Spring oats received on average 3.1 pesticide sprays (Table 1). These sprays included 1.7 fungicide applications and 1.9 herbicide/desiccant applications (applied to 90 per cent and 92 per cent of the crop area respectively), 1.1 applications of growth regulators (applied to 79 per cent) and 1.0 application of insecticides (applied to 24 per cent)
- Timings of pesticide applications are shown in Figure 22
- Where reasons were given (60 per cent), 38 per cent of fungicide use was for mildew, 21 per cent for leaf spot, 19 per cent for disease control and 10 per cent for crown rust, with six other reasons for fungicide use accounting for the rest.
- Reasons for herbicide/desiccant use were given for 70 per cent of the area, 24 per cent for general weed control, 15 per cent each for annual broad-leaved weeds and desiccation/harvest aid, 13 per cent for volunteer rape, seven per cent each for both cleavers and fumitory, five per cent for field pansy, three per cent for fat hen, two per cent each for mayweed, annual grass weeds, desiccation, volunteer beans, knotgrass and annual meadow grass with one per cent each for thistles, redshank and chickweed.
- Where specified (72 per cent), 74 per cent of insecticide use was for aphids and 26 per cent for cereal leaf beetle
- The most common variety encountered was WPB Elyann, accounting for 25 per cent of the sample area followed by Conway at 24 per cent
- The average reported yield was 6.6 t/ha

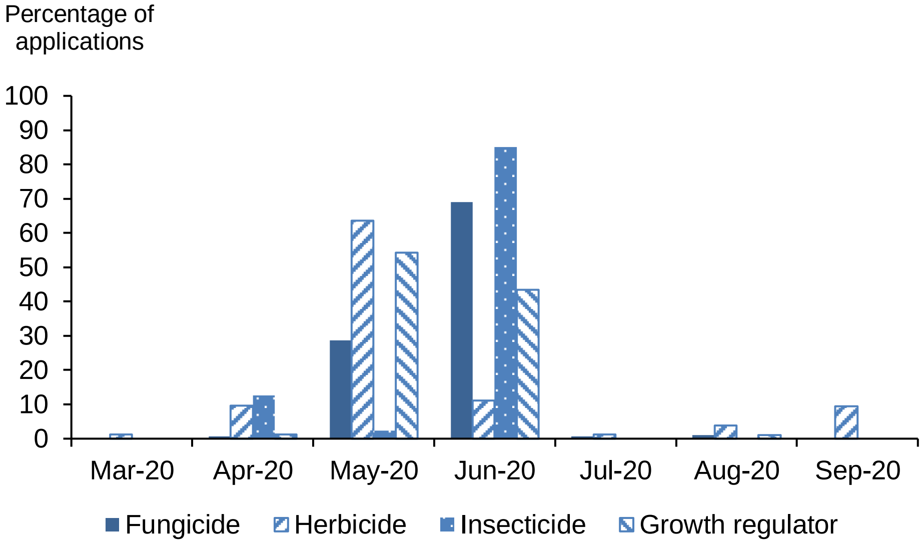
Summary of pesticide use on spring oats:

| Pesticide group | Formulation area treated | Weight of pesticides applied | Percentage of crop treated | Most used formulations |
|---|---|---|---|---|
| | ha | kg | % | ha |
| Fungicides | 52,432 | 7,008 | 90 | Cyflufenamid (8,787) |
| Herbicides/ desiccants | 63,182 | 16,205 | 92 | Fluroxypyr (11,253) |
| Insecticides | 6,225 | 31 | 24 | Lambda-cyhalothrin (6,225) |
| Growth regulators | 26,857 | 15,810 | 79 | Chlormequat (14,255) |
| Sulphur | 294 | 1,168 | 1 | N/A |
| Seed treatments | 21,512 | 314 | 83 | Prothioconazole/ tebuconazole (9,929) |
| **All pesticides** | **170,500** | **40,535** | **93** | |

### Figure 21 Use of pesticides on spring oats (percentage of total area treated with formulations) – 2020



## Figure 22 Timing of pesticide applications on spring oats – 2020




Note: Herbicides include desiccants.

### Oilseed rape

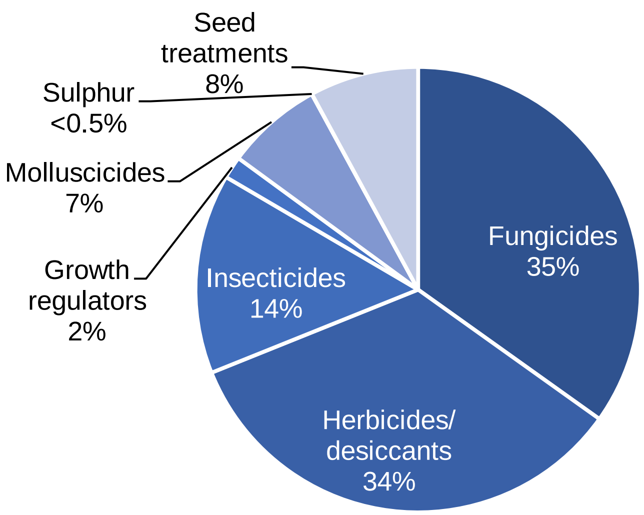
- An estimated 30,793 hectares of oilseed rape (winter and spring) were grown in Scotland in 2020, representing a decrease of six per cent since 2018
- One hundred per cent of the crop was treated with a pesticide (see Figure 23 for types of pesticides used)
- Pesticides were applied to 285,283 treated hectares
- There were 78,623 kilograms of pesticide used in total on the crop (see summary table)
- The oilseed rape crop received on average 5.8 pesticide applications (Table 1). These included 2.7 fungicide applications and 2.6 herbicide/desiccant applications (applied to 98 and 100 per cent of the crop area respectively), 1.0 application of growth regulators (applied to 15 per cent), 1.4 molluscicide applications (applied to 46 per cent) and 1.8 insecticides applications to 73 per cent of the crop area
- Timings of pesticide applications are shown in Figure 24
- Reasons were given for 48 per cent of total fungicide use with 43 per cent being for light leaf spot, 27 per cent for *Sclerotinia*, 16 per cent for disease control/precaution, four per cent for *Phoma* leaf spot, three per cent *Alternaria.* Seven other diseases were listed at below one per cent
- Reasons were supplied for 57 per cent of herbicide/desiccant use; 22 per cent for volunteer cereals, 21 per cent each for general weed control, 17 per cent for desiccation/harvest aid, 11 per cent for annual broad-leaved weeds, six per cent for annual meadow grass, five per cent for mayweed, four per cent each for annual grass weeds and brome, three per cent for cleavers, two per cent for fumitory and one per cent each for volunteer barley, charlock, wild oats and sterile brome. Chickweed, black grass, couch, cranesbill and shepherds purse were all recorded at below one per cent
- Reasons were supplied for 59 per cent of total insecticide use. Twenty-six per cent of which was for flea beetle, 22 per cent for seed weevil, 20 per cent for pollen beetle, 15 per cent for cabbage stem flea beetle, 11 per cent for winter stem beetle, three per cent stem weevil and two per cent each for aphids and pod midge
- Anastasia was the most common variety, accounting for 14 per cent of the sample area, followed by DK Exalte at 10 per cent
- The average reported yield was 4 t/ha

Summary of pesticide use on oilseed rape:

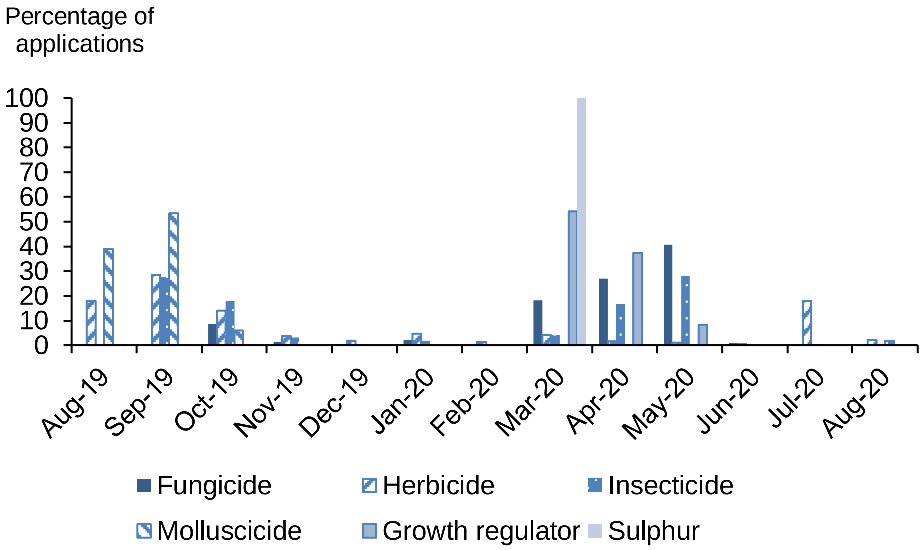
| Pesticide group | Formulation area treated | Weight of pesticides applied | Percentage of crop treated | Most used formulations |
|---|---|---|---|---|
| | ha | kg | % | ha |
| Fungicides | 99,321 | 15,344 | 98 | Prothioconazole/ tebuconazole (25,499) |
| Herbicides/ desiccants | 97,013 | 59,219 | 100 | Glyphosate (21,228) |
| Insecticides | 41,369 | 801 | 73 | Lambda-cyhalothrin (26,390) |
| Growth regulators | 4,603 | 859 | 15 | Mepiquat chloride/ metconazole (4,603) |
| Molluscicides | 19,980 | 2,138 | 46 | Ferric phosphate (14,546) |
| Sulphur | 53 | 169 | <0.5 | N/A |
| Seed treatments | 22,944 | 93 | 75 | Thiram (11,966) |
| **All pesticides** | **285,283** | **78,623** | **100** | |

N/A = not applicable

## Figure 23 Use of pesticides on oilseed rape (percentage of total area treated with formulations) – 2020



## Figure 24 Timing of pesticide applications on oilseed rape – 2020




Note: there were small amounts (<0.5%) of herbicide applications on oilseed rape in September 2020 which are not shown on this figure; herbicides include desiccants.

## Seed potatoes

- An estimated 12,003 hectares of seed potatoes were grown in Scotland in 2020, representing a decrease of one per cent since 2018
- One hundred per cent of the crop was treated with a pesticide (see Figure 25 for types of pesticide used)
- Pesticides were applied to 292,245 treated hectares
- There were 102,026 kilograms of pesticide used in total on the crop (see summary table below)
- The seed potato crop received on average 10.9 pesticide applications (Table 1). These included 8.8 fungicide applications and 2.3 herbicide/desiccant applications (applied to 100 per cent of the crop area for both groups), insecticides and molluscicides received 6.5 and 1.9 applications respectively (applied to 92 and 34 per cent of the area respectively)
- Timings of pesticide applications are shown in Figure 26
- Reasons were given for 62 per cent of total fungicide use, 98 per cent was for blight, one per cent each for powdery scab and mildew. *Sclerotinia* was recorded at below one per cent
- Reasons were given for 63 per cent of herbicide/desiccant use; 43 per cent was for general weed control, 37 per cent for desiccation, 13 per cent for annual broad-leaved weeds, five per cent for annual meadow grass and one per cent each for both volunteer rape and couch
- Reasons were supplied for 51 per cent of total insecticide/nematicide use, all of which was for aphids
- Maris Piper was the most common variety, accounting for 12 per cent of the sample area, followed by Hermes at eight per cent
- The average reported yield was 39.3 t/ha

Summary of pesticide use on seed potatoes:

| Pesticide group | Formulation area treated | Weight of pesticides applied | Percentage of crop treated | Most used formulations |
|---|---|---|---|---|
| | ha | kg | % | ha |
| Fungicides | 145,927 | 79,885 | 100 | Cyazofamid (27,113) |
| Herbicides/ desiccants | 43,893 | 15,560 | 100 | Carfentrazone-ethyl (13,408) |
| Insecticides | 83,722 | 2,684 | 92 | Lambda-cyhalothrin (32,806) |
| Molluscicides | 7,811 | 1,034 | 34 | Ferric phosphate (7,400) |
| Seed treatments | 10,891 | 2,863 | 88 | Flutolanil (5,477) |
| **All pesticides** | **292,245** | **102,026** | **100** | |

**Figure 25 Use of pesticides on seed potatoes (percentage of total area treated with formulations) – 2020**

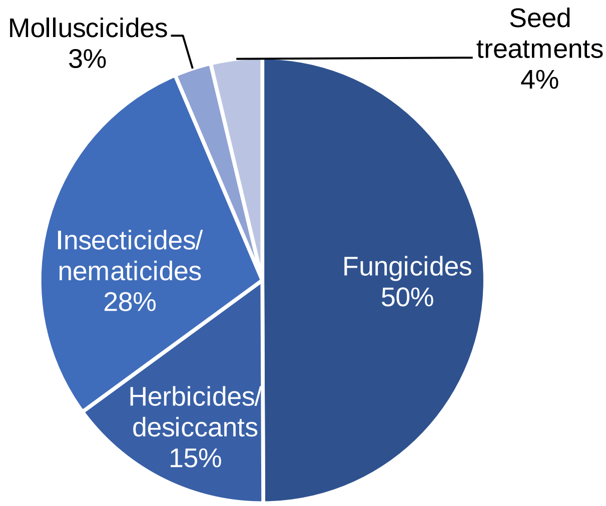
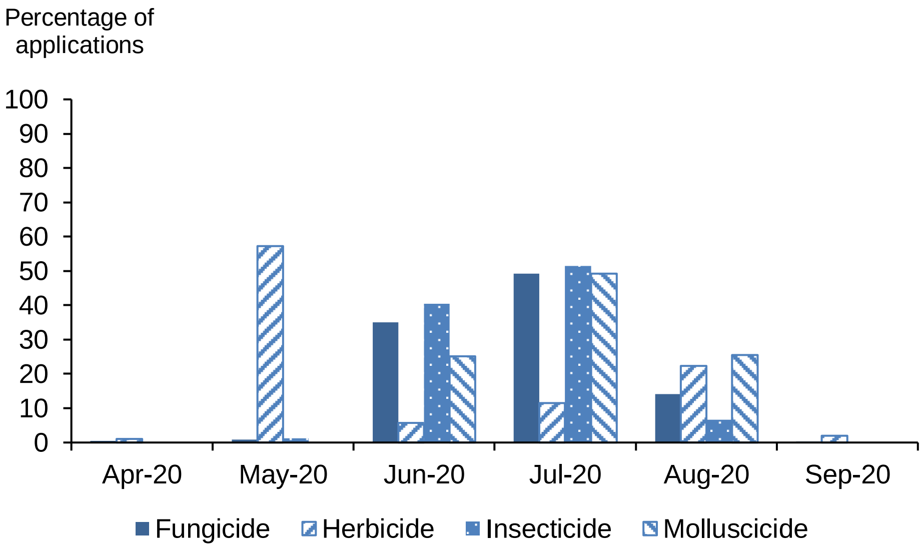



**Figure 26 Timing of pesticide applications on seed potatoes – 2020**




Note: Insecticides include nematicides and herbicides include desiccants.

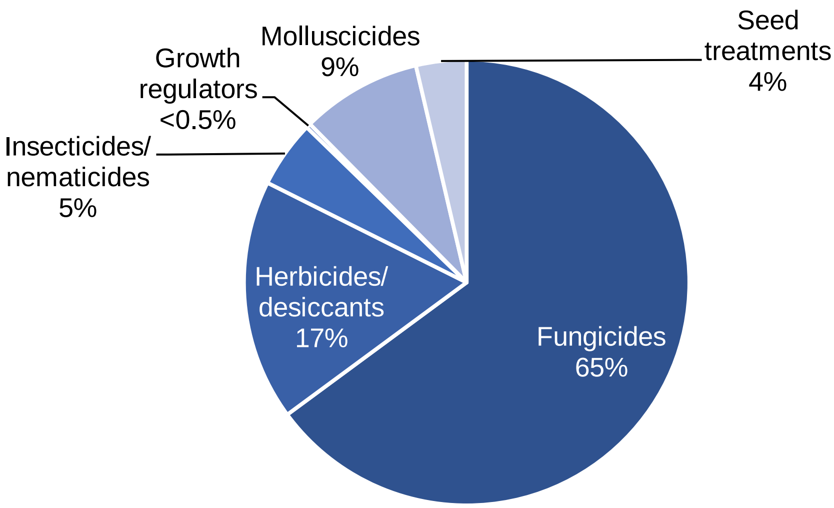
## Ware potatoes

- An estimated 16,294 hectares of ware potatoes were grown in Scotland in 2020, representing an increase of seven per cent since 2018
- One hundred per cent of the crop was treated with a pesticide (see Figure 27 for types of pesticide used)
- Pesticides were applied to 389,323 treated hectares with 201,609 kilograms of pesticide applied in total (see summary table below)
- The ware potato crop received on average 13.8 pesticide applications (Table 1). These included 10.2 fungicide applications and 2.4 herbicide/desiccant applications (applied to 99 per cent of the crop area for both groups), insecticides and molluscicides received 1.9 and 3.3 applications each (applied to 58 per cent of the area for both groups)
- Timings of pesticide applications are shown in Figure 28
- Reasons were given for 50 per cent of total fungicide use, 96 per cent of which was for blight control, two per cent each for both black dot and *Alternaria*. *Sclerotinia* was recorded at below one per cent
- Reasons were supplied for 45 per cent of herbicide/desiccant use; 58 per cent was for general weed control, 32 per cent for desiccation, seven per cent for annual broad-leaved weeds and four per cent for annual meadow grass
- Reasons were supplied for 47 per cent of total insecticide/nematicide use. 96 per cent of which was for aphids with two per cent each for both nematodes and wireworm
- Maris Piper was the most common variety grown for ware, accounting for 30 per cent of the sample area followed by Cultra at 18 per cent
- The average reported yield was 53.9 t/ha

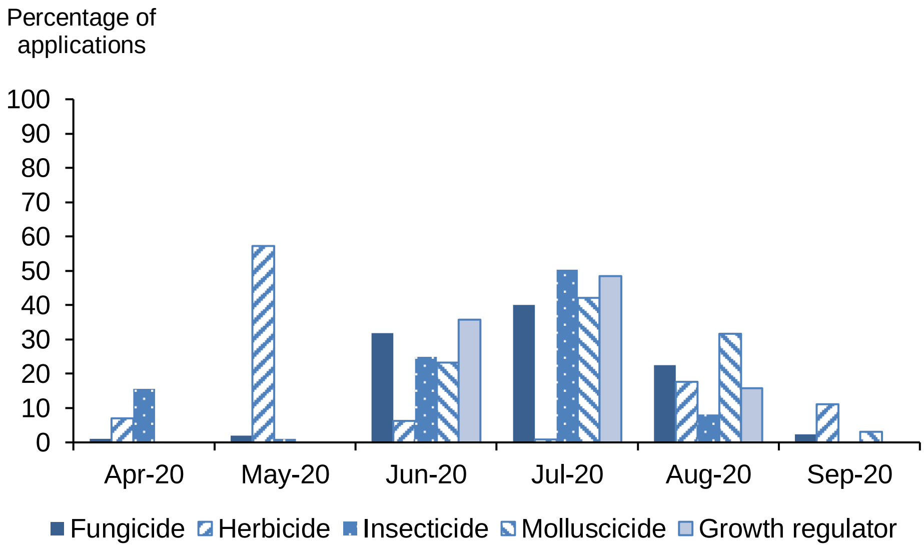
Summary of pesticide use on ware potatoes:

| Pesticide group | Formulation area treated | Weight of pesticides applied | Percentage of crop treated | Most used formulations |
|---|---|---|---|---|
| | ha | kg | % | ha |
| Fungicides | 252,674 | 160,160 | 99 | Cymoxanil/mancozeb (61,530) |
| Herbicides/ desiccants | 68,055 | 25,270 | 99 | Pyraflufen-ethyl (18,456) |
| Insecticides | 18,964 | 6,413 | 58 | Esfenvalerate (7,073) |
| Growth regulators | 1,277 | 3,830 | 8 | Maleic hydrazide (1,277) |
| Molluscicides | 34,095 | 3,911 | 58 | Ferric phosphate (29,385) |
| Seed treatments | 14,259 | 2,025 | 85 | Flutolanil (6,670) |
| **All pesticides** | **389,223** | **201,609** | **100** | |

## Figure 27 Use of pesticides on ware potatoes (percentage of total area treated with formulations) – 2020




## Figure 28 Timing of pesticide applications on ware potatoes – 2020




Note: there were small amounts (<0.5%) of fungicide and herbicides/desiccants applied in October 2020 which are not shown on this figure; insecticides include nematicides and herbicides include desiccants.

## Legumes

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

- An estimated 2,466 hectares of legumes were grown in Scotland in 2020, representing a decrease of three per cent since 2018
- Eighty-nine per cent of the crop was treated with a pesticide (see Figure 29 for types of pesticide used)
- Pesticides were applied to 7,491 treated hectares
- There were 4,282 kilograms of pesticide used in total on the crop (see summary table below)
- The legume crop received on average 2.5 pesticide applications (Table 1). These included 1.1 fungicide applications and 1.9 herbicide/desiccant applications (applied to 46 and 89 per cent of the crop area respectively)
- Timings of pesticide applications are shown in Figure 30
- Reasons were given for 70 per cent of total fungicide use with 46 per cent for *Ascochyta*, 28 per cent for rust and 26 per cent for *Sclerotinia*. Chocolate spot (botrytis) which is a common problem was not recorded
- Reasons were supplied for 81 per cent of herbicide/desiccant use; 23 per cent was for cleavers, 20 per cent for desiccation/harvest aid, 19 per cent for general weed control, 12 per cent was for annual broad-leaved weeds, 11 per cent for annual meadow grass, six per cent for volunteer cereals and three per cent each for annual grass weeds, brome and wild oats
- The most common variety, accounting for 37 per cent of the sample area, was Fuego followed by Honey at 19 per cent
- The average reported yield was 4.4 t/ha

Summary of pesticide use on legumes:

| **Pesticide group** | **Formulation area treated** | **Weight of pesticides applied** | **Percentage of crop treated** | **Most used formulations** |
|---|---|---|---|---|
| | **ha** | **kg** | **%** | **ha** |
| Fungicides | 1,800 | 289 | 46 | Azoxystrobin (772) |
| Herbicides/ desiccants | 5,319 | 3,993 | 89 | Glyphosate (1,360) |
| Insecticides | 175 | 1 | 7 | Esfenvalerate (91) |
| Seed treatments | 197 | N/A | 8 | Unspecified seed treatment (197) |
| **All pesticides** | **7,491** | **4,282** | **89** | |

Note: 92 per cent of legumes in 2020 had no seed treatment; the seed treatment information for the remaining eight per cent was unspecified (see appendix 3 for definitions). N/A = not applicable

**Figure 29 Use of pesticides on legumes (percentage of total area treated with formulations) – 2020**

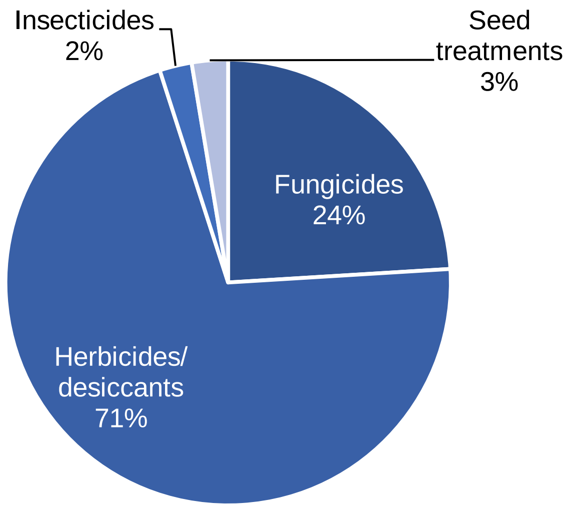
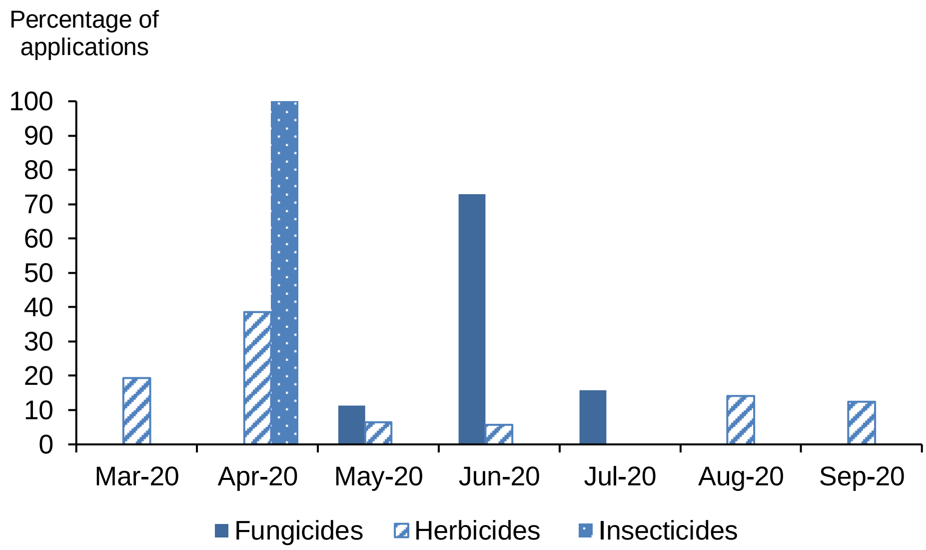



**Figure 30 Timing of pesticide applications on legumes – 2020**




Note: September 2019 herbicide spray (3%) omitted for ease of reading. Herbicides include desiccants.

# Appendix 1 – Estimated application tables

## Table 1 Percentage of each crop treated with pesticides and mean number of spray applications - 2020

| Crop | Fungicides | | Herbicides/ desiccants | | Insecticides[1] | | Molluscicide | | Sulphur | | Growth regulators | | Any pesticide exc. STs | | Seed treatments | Any pesticide inc. STs |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | % | spray apps | % | spray apps | % | spray apps | % | spray apps | % | spray apps | % | spray apps | % | spray apps | % | % |
| Winter barley | 96 | 2.6 | 96 | 2.1 | 19 | 1.0 | 2 | 1.1 | 0 | 0.0 | 89 | 1.9 | 100 | 4.1 | 88 | 100 |
| Spring barley | 95 | 1.8 | 99 | 1.8 | 8 | 1.0 | <0.5 | 1.0 | 3 | 1.0 | 35 | 1.2 | 99 | 2.7 | 92 | 99 |
| Winter wheat | 100 | 3.5 | 97 | 2.1 | 24 | 1.2 | 18 | 1.3 | 0 | 0.0 | 96 | 1.9 | 100 | 5.1 | 94 | 100 |
| Spring wheat | 100 | 1.9 | 100 | 1.6 | 0 | 0.0 | 0 | 0.0 | 0 | 0.0 | 79 | 1.0 | 100 | 2.8 | 79 | 100 |
| Winter oats | 74 | 2.4 | 82 | 1.5 | 14 | 1.0 | 0 | 0.0 | 0 | 0.0 | 80 | 1.5 | 89 | 3.3 | 84 | 89 |
| Spring oats | 90 | 1.7 | 92 | 1.9 | 24 | 1.0 | 0 | 0.0 | 1 | 1.0 | 79 | 1.1 | 93 | 3.1 | 83 | 93 |
| Winter rye | 100 | 1.5 | 100 | 1.9 | 0 | 0.0 | 0 | 0.0 | 0 | 0.0 | 100 | 1.7 | 100 | 3.2 | 100 | 100 |
| Oilseed rape | 98 | 2.7 | 100 | 2.6 | 73 | 1.8 | 46 | 1.4 | <0.5 | 1.0 | 15 | 1.0 | 100 | 5.8 | 75 | 100 |
| Seed potatoes | 100 | 8.8 | 100 | 2.3 | 92 | 6.5 | 34 | 1.9 | 0 | 0.0 | 0 | 0.0 | 100 | 10.9 | 88 | 100 |
| Ware potatoes | 99 | 10.2 | 99 | 2.4 | 58 | 1.9 | 58 | 3.3 | 0 | 0.0 | 8 | 1.0 | 99 | 13.8 | 85 | 100 |
| Legumes | 46 | 1.1 | 89 | 1.9 | 7 | 1.0 | 0 | 0.0 | 0 | 0.0 | 0 | 0.0 | 89 | 2.5 | 8[2] | 89 |
| **Total arable crops** | **96** | **2.7** | **98** | **2.0** | **20** | **1.9** | **9** | **1.8** | **2** | **1.0** | **52** | **1.5** | **99** | **4.1** | **90** | **99** |

(1) Includes nematicides
(2) 92 per cent of legumes in 2020 had no seed treatment; the seed treatment information for the remaining eight per cent was unspecified
Note: STs = seed treatments
The average number of spray applications is calculated only on the areas receiving each pesticide group and therefore the minimum number of applications is always one (see Appendix 3 – definitions and notes for details)

## Table 2 Cereal seed treatment formulations - 2020

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

| Seed treatments | Winter barley | | Spring barley | | Winter wheat | | Spring wheat | | Winter oats | | Spring oats | | Total 2020(1) | Total 2020(1) | 2018(2,3) | 2018(2,3) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | ha | % | ha | % | ha | % | ha | % | ha | % | ha | % | **ha** | **kg** | ha | kg |
| Cypermethrin | 0 | 0 | 0 | 0 | 1,625 | 2 | 0 | 0 | 0 | 0 | 0 | 0 | **1,625** | **202** | 1,986 | 275 |
| Difenoconazole/ fludioxonil | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | **2,184** | **14** | 73 | <0.5 |
| Fludioxonil | 3,833 | 9 | 18,490 | 7 | 41,449 | 45 | 754 | 33 | 3,223 | 40 | 9,236 | 36 | **77,725** | **774** | 59,813 | 612 |
| Fludioxonil/ sedaxane | 0 | 0 | 0 | 0 | 8,904 | 10 | 0 | 0 | 0 | 0 | 251 | 1 | **9,155** | **181** | 5,915 | 100 |
| Fludioxonil/ tebuconazole | 0 | 0 | 0 | 0 | 0 | 0 | 1,039 | 46 | 0 | 0 | 0 | 0 | **1,039** | **12** | 0 | 0 |
| Fludioxonil/ tefluthrin | 0 | 0 | 429 | <0.5 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | **429** | **20** | 846 | 47 |
| Fluopyram/ prothioconazole/ tebuconazole | 10,955 | 25 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | **10,955** | **201** | 41,058 | 773 |
| Imazalil/ ipconazole | 14,628 | 34 | 31,573 | 12 | 651 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | **46,853** | **636** | 101,960 | 1,431 |
| Prothioconazole | 1,079 | 3 | 19,455 | 8 | 2,546 | 3 | 0 | 0 | 255 | 3 | 575 | 2 | **23,909** | **463** | 14,421 | 268 |
| Prothioconazole /tebuconazole | 5,736 | 13 | 142,480 | 55 | 24,900 | 27 | 0 | 0 | 2,836 | 36 | 9,929 | 38 | **188,094** | **4,257** | 80,299 | 1,842 |

**Cont…**

## Table 2 Cereal seed treatment formulations – 2020 continued

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

| **Seed treatments** | **Winter barley** | | **Spring barley** | | **Winter wheat** | | **Spring wheat** | | **Winter oats** | | **Spring oats** | | **Total 2020**[1] | **Total 2020**[1] | **2018**[1,2] | **2018**[1,2] |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | ha | % | ha | % | ha | % | ha | % | ha | % | ha | % | **ha** | **kg** | ha | kg |
| Silthiofam | 0 | 0 | 0 | 0 | 6,381 | 7 | 0 | 0 | 0 | 0 | 0 | 0 | **6,381** | **330** | 3,398 | 179 |
| Unspecified seed treatment[3] | 1,718 | 4 | 26,816 | 10 | 3,929 | 4 | 0 | 0 | 413 | 5 | 1,521 | 6 | **34,397** | **N/A** | 27,302 | N/A |
| **All seed treatments** | **37,949** | **88** | **239,243** | **92** | **90,385** | **94** | **1,792** | **79** | **6,727** | **84** | **21,512** | **83** | **402,746** | **7,091** | **365,829** | **8,435** |
| No information seed treatment[3] | 2,793 | 6 | 4,184 | 2 | 4,618 | 5 | 490 | 21 | 175 | 2 | 371 | 1 | **12,631** | **N/A** | 36,772 | N/A |
| No seed treatment | 2,347 | 5 | 15,275 | 6 | 1,037 | 1 | 0 | 0 | 1,082 | 14 | 4,116 | 16 | **23,857** | **N/A** | 28,039 | N/A |
| Area grown | 43,089 | | 258,702 | | 91,249 | | 2,282 | | 7,984 | | 25,999 | | **434,443** | | 425,674 | |

(1) Includes winter rye
(2) For full list of formulations recorded in 2018 please refer to the 2018 report[3]
(3) Refer to Appendix 3 for definitions
N/A = not applicable

## Table 3 Cereal insecticide and molluscicide formulations - 2020

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

| Insecticides | Winter barley | | Spring barley | | Winter wheat | | Spring wheat | | Winter oats | | Spring oats | | Total 2020[1] | Total 2020[1] | 2018[1,2] | 2018[1,2] |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | ha | % | ha | % | ha | % | ha | % | ha | % | ha | % | **ha** | **kg** | ha | kg |
| Deltamethrin | 231 | 1 | 2,665 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | **2,896** | **17** | 2,835 | 11 |
| Esfenvalerate | 2,231 | 5 | 819 | <0.5 | 5,452 | 6 | 0 | 0 | 0 | 0 | 0 | 0 | **8,502** | **33** | 8,666 | 30 |
| Lambda-cyhalothrin | 5,810 | 13 | 17,502 | 7 | 21,240 | 19 | 0 | 0 | 1,095 | 14 | 6,225 | 24 | **51,871** | **240** | 61,626 | 281 |
| **All insecticides** | **8,272** | **19** | **20,985** | **8** | **26,692** | **24** | **0** | **0** | **1,095** | **14** | **6,225** | **24** | **63,269** | **291** | **78,127** | **385** |
| **Molluscicides** | | | | | | | | | | | | | | | | |
| Ferric phosphate | 236 | 1 | 0 | 0 | 16,394 | 16 | 0 | 0 | 0 | 0 | 0 | 0 | **16,631** | **1,814** | 9,227 | 1,196 |
| Metaldehyde | 592 | 1 | 34 | <0.5 | 5,351 | 4 | 0 | 0 | 0 | 0 | 0 | 0 | **5,977** | **327** | 20,213 | 2,126 |
| **All molluscicides** | **828** | **2** | **34** | **<0.5** | **21,746** | **18** | **0** | **0** | **0** | **0** | **0** | **0** | **22,608** | **2,141** | **29,439** | **3,322** |
| Area grown | 43,089 | | 258,702 | | 91,249 | | 2,282 | | 7,984 | | 25,999 | | **434,443** | | 425,674 | |

(1) Includes winter rye
(2) For full list of formulations recorded in 2018 please refer to the 2018 report[3]
N/A = not applicable

## Table 4 Cereal fungicide and sulphur formulations - 2020

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

| Fungicides | Winter barley | | Spring barley | | Winter wheat | | Spring wheat | | Winter oats | | Spring oats | | Total 2020[1] | Total 2020[1] | 2018[1,2] | 2018[1,2] |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | ha | % | ha | % | ha | % | ha | % | ha | % | ha | % | **ha** | **kg** | ha | kg |
| Azoxystrobin | 787 | 2 | 135 | <0.5 | 12,894 | 14 | 490 | 21 | 0 | 0 | 1,171 | 5 | **15,478** | **1,466** | 2,821 | 417 |
| Azoxystrobin/ chlorothalonil | 0 | 0 | 265 | <0.5 | 337 | <0.5 | 0 | 0 | 0 | 0 | 0 | 0 | **601** | **291** | 13,306 | 8,625 |
| Azoxystrobin/ cyproconazole | 1,286 | 3 | 1,364 | <0.5 | 2,692 | 3 | 0 | 0 | 413 | 5 | 0 | 0 | **5,755** | **840** | 2,551 | 538 |
| Benzovindiflupyr | 608 | 1 | 1,066 | <0.5 | 12,437 | 14 | 0 | 0 | 0 | 0 | 0 | 0 | **14,112** | **718** | 21,164 | 1,066 |
| Benzovindiflupyr/ prothioconazole | 1,558 | 4 | 3,212 | 1 | 1,276 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | **6,045** | **709** | 3,665 | 614 |
| Bixafen | 8,438 | 20 | 32,759 | 13 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | **41,196** | **1,062** | 10,196 | 289 |
| Bixafen/fluopyram | 0 | 0 | 0 | 0 | 185 | <0.5 | 0 | 0 | 0 | 0 | 0 | 0 | **185** | **26** | 0 | 0 |
| Bixafen/fluopyram/ prothioconazole | 0 | 0 | 0 | 0 | 4,974 | 5 | 0 | 0 | 0 | 0 | 0 | 0 | **4,974** | **1,455** | 2,286 | 670 |
| Bixafen/ fluoxastrobin/ prothioconazole | 0 | 0 | 0 | 0 | 11,398 | 12 | 490 | 21 | 0 | 0 | 0 | 0 | **11,888** | **2,810** | 8,132 | 1,952 |
| Bixafen/ prothioconazole | 9,942 | 17 | 22,110 | 6 | 903 | 1 | 0 | 0 | 1,302 | 12 | 575 | 2 | **34,832** | **3,946** | 38,391 | 4,755 |
| Bixafen/ prothioconazole/ spiroxamine | 3,675 | 9 | 13,562 | 5 | 19,997 | 20 | 0 | 0 | 962 | 9 | 7,481 | 24 | **45,675** | **17,217** | 15,051 | 7,642 |

**Cont…**

## Table 4 Cereal fungicide and sulphur formulations – 2020 continued

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

| Fungicides | Winter barley | | Spring barley | | Winter wheat | | Spring wheat | | Winter oats | | Spring oats | | Total 2020[1] | Total 2020[1] | 2018[1,2] | 2018[1,2] |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | ha | % | ha | % | ha | % | ha | % | ha | % | ha | % | **ha** | **kg** | ha | kg |
| Bixafen/ prothioconazole/ spiroxamine | 3,675 | 9 | 13,562 | 5 | 19,997 | 20 | 0 | 0 | 962 | 9 | 7,481 | 24 | **45,675** | **17,217** | 15,051 | 7,642 |
| Bixafen/ prothioconazole/ tebuconazole | 0 | 0 | 0 | 0 | 5,063 | 6 | 819 | 36 | 0 | 0 | 0 | 0 | **5,882** | **1,553** | 8,071 | 2,308 |
| Boscalid/ epoxiconazole | 0 | 0 | 1,600 | 1 | 32,567 | 35 | 0 | 0 | 0 | 0 | 703 | 3 | **35,610** | **9,779** | 42,733 | 11,869 |
| Boscalid/ epoxiconazole/ pyraclostrobin | 1,567 | 4 | 0 | 0 | 3,142 | 3 | 0 | 0 | 0 | 0 | 0 | 0 | **4,709** | **1,793** | 853 | 300 |
| Bromuconazole/ tebuconazole | 0 | 0 | 0 | 0 | 7,125 | 8 | 0 | 0 | 0 | 0 | 0 | 0 | **7,125** | **1,751** | 0 | 0 |
| Chlorothalonil | 37,730 | 64 | 45,821 | 17 | 103,788 | 71 | 819 | 36 | 0 | 0 | 0 | 0 | **188,159** | **98,313** | 458,712 | 224,660 |
| Chlorothalonil/ cyproconazole | 65 | <0.5 | 0 | 0 | 2,237 | 2 | 0 | 0 | 0 | 0 | 0 | 0 | **2,301** | **1,032** | 11,987 | 5,090 |
| Chlorothalonil/ proquinazid | 552 | 1 | 0 | 0 | 1,471 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | **2,022** | **1,058** | 10,527 | 5,090 |
| Chlorothalonil/ tebuconazole | 246 | 1 | 0 | 0 | 4,109 | 4 | 0 | 0 | 0 | 0 | 0 | 0 | **4,355** | **2,355** | 20,846 | 11,296 |
| Copper oxychloride | 320 | 1 | 1,954 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | **2,274** | **412** | 0 | 0 |
| Cyflufenamid | 5,927 | 12 | 1,404 | 1 | 13,777 | 11 | 490 | 21 | 4,460 | 39 | 8,787 | 34 | **34,845** | **292** | 49,159 | 431 |

**Cont…**

## Table 4 Cereal fungicide and sulphur formulations – 2020 continued

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

| Fungicides | Winter barley | | Spring barley | | Winter wheat | | Spring wheat | | Winter oats | | Spring oats | | Total 2020[(1)] | Total 2020[(1)] | 2018[(1,2)] | 2018[(1,2)] |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | ha | % | ha | % | ha | % | ha | % | ha | % | ha | % | **ha** | **kg** | ha | kg |
| Cyproconazole/ penthiopyrad | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1,438 | 18 | 2,530 | 10 | **3,968** | **644** | 2,695 | 362 |
| Cyprodinil | 11,181 | 26 | 14,898 | 5 | 857 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | **26,936** | **5,603** | 22,523 | 4,083 |
| Cyprodinil/ isopyrazam | 0 | 0 | 2,553 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | **2,553** | **528** | 12,775 | 2,579 |
| Epoxiconazole | 0 | 0 | 3,115 | 1 | 25,572 | 26 | 0 | 0 | 1,334 | 17 | 3,174 | 10 | **33,195** | **2,203** | 68,924 | 4,333 |
| Epoxiconazole/ fenpropimorph | 857 | 2 | 5,469 | 2 | 541 | 1 | 0 | 0 | 483 | 6 | 0 | 0 | **7,350** | **1,161** | 37,041 | 8,805 |
| Epoxiconazole/ fenpropimorph/ kresoxim-methyl | 0 | 0 | 571 | <0.5 | 0 | 0 | 0 | 0 | 0 | 0 | 675 | 3 | **1,246** | **191** | 20,637 | 4,417 |
| Epoxiconazole/ fenpropimorph/ metrafenone | 0 | 0 | 0 | 0 | 154 | <0.5 | 0 | 0 | 342 | 4 | 803 | 3 | **1,300** | **271** | 14,523 | 4,071 |
| Epoxiconazole/ fluxapyroxad | 0 | 0 | 1,632 | 1 | 13,380 | 14 | 0 | 0 | 0 | 0 | 0 | 0 | **15,012** | **1,710** | 51,999 | 6,302 |
| Epoxiconazole/ fluxapyroxad/ pyraclostrobin | 3,554 | 7 | 2,747 | 1 | 877 | 1 | 0 | 0 | 0 | 0 | 1,304 | 5 | **8,482** | **1,496** | 19,226 | 3,071 |
| Epoxiconazole/ folpet | 0 | 0 | 75 | <0.5 | 678 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | **754** | **422** | 1,618 | 810 |

**Cont…**

## Table 4 Cereal fungicide and sulphur formulations – 2020 continued

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

| Fungicides | Winter barley | | Spring barley | | Winter wheat | | Spring wheat | | Winter oats | | Spring oats | | Total 2020[1] | Total 2020[1] | 2018[1,2] | 2018[1,2] |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | ha | % | ha | % | ha | % | ha | % | ha | % | ha | % | **ha** | **kg** | ha | kg |
| Epoxiconazole/ isopyrazam | 0 | 0 | 149 | <0.5 | 141 | <0.5 | 0 | 0 | 0 | 0 | 0 | 0 | **290** | **22** | 951 | 82 |
| Epoxiconazole/ metconazole | 0 | 0 | 0 | 0 | 15,407 | 13 | 469 | 21 | 0 | 0 | 0 | 0 | **15,876** | **985** | 13,335 | 771 |
| Epoxiconazole/ metrafenone | 1,417 | 3 | 0 | 0 | 3,760 | 4 | 0 | 0 | 228 | 3 | 1,355 | 5 | **6,760** | **1,002** | 12,710 | 1,665 |
| Epoxiconazole/ pyraclostrobin | 847 | 2 | 4,583 | 2 | 2,773 | 3 | 66 | 1 | 152 | 2 | 1,846 | 7 | **10,702** | **1,210** | 4,825 | 487 |
| Fenpropidin/ prochloraz/ tebuconazole | 0 | 0 | 0 | 0 | 159 | <0.5 | 0 | 0 | 0 | 0 | 0 | 0 | **159** | **8** | 1,492 | 671 |
| Fenpropimorph | 5,114 | 12 | 1,452 | 1 | 1,174 | 1 | 0 | 0 | 2,117 | 25 | 2,466 | 9 | **12,323** | **2,913** | 39,691 | 7,907 |
| Fenpropimorph/ pyraclostrobin | 0 | 0 | 338 | <0.5 | 0 | 0 | 0 | 0 | 87 | 1 | 0 | 0 | **425** | **40** | 17,661 | 5,551 |
| Fluoxastrobin/ prothioconazole | 0 | 0 | 3,617 | 1 | 3,726 | 4 | 0 | 0 | 1,295 | 16 | 2,388 | 8 | **11,026** | **1,614** | 15,423 | 2,030 |
| Fluoxastrobin/ prothioconazole/ trifloxystrobin | 10,847 | 17 | 56,265 | 19 | 750 | <0.5 | 0 | 0 | 0 | 0 | 0 | 0 | **67,861** | **8,605** | 56,944 | 6,674 |
| Fluxapyroxad | 9,964 | 22 | 27,599 | 10 | 23,267 | 24 | 301 | 13 | 239 | 3 | 1,305 | 5 | **62,675** | **2,439** | 49,974 | 2,337 |
| Fluxapyroxad/ mefentrifluconazole | 637 | 1 | 1,143 | <0.5 | 26,702 | 23 | 0 | 0 | 0 | 0 | 0 | 0 | **28,482** | **3,311** | 0 | 0 |

**Cont…**

## Table 4 Cereal fungicide and sulphur formulations – 2020 continued

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

| Fungicides | Winter barley | | Spring barley | | Winter wheat | | Spring wheat | | Winter oats | | Spring oats | | Total 2020[1] | Total 2020[1] | 2018[1,2] | 2018[1,2] |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | ha | % | ha | % | ha | % | ha | % | ha | % | ha | % | **ha** | **kg** | ha | kg |
| Fluxapyroxad/ metconazole | 0 | 0 | 0 | 0 | 1,150 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | **1,150** | **121** | 1,379 | 189 |
| Fluxapyroxad/ pyraclostrobin | 6,886 | 15 | 10,749 | 4 | 16,223 | 18 | 0 | 0 | 0 | 0 | 0 | 0 | **33,858** | **4,994** | 20,810 | 2,748 |
| Folpet | 14,740 | 26 | 145,294 | 49 | 76,937 | 57 | 803 | 35 | 0 | 0 | 0 | 0 | **237,775** | **111,591** | 20,200 | 9,114 |
| Isopyrazam/ prothioconazole | 463 | 1 | 17,963 | 7 | 1,117 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | **19,543** | **3,619** | 0 | 0 |
| Mancozeb | 0 | 0 | 0 | 0 | 18,602 | 15 | 0 | 0 | 0 | 0 | 0 | 0 | **18,602** | **15,175** | 7,554 | 5,734 |
| Mefentrifluconazole | 0 | 0 | 1,270 | <0.5 | 20,030 | 22 | 0 | 0 | 0 | 0 | 0 | 0 | **21,300** | **1,636** | 0 | 0 |
| Metconazole | 0 | 0 | 0 | 0 | 1,956 | 2 | 0 | 0 | 0 | 0 | 0 | 0 | **1,956** | **106** | 918 | 37 |
| Metrafenone | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 300 | 1 | **300** | **19** | 0 | 0 |
| Prochloraz/ proquinazid/ tebuconazole | 243 | 1 | 1,258 | <0.5 | 5,798 | 6 | 0 | 0 | 201 | 3 | 0 | 0 | **7,500** | **1,930** | 18,211 | 4,939 |
| Prochloraz/ tebuconazole | 0 | 0 | 0 | 0 | 11,401 | 11 | 0 | 0 | 0 | 0 | 0 | 0 | **11,401** | **4,377** | 13,596 | 4,612 |
| Proquinazid | 2,461 | 6 | 500 | <0.5 | 5,036 | 4 | 33 | 1 | 1,098 | 14 | 2,134 | 7 | **13,446** | **363** | 16,651 | 502 |
| Prothioconazole | 16,006 | 28 | 40,523 | 15 | 23,258 | 25 | 819 | 36 | 1,765 | 15 | 3,604 | 13 | **86,392** | **8,201** | 68,565 | 5,944 |
| Prothioconazole/ spiroxamine | 9,815 | 20 | 58,058 | 19 | 2,269 | 2 | 0 | 0 | 1,249 | 16 | 4,057 | 16 | **75,448** | **16,439** | 54,938 | 12,208 |

**Cont…**

## Table 4 Cereal fungicide and sulphur formulations – 2020 continued

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

| Fungicides | Winter barley | | Spring barley | | Winter wheat | | Spring wheat | | Winter oats | | Spring oats | | Total 2020[1] | Total 2020[1] | 2018[1,2] | 2018[1,2] |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | ha | % | ha | % | ha | % | ha | % | ha | % | ha | % | **ha** | **kg** | ha | kg |
| Prothioconazole /spiroxamine/ tebuconazole | 463 | 1 | 3,364 | 1 | 404 | <0.5 | 0 | 0 | 0 | 0 | 415 | 2 | **4,645** | **781** | 2,187 | 400 |
| Prothioconazole /tebuconazole | 11,413 | 21 | 70,466 | 25 | 38,740 | 35 | 1,003 | 31 | 0 | 0 | 1,584 | 6 | **125,925** | **15,894** | 110,355 | 14,593 |
| Prothioconazole /trifloxystrobin | 12,031 | 25 | 77,347 | 24 | 5,513 | 5 | 0 | 0 | 0 | 0 | 0 | 0 | **94,890** | **11,553** | 76,459 | 9,351 |
| Pyraclostrobin | 441 | 1 | 0 | 0 | 1,709 | 2 | 0 | 0 | 0 | 0 | 449 | 2 | **3,016** | **245** | 6,199 | 510 |
| Tebuconazole | 0 | 0 | 988 | <0.5 | 39,825 | 36 | 291 | 13 | 1,653 | 21 | 3,327 | 13 | **49,627** | **6,727** | 42,191 | 5,314 |
| Trifloxystrobin | 3,986 | 9 | 23,165 | 8 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | **27,151** | **1,697** | 15,420 | 1,204 |
| Unspecified fungicide[3] | 114 | <0.5 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | **114** | **N/A** | 0 | N/A |
| **All fungicides** | **196,180** | **96** | **702,401** | **95** | **630,257** | **100** | **6,894** | **100** | **20,818** | **74** | **52,432** | **90** | **1,619,439** | **390,727** | **1,710,838** | **450,428** |
| **Sulphur** | **0** | **0** | **8,841** | **3** | **0** | **0** | **0** | **0** | **0** | **0** | **294** | **1** | **9,135** | **38,254** | **1,339** | **2,261** |
| Area grown | 43,089 | | 258,702 | | 91,249 | | 2,282 | | 7,984 | | 25,999 | | **434,443** | | 425,674 | |

(1) Includes winter rye
(2) For full list of formulations recorded in 2018 please refer to the 2018 report[3]
(3) Refer to Appendix 3 for definitions

**Table 5 Cereal herbicide/desiccant and growth regulator formulations – 2020**

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

| Herbicides/ desiccants | Winter barley | | Spring barley | | Winter wheat | | Spring wheat | | Winter oats | | Spring oats | | Total 2020[1] | Total 2020[1] | 2018[1,2] | 2018[21,2] |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | ha | % | ha | % | ha | % | ha | % | ha | % | ha | % | **ha** | **kg** | ha | kg |
| 2,4-D/glyphosate | 0 | 0 | 136 | <0.5 | 94 | <0.5 | 0 | 0 | 0 | 0 | 0 | 0 | **231** | **332** | 7 | 15 |
| 2,4-D/MCPA | 0 | 0 | 2,365 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | **2,365** | **3,991** | 527 | 836 |
| 2,4-DB | 0 | 0 | 3,054 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 11 | <0.5 | **3,065** | **3,392** | 5,897 | 5,484 |
| 2,4-DB/MCPA | 0 | 0 | 592 | <0.5 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | **592** | **759** | 322 | 460 |
| Amidosulfuron/ iodosulfuron-methyl-sodium | 1,249 | 3 | 248 | <0.5 | 2,945 | 3 | 0 | 0 | 0 | 0 | 0 | 0 | **4,441** | **100** | 868 | 17 |
| Amidosulfuron/ iodosulfuron-methyl-sodium/ mesosulfuron-methyl | 0 | 0 | 0 | 0 | 411 | <0.5 | 0 | 0 | 0 | 0 | 0 | 0 | **411** | **15** | 0 | 0 |
| Bromoxynil | 0 | 0 | 1,142 | <0.5 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | **1,142** | **229** | 0 | 0 |
| Bromoxynil/ diflufenican | 0 | 0 | 0 | 0 | 892 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | **892** | **166** | 1,137 | 64 |
| Chlorotoluron/ diflufenican/ pendimethalin | 5,047 | 12 | 4,050 | 2 | 6,070 | 7 | 0 | 0 | 0 | 0 | 0 | 0 | **16,943** | **18,913** | 11,847 | 13,235 |

**Cont…**

## Table 5 Cereal herbicide/desiccant and growth regulator formulations – 2020 continued

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

| Herbicides/ desiccants | Winter barley | | Spring barley | | Winter wheat | | Spring wheat | | Winter oats | | Spring oats | | Total 2020[1] | Total 2020[1] | 2018[1,2] | 2018[1,2] |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | ha | % | ha | % | ha | % | ha | % | ha | % | ha | % | **ha** | **kg** | ha | kg |
| Clodinafop-propargyl | 0 | 0 | 0 | 0 | 6,565 | 7 | 148 | 6 | 0 | 0 | 0 | 0 | **6,714** | **181** | 9,815 | 272 |
| Clodinafop-propargyl/ pinoxaden | 0 | 0 | 0 | 0 | 1,436 | 2 | 0 | 0 | 0 | 0 | 0 | 0 | **1,436** | **43** | 0 | 0 |
| Clopyralid | 0 | 0 | 0 | 0 | 1,216 | 1 | 0 | 0 | 0 | 0 | 547 | 2 | **1,764** | **123** | 426 | 25 |
| Clopyralid/ florasulam/ fluroxypyr | 1,559 | 4 | 6,383 | 2 | 678 | 1 | 0 | 0 | 201 | 3 | 395 | 2 | **9,216** | **1,378** | 12,896 | 1,856 |
| Dicamba/ MCPA/ mecoprop-p | 0 | 0 | 1,623 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | **1,623** | **500** | 1,301 | 1,072 |
| Dicamba/ mecoprop-p | 121 | <0.5 | 25,103 | 10 | 1,418 | 2 | 0 | 0 | 0 | 0 | 208 | 1 | **26,849** | **13,510** | 38,364 | 19,363 |
| Dichlorprop-p/ MCPA/ mecoprop-p | 0 | 0 | 2,620 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | **2,620** | **1,834** | 6,240 | 5,362 |
| Diflufenican | 11,197 | 26 | 20,112 | 8 | 24,388 | 27 | 0 | 0 | 87 | 1 | 6,773 | 26 | **65,158** | **4,277** | 64,562 | 4,324 |
| Diflufenican/ florasulam | 335 | 1 | 0 | 0 | 1,475 | 2 | 0 | 0 | 0 | 0 | 0 | 0 | **1,810** | **62** | 6,752 | 231 |
| Diflufenican/ flufenacet | 13,315 | 31 | 35,305 | 14 | 21,677 | 24 | 490 | 21 | 4,355 | 55 | 0 | 0 | **78,504** | **12,822** | 60,984 | 9,307 |

**Cont...**

## Table 5 Cereal herbicide/desiccant and growth regulator formulations – 2020 continued

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

| Herbicides/ desiccants | Winter barley | | Spring barley | | Winter wheat | | Spring wheat | | Winter oats | | Spring oats | | Total 2020[1] | Total 2020[1] | 2018[1,2] | 2018[1,2] |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | ha | % | ha | % | ha | % | ha | % | ha | % | ha | % | **ha** | **kg** | ha | kg |
| Diflufenican/ flufenacet/ flurtamone | 0 | 0 | 0 | 0 | 597 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | **597** | **134** | 4,215 | 1,359 |
| Diflufenican/ iodosulfuron-methyl-sodium/ mesosulfuron-methyl | 0 | 0 | 0 | 0 | 6,514 | 7 | 0 | 0 | 0 | 0 | 0 | 0 | **6,514** | **341** | 4,021 | 184 |
| Diflufenican/ pendimethalin | 391 | 1 | 0 | 0 | 1,062 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | **1,453** | **1,099** | 6,209 | 4,074 |
| Fenoxaprop-p-ethyl | 949 | 2 | 10,162 | 4 | 820 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | **11,930** | **665** | 9,258 | 532 |
| Florasulam | 1,610 | 4 | 3,767 | 1 | 3,398 | 4 | 0 | 0 | 26 | <0.5 | 911 | 4 | **9,712** | **35** | 5,352 | 15 |
| Florasulam/ fluroxypyr | 868 | 2 | 16,963 | 7 | 4,316 | 5 | 0 | 0 | 1,129 | 14 | 2,220 | 9 | **26,237** | **1,914** | 20,068 | 1,471 |
| Florasulam/ halauxifen-methyl | 5,292 | 12 | 22,138 | 9 | 8,544 | 9 | 819 | 36 | 0 | 0 | 0 | 0 | **36,794** | **265** | 38,669 | 240 |
| Florasulam/ pinoxaden | 0 | 0 | 75 | <0.5 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | **75** | **1** | 0 | 0 |
| Florasulam/ pyroxsulam | 0 | 0 | 0 | 0 | 3,325 | 4 | 0 | 0 | 0 | 0 | 0 | 0 | **3,325** | **75** | 4,635 | 103 |

**Cont…**

**Table 5 Cereal herbicide/desiccant and growth regulator formulations – 2020 continued**

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

| Herbicides/ desiccants | Winter barley | | Spring barley | | Winter wheat | | Spring wheat | | Winter oats | | Spring oats | | Total 2020[1] | Total 2020[1] | 2018[1,2] | 2018[1,2] |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | ha | % | ha | % | ha | % | ha | % | ha | % | ha | % | **ha** | **kg** | ha | kg |
| Florasulam/ tribenuron-methyl | 0 | 0 | 1,365 | <0.5 | 0 | 0 | 0 | 0 | 0 | 0 | 4,094 | 16 | **5,458** | **86** | 0 | 0 |
| Flufenacet | 1,026 | 2 | 0 | 0 | 3,662 | 4 | 0 | 0 | 0 | 0 | 0 | 0 | **4,689** | **722** | 2,291 | 248 |
| Flufenacet/ pendimethalin | 2,319 | 5 | 572 | <0.5 | 3,076 | 3 | 0 | 0 | 0 | 0 | 0 | 0 | **5,967** | **5,652** | 6,167 | 4,240 |
| Flufenacet/ picolinafen | 7,099 | 16 | 0 | 0 | 12,002 | 13 | 0 | 0 | 0 | 0 | 0 | 0 | **19,100** | **3,348** | 12,658 | 2,316 |
| Flumioxazine | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 220 | 3 | 0 | 0 | **220** | **7** | 81 | 2 |
| Fluroxypyr | 5,909 | 14 | 61,790 | 24 | 10,611 | 12 | 170 | 7 | 1,166 | 15 | 11,253 | 43 | **90,898** | **11,005** | 84,597 | 10,405 |
| Fluroxypyr/ halauxifen-methyl | 1,252 | 3 | 65,052 | 25 | 1,761 | 2 | 992 | 43 | 0 | 0 | 0 | 0 | **69,057** | **6,318** | 45,060 | 4,403 |
| Fluroxypyr/ metsulfuron-methyl | 0 | 0 | 5,181 | 2 | 234 | <0.5 | 0 | 0 | 0 | 0 | 0 | 0 | **5,414** | **510** | 0 | 0 |
| Glyphosate | 25,163 | 58 | 89,222 | 34 | 34,446 | 34 | 803 | 35 | 1,560 | 17 | 9,230 | 35 | **161,783** | **127,410** | 134,985 | 96,176 |
| Iodosulfuron-methyl-sodium/ mesosulfuron-methyl | 0 | 0 | 0 | 0 | 13,934 | 15 | 0 | 0 | 0 | 0 | 0 | 0 | **13,934** | **149** | 6,245 | 77 |
| MCPA | 0 | 0 | 4,762 | 2 | 0 | 0 | 0 | 0 | 0 | 0 | 534 | 2 | **5,296** | **4,992** | 4,563 | 3,423 |

**Cont…**

## Table 5 Cereal herbicide/desiccant and growth regulator formulations – 2020 continued

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

| Herbicides/ desiccants | Winter barley | | Spring barley | | Winter wheat | | Spring wheat | | Winter oats | | Spring oats | | Total 2020[1] | Total 2020[1] | 2018[1,2] | 2018[1,2] |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | ha | % | ha | % | ha | % | ha | % | ha | % | ha | % | **ha** | **kg** | ha | kg |
| Mecoprop-p | 2,310 | 5 | 49,494 | 19 | 13,867 | 15 | 301 | 13 | 359 | 5 | 9,701 | 37 | **76,033** | **47,658** | 79,978 | 49,935 |
| Mesosulfuron-methyl/ propoxycarbazone-sodium | 0 | 0 | 0 | 0 | 567 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | **567** | **19** | 394 | 15 |
| Metsulfuron-methyl | 1,881 | 4 | 7,870 | 3 | 4,666 | 5 | 523 | 23 | 359 | 5 | 1,114 | 4 | **16,413** | **73** | 13,674 | 57 |
| Metsulfuron-methyl/ thifensulfuron-methyl | 1,065 | 2 | 114,027 | 44 | 7,015 | 8 | 1,759 | 77 | 0 | 0 | 0 | 0 | **123,867** | **3,558** | 109,890 | 3,228 |
| Metsulfuron-methyl/ tribenuron-methyl | 4,088 | 9 | 30,357 | 12 | 8,349 | 9 | 0 | 0 | 1,495 | 19 | 6,040 | 23 | **51,260** | **396** | 54,098 | 478 |
| Pendimethalin | 4,634 | 11 | 3,727 | 1 | 12,665 | 14 | 0 | 0 | 0 | 0 | 0 | 0 | **21,462** | **16,982** | 37,066 | 28,111 |
| Pendimethalin/ picolinafen | 12,055 | 28 | 26,236 | 10 | 17,611 | 19 | 0 | 0 | 0 | 0 | 0 | 0 | **55,902** | **44,507** | 74,828 | 54,317 |
| Pinoxaden | 2,734 | 6 | 32,407 | 13 | 2,043 | 2 | 170 | 7 | 0 | 0 | 0 | 0 | **37,354** | **1,105** | 48,042 | 1,167 |
| Prosulfocarb | 893 | 2 | 5,772 | 2 | 2,993 | 3 | 0 | 0 | 0 | 0 | 0 | 0 | **11,018** | **13,217** | 4,271 | 5,431 |
| Pyroxsulam | 0 | 0 | 0 | 0 | 733 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | **2,093** | **39** | 1,042 | 20 |

**Cont…**

## Table 5 Cereal herbicide/desiccant and growth regulator formulations – 2020 continued

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

| Herbicides/ dessicants | Winter barley | | Spring barley | | Winter wheat | | Spring wheat | | Winter oats | | Spring oats | | Total 2020[1] | Total 2020[1] | 2018[1,2] | 2018[1,2] |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | ha | % | ha | % | ha | % | ha | % | ha | % | ha | % | **ha** | **kg** | ha | kg |
| Sulfosulfuron | 0 | 0 | 0 | 0 | 108 | <0.5 | 0 | 0 | 0 | 0 | 0 | 0 | **108** | **2** | 559 | 11 |
| Thifensulfuron-methyl | 0 | 0 | 0 | 0 | 640 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | **640** | **19** | 1,375 | 31 |
| Thifensulfuron-methyl/ tribenuron-methyl | 4,034 | 9 | 54,763 | 21 | 8,387 | 9 | 0 | 0 | 528 | 7 | 9,829 | 38 | **77,542** | **1,830** | 56,272 | 1,473 |
| Tri-allate | 243 | 1 | 241 | <0.5 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | **484** | **481** | 0 | 0 |
| Tribenuron-methyl | 320 | 1 | 7,160 | 3 | 3,539 | 4 | 0 | 0 | 0 | 0 | 322 | 1 | **11,340** | **74** | 10,763 | 58 |
| **All herbicides/ desiccants** | **118,957** | **96** | **715,836** | **99** | **260,752** | **97** | **6,175** | **100** | **11,488** | **82** | **63,182** | **92** | **1,190,313** | **357,315** | **1,130,538** | **336,584** |

**Cont…**

## Table 5 Cereal herbicide/desiccant and growth regulator formulations – 2020 continued

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

| **Growth regulators** | **Winter barley** | | **Spring barley** | | **Winter wheat** | | **Spring wheat** | | **Winter oats** | | **Spring oats** | | **Total 2020[1]** | **Total 2020[1]** | **2018[1,2]** | **2018[1,2]** |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | ha | % | ha | % | ha | % | ha | % | ha | % | ha | % | **ha** | **kg** | ha | kg |
| 2-chloroethylphosphonic acid | 7,259 | 17 | 18,792 | 7 | 9,871 | 11 | 0 | 0 | 0 | 0 | 0 | 0 | **35,921** | **5,938** | 41,643 | 8,017 |
| 2-chloroethylphosphonic acid/chlormequat | 2,832 | 7 | 4,896 | 2 | 8,601 | 9 | 0 | 0 | 0 | 0 | 0 | 0 | **16,329** | **6,041** | 11,757 | 5,015 |
| 2-chloroethylphosphonic acid/chlormequat chloride | 704 | 2 | 706 | <0.5 | 1,100 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | **2,510** | **964** | 3,715 | 1,517 |
| 2-chloroethylphosphonic acid/mepiquat | 2,225 | 5 | 148 | <0.5 | 272 | <0.5 | 0 | 0 | 0 | 0 | 0 | 0 | **2,644** | **1,005** | 562 | 346 |
| 2-chloroethylphosphonic acid/mepiquat chloride | 405 | 1 | 538 | <0.5 | 606 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | **1,549** | **508** | 0 | 0 |
| Chlormequat | 35,880 | 66 | 41,806 | 16 | 108,909 | 92 | 523 | 23 | 5,262 | 63 | 14,255 | 50 | **211,357** | **160,806** | 177,045 | 154,752 |
| Chlormequat/imazaquin | 0 | 0 | 0 | 0 | 646 | <0.5 | 0 | 0 | 0 | 0 | 0 | 0 | **646** | **195** | 12,448 | 5,451 |
| Mepiquat chloride/ prohexadione-calcium | 11,812 | 24 | 11,490 | 4 | 16,020 | 17 | 0 | 0 | 626 | 7 | 2,725 | 10 | **44,470** | **8,117** | 51,548 | 7,642 |
| Prohexadione-calcium | 3,440 | 8 | 203 | <0.5 | 1,673 | 2 | 0 | 0 | 0 | 0 | 0 | 0 | **5,316** | **143** | 0 | 0 |

**Cont…**

## Table 5 Cereal herbicide/desiccant and growth regulator formulations – 2020 continued

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

| Growth regulators | Winter barley | | Spring barley | | Winter wheat | | Spring wheat | | Winter oats | | Spring oats | | Total 2020[1] | Total 2020[1] | 2018[1,2] | 2018[1,2] |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | ha | % | ha | % | ha | % | ha | % | ha | % | ha | % | **ha** | **kg** | ha | kg |
| Prohexadione-calcium/ trinexapac-ethyl | 463 | 1 | 2,200 | 1 | 2,039 | 1 | 0 | 0 | 0 | 0 | 3,057 | 11 | **10,776** | **359** | 9,962 | 326 |
| Trinexapac-ethyl | 26,210 | 52 | 34,338 | 12 | 91,278 | 74 | 1,813 | 79 | 6,095 | 64 | 6,819 | 23 | **170,012** | **5,663** | 138,678 | 4,984 |
| **All growth regulators** | **91,230** | **89** | **115,117** | **35** | **241,015** | **96** | **2,335** | **79** | **11,983** | **80** | **26,857** | **79** | **501,530** | **189,739** | **448,775** | **188,943** |
| Area grown | 43,089 | | 258,702 | | 91,249 | | 2,282 | | 7,984 | | 25,999 | | **434,443** | | 425,674 | |

(1) Includes winter rye
(2) For full list of formulations recorded in 2018 please refer to the 2018 report[3]

## Table 6 Oilseed rape seed treatment formulations - 2020

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

| Seed treatments | Oilseed Rape 2020(1) | | Oilseed Rape 2020(1) | 2018(1,2) | 2018(1,2) |
|---|---|---|---|---|---|
| | ha | % | kg | ha | kg |
| *Bacillus amyloliquefaciens* strain MBI600 | 7,783 | 25 | 2 | 0 | 0 |
| Thiram | 11,966 | 39 | 90 | 1,430 | 8 |
| Unspecified seed treatment(3) | 3,195 | 10 | N/A | 1,380 | N/A |
| **All seed treatments** | **22,944** | **75** | **93** | **29,574** | **323** |
| No information seed treatment(3) | 1,987 | 6 | N/A | 3,091 | N/A |
| No seed treatment | 5,862 | 19 | N/A | 456 | N/A |
| Area grown | 30,793 | | | 32,735 | |

(1) Oilseed rape figures from 2018 and 2020 include spring oilseed rape.
(2) For full list of formulations recorded in 2018 please refer to the 2018 report(3)
(3) Refer to Appendix 3 for definitions
N/A = not applicable

## Table 7 Oilseed rape insecticide and molluscicide formulations - 2020

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

| Insecticides | Oilseed Rape 2020(1) | | Oilseed Rape 2020(1) | 2018(1,2) | 2018(1,2) |
|---|---|---|---|---|---|
| | ha | % | kg | ha | kg |
| Acetamiprid | 656 | 2 | 26 | 0 | 0 |
| Alpha-cypermethrin | 324 | 1 | 3 | 0 | 0 |
| Deltamethrin | 368 | 1 | 3 | 1,701 | 10 |
| Esfenvalerate | 444 | 1 | 2 | 0 | 0 |
| Indoxacarb | 503 | 1 | 12 | 199 | 4 |
| Lambda-cyhalothrin | 26,390 | 41 | 182 | 14,318 | 84 |
| Tau-fluvalinate | 11,293 | 25 | 473 | 10,667 | 389 |
| Thiacloprid | 1,392 | 3 | 100 | 0 | 0 |
| **All insecticides** | **41,369** | **73** | **801** | **33,353** | **551** |
| **Molluscicides** | | | | | |
| Ferric phosphate | 14,546 | 56 | 1,754 | 8,174 | 926 |
| Metaldehyde | 5,434 | 19 | 384 | 15,743 | 1,513 |
| **All molluscicides** | **19,980** | **46** | **2,138** | **23,917** | **2,439** |
| Area grown | 30,793 | | | 32,735 | |

(1) Oilseed rape figures from 2018 and 2020 include spring oilseed rape.
(2) For full list of formulations recorded in 2018 please refer to the 2018 report(3)

## Table 8 Oilseed rape fungicide and sulphur formulations - 2020

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

| Fungicides | Oilseed Rape 2020[1] | | Oilseed Rape 2020[1] | 2018[1,2] | 2018[1,2] |
|---|---|---|---|---|---|
| | ha | % | kg | ha | kg |
| Azoxystrobin | 4,898 | 5 | 701 | 6,756 | 1,089 |
| Azoxystrobin/cyproconazole | 2,698 | 3 | 469 | 4,427 | 940 |
| Azoxystrobin/isopyrazam | 762 | 1 | 147 | 294 | 72 |
| Azoxystrobin/tebuconazole | 714 | 1 | 217 | 114 | 36 |
| Bixafen/prothioconazole | 137 | <0.5 | 26 | 0 | 0 |
| Bixafen/prothioconazole/tebuconazole | 3,549 | 4 | 985 | 3,069 | 768 |
| Boscalid | 4,080 | 4 | 671 | 10,917 | 2,010 |
| Boscalid/dimoxystrobin | 2,886 | 2 | 431 | 1,296 | 259 |
| Boscalid/metconazole | 7,724 | 7 | 1,231 | 3,463 | 612 |
| Difenoconazole | 334 | <0.5 | 29 | 777 | 54 |
| Fluopyram/prothioconazole | 9,073 | 7 | 1,752 | 8,103 | 1,650 |
| Fluoxastrobin/tebuconazole | 2,259 | 2 | 534 | 0 | 0 |
| Metconazole | 3,309 | 3 | 71 | 1,869 | 28 |
| Prothioconazole | 24,014 | 17 | 2,711 | 24,563 | 3,093 |
| Prothioconazole/tebuconazole | 25,499 | 16 | 4,133 | 27,435 | 4,797 |
| Tebuconazole | 6,897 | 7 | 1,090 | 4,172 | 604 |
| Thiophanate-methyl | 488 | <0.5 | 147 | 909 | 281 |
| **All fungicides** | **99,321** | **98** | **15,344** | **109,052** | **18,933** |
| **Sulphur** | **53** | **<0.5** | **169** | **223** | **401** |
| Area grown | 30,793 | | | 32,735 | |

(1) Oilseed rape figures from 2018 and 2020 include spring oilseed rape.
(2) For full list of formulations recorded in 2018 please refer to the 2018 report[3]

## Table 9 Oilseed rape herbicide/desiccant and growth regulator formulations - 2020

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

| Herbicides/desiccants | Oilseed Rape 2020(1) | | Oilseed Rape 2020(1) | 2018(1,2) | 2018(1,2) |
|---|---|---|---|---|---|
| | ha | % | kg | ha | kg |
| Aminopyralid/metazachlor/picloram | 1,776 | 2 | 1,264 | 1,073 | 834 |
| Aminopyralid/propyzamide | 1,163 | 1 | 957 | 878 | 739 |
| Bifenox | 673 | 1 | 323 | 270 | 129 |
| Clethodim | 444 | <0.5 | 34 | 0 | 0 |
| Clomazone | 9,069 | 9 | 514 | 10,295 | 607 |
| Clomazone/metazachlor | 3,327 | 3 | 2,248 | 3,988 | 2,679 |
| Clopyralid | 1,119 | 1 | 113 | 845 | 117 |
| Clopyralid/halauxifen-methyl | 1,280 | 1 | 112 | 0 | 0 |
| Clopyralid/picloram | 239 | <0.5 | 25 | 2,074 | 225 |
| Dimethenamid-p/metazachlor | 267 | <0.5 | 215 | 592 | 557 |
| Dimethenamid-p/metazachlor/quinmerac | 3,046 | 3 | 3,328 | 6,128 | 6,285 |
| Fluazifop-p-butyl | 1,785 | 2 | 154 | 2,243 | 211 |
| Glyphosate | 21,228 | 22 | 29,860 | 26,942 | 35,098 |
| Halauxifen-methyl/picloram | 1,186 | 1 | 18 | 0 | 0 |
| Imazamox/quinmerac | 999 | 1 | 276 | 0 | 0 |
| Metazachlor | 14,679 | 15 | 9,041 | 17,222 | 10,600 |
| Metazachlor/quinmerac | 2,221 | 2 | 2,038 | 1,627 | 1,392 |
| Propaquizafop | 8,889 | 9 | 497 | 11,854 | 593 |
| Propyzamide | 11,663 | 12 | 7,821 | 6,328 | 4,088 |
| Quizalofop-p-ethyl | 8,245 | 8 | 287 | 4,690 | 177 |
| Quizalofop-p-tefuryl | 3,714 | 4 | 95 | 2,122 | 60 |
| **All herbicides/desiccants** | **97,013** | **100** | **59,219** | **100,286** | **64,895** |
| **Growth regulators** | | | | | |
| Mepiquat chloride/metconazole | 4,603 | 15 | 859 | 5,139 | 938 |
| **All growth regulators** | **4,603** | **15** | **859** | **5,139** | **938** |
| Area grown | 30,793 | | | 32,735 | |

(1) Oilseed rape figures from 2018 and 2020 include spring oilseed rape.
(2) For full list of formulations recorded in 2018 please refer to the 2018 report[3]

## Table 10 Potato seed treatment formulations - 2020

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

| **Seed treatments** | **Seed potatoes** | | **Ware potatoes** | | **Total 2020** | **Total 2020** | **2018** | **2018** |
|---|---|---|---|---|---|---|---|---|
| | ha | % | ha | % | **ha** | **kg** | ha | kg |
| Fludioxonil | 2,196 | 18 | 3,022 | 19 | **5,218** | **420** | 2,574 | 278 |
| Flutolanil | 5,477 | 46 | 6,670 | 41 | **12,148** | **3,832** | 7,369 | 2,166 |
| Imazalil | 659 | 5 | 1,989 | 12 | **2,648** | **113** | 3,391 | 153 |
| Pencycuron | 205 | 2 | 155 | 1 | **360** | **231** | 9,321 | 4,642 |
| Penflufen | 1,931 | 16 | 1,986 | 12 | **3,916** | **292** | 0 | 0 |
| Unspecified seed treatment(1) | 423 | 4 | 438 | 3 | **860** | **N/A** | 2,394 | N/A |
| **All seed treatments** | **10,891** | **88** | **14,259** | **85** | **25,150** | **4,888** | **25,048** | **7,239** |
| No information seed treatment(1) | 666 | 6 | 899 | 6 | **1,565** | **N/A** | 1,449 | N/A |
| No seed treatment | 713 | 6 | 1,592 | 10 | **2,305** | **N/A** | 2,423 | N/A |
| Area grown | 12,003 | | 16,294 | | 28,298 | | 27,359 | |

(1) Refer to Appendix 3 for definitions
N/A = not applicable

### Table 11 Potato insecticide and molluscicide formulations - 2020

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

| **Insecticides/nematicides** | **Seed potatoes** | | **Ware potatoes** | | **Total 2020** | **Total 2020** | **2018[1]** | **2018[1]** |
|---|---|---|---|---|---|---|---|---|
| | ha | % | ha | % | **ha** | **kg** | ha | kg |
| Acetamiprid | 4,998 | 38 | 3,036 | 11 | **8,033** | **383** | 746 | 37 |
| Esfenvalerate | 24,867 | 74 | 7,073 | 23 | **31,940** | **157** | 22,601 | 109 |
| Flonicamid | 7,931 | 49 | 102 | 1 | **8,033** | **634** | 6,785 | 447 |
| Fosthiazate | 0 | 0 | 744 | 5 | **744** | **1,873** | 108 | 162 |
| Lambda-cyhalothrin | 32,860 | 87 | 4,584 | 21 | **37,444** | **269** | 41,126 | 280 |
| Oxamyl | 120 | 1 | 2,413 | 15 | **2,532** | **4,524** | 1,786 | 5,033 |
| Spirotetramat | 1,298 | 10 | 0 | 0 | **1,298** | **76** | 0 | 0 |
| Thiacloprid | 11,649 | 69 | 1,012 | 6 | **12,662** | **1,181** | 12,432 | 1,093 |
| **All insecticides/nematicides** | **83,722** | **92** | **18,964** | **58** | **102,686** | **9,097** | **90,685** | **7,675** |
| **Molluscicides** | | | | | | | | |
| Ferric phosphate | 7,400 | 34 | 29,385 | 56 | **36,785** | **4,534** | 8,456 | 1,330 |
| Metaldehyde | 411 | 3 | 4,261 | 10 | **4,673** | **410** | 13,220 | 1,624 |
| Unspecified molluscicide[2] | 0 | 0 | 448 | 1 | **448** | **N/A** | N/A | N/A |
| **All molluscicides** | **7,811** | **34** | **34,095** | **58** | **41,906** | **4,945** | **21,676** | **2,955** |
| Area grown | 12,003 | | 16,294 | | **28,298** | | 27,359 | |

(1) For full list of formulations recorded in 2018 please refer to the 2018 report[3]
(2) Refer to Appendix 3 for definitions
N/A = not applicable

## Table 12 Potato fungicide formulations - 2020

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

| Fungicides | Seed potatoes | | Ware potatoes | | Total 2020 | Total 2020 | 2018[(1)] | 2018[(1)] |
|---|---|---|---|---|---|---|---|---|
| | ha | % | ha | % | **ha** | **kg** | ha | kg |
| Ametoctradin | 0 | 0 | 449 | 2 | **449** | **108** | 0 | 0 |
| Ametoctradin/dimethomorph | 5,092 | 33 | 11,519 | 46 | **16,612** | **6,883** | 20,594 | 8,650 |
| Amisulbrom | 8,011 | 40 | 13,361 | 52 | **21,372** | **1,832** | 25,318 | 2,210 |
| Azoxystrobin | 0 | 0 | 7,947 | 28 | **7,947** | **2,398** | 2,907 | 972 |
| Benthiavalicarb | 806 | 7 | 6,057 | 21 | **6,863** | **333** | 0 | 0 |
| Benthiavalicarb/oxathiapiprolin | 5,269 | 34 | 6,683 | 30 | **11,952** | **469** | 0 | 0 |
| Benthiavalicarb isopropyl/ mancozeb | 5,469 | 29 | 7,861 | 20 | **13,330** | **15,278** | 9,311 | 10,612 |
| Boscalid/pyraclostrobin | 0 | 0 | 113 | 1 | **113** | **9** | 0 | 0 |
| Cyazofamid | 27,113 | 87 | 38,014 | 86 | **65,128** | **5,173** | 54,530 | 4,382 |
| Cymoxanil | 16,488 | 59 | 26,778 | 69 | **43,266** | **4,140** | 21,699 | 1,982 |
| Cymoxanil/mancozeb | 25,957 | 78 | 61,530 | 88 | **87,486** | **114,430** | 59,343 | 74,762 |
| Cymoxanil/mandipropamid | 4,364 | 14 | 922 | 5 | **5,287** | **1,361** | 1,734 | 446 |
| Cymoxanil/ propamocarb hydrochloride | 2,849 | 21 | 8,030 | 28 | **10,879** | **11,596** | 4,746 | 4,276 |
| Cymoxanil/zoxamide | 1,911 | 11 | 2,486 | 10 | **4,397** | **1,279** | 323 | 96 |
| Dimethomorph | 1,063 | 4 | 4,855 | 19 | **5,917** | **888** | 3,118 | 468 |
| Dimethomorph/mancozeb | 2,754 | 20 | 10,599 | 36 | **13,354** | **23,525** | 10,663 | 18,628 |
| Dimethomorph/ propamocarb hydrochloride | 0 | 0 | 397 | 2 | **397** | **469** | 0 | 0 |

**Cont…**

**Table 12 Potato fungicide formulations – 2020 continued**

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

| Fungicides | Seed potatoes | | Ware potatoes | | Total 2020 | Total 2020 | 2018(1) | 2018(1) |
|---|---|---|---|---|---|---|---|---|
| | ha | % | ha | % | **ha** | **kg** | ha | kg |
| Fluazinam | 4,346 | 21 | 6,257 | 23 | **10,603** | **3,046** | 14,077 | 3,896 |
| Fluopicolide/ propamocarb hydrochloride | 8,175 | 41 | 13,134 | 54 | **21,309** | **23,072** | 13,981 | 14,592 |
| Mancozeb | 6,454 | 24 | 6,160 | 21 | **12,614** | **16,014** | 7,659 | 8,749 |
| Mancozeb/zoxamide | 0 | 0 | 3,168 | 9 | **3,168** | **3,472** | 791 | 1,068 |
| Mandipropamid | 15,970 | 71 | 12,136 | 43 | **28,106** | **4,160** | 30,132 | 4,346 |
| Oxathiapiprolin | 3,836 | 20 | 4,216 | 22 | **8,052** | **111** | 10,100 | 149 |
| **All fungicides** | **145,927** | **100** | **252,674** | **99** | **398,601** | **240,046** | **306,927** | **166,694** |
| Area grown | 12,003 | | 16,294 | | **28,298** | | 27,359 | |

(1) For full list of formulations recorded in 2018 please refer to the 2018 report[3]

**Table 13 Potato herbicide/desiccant and growth regulator formulations – 2020**

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

| Herbicides/desiccants | Seed potatoes | | Ware potatoes | | Total 2020 | Total 2020 | 2018[1] | 2018[1] |
|---|---|---|---|---|---|---|---|---|
| | ha | % | ha | % | **ha** | **kg** | ha | kg |
| Aclonifen | 1,612 | 13 | 861 | 5 | **2,473** | **2,589** | 0 | 0 |
| Carfentrazone-ethyl | 13,408 | 88 | 14,606 | 61 | **28,013** | **1,393** | 20,949 | 1,001 |
| Clomazone | 694 | 6 | 1,907 | 12 | **2,601** | **146** | 733 | 37 |
| Clomazone/pendimethalin | 531 | 4 | 1,833 | 11 | **2,364** | **1,717** | 323 | 176 |
| Cycloxydim | 62 | 1 | 446 | 3 | **508** | **173** | 2,274 | 436 |
| Diquat | 0 | 0 | 1,183 | 7 | **1,183** | **355** | 39,290 | 13,161 |
| Flufenacet/metribuzin | 1,323 | 11 | 1,752 | 11 | **3,075** | **2,856** | 3,621 | 3,524 |
| Glyphosate | 398 | 3 | 282 | 2 | **680** | **477** | 3,129 | 2,000 |
| Metobromuron | 4,540 | 38 | 7,136 | 44 | **11,676** | **12,697** | 7,559 | 7,876 |
| Metribuzin | 8,768 | 73 | 13,003 | 80 | **21,771** | **9,554** | 19,655 | 9,638 |
| Pendimethalin | 0 | 0 | 1,097 | 7 | **1,097** | **1,097** | 702 | 730 |
| Propaquizafop | 190 | 2 | 0 | 0 | **190** | **10** | 391 | 31 |
| Prosulfocarb | 806 | 7 | 2,304 | 14 | **3,110** | **7,288** | 793 | 2,421 |
| Pyraflufen-ethyl | 11,277 | 72 | 18,456 | 78 | **29,733** | **440** | 6,687 | 104 |
| Rimsulfuron | 283 | 2 | 3,190 | 20 | **3,472** | **37** | 3,866 | 44 |
| **All herbicides/desiccants** | **43,893** | **100** | **68,055** | **99** | **111,948** | **40,830** | **113,567** | **43,202** |

**Cont…**

## Table 13 Potato herbicide/desiccant and growth regulator formulations – 2020 continued

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

| Growth regulators | Seed potatoes | | Ware potatoes | | Total 2020 | Total 2020 | 2018(1) | 2018(1) |
|---|---|---|---|---|---|---|---|---|
| | ha | % | ha | % | ha | kg | ha | kg |
| Maleic hydrazide | 0 | 0 | 1,277 | 8 | **1,277** | **3,830** | 323 | 775 |
| **All growth regulators** | **0** | **0** | **1,277** | **8** | **1,277** | **3,830** | **323** | **775** |
| Area grown | 12,003 | | 16,294 | | **28,298** | | 27,359 | |

(1) For full list of formulations recorded in 2018 please refer to the 2018 report[3]

## Table 14 Legume seed treatment formulations - 2020

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

| Seed treatments | Legumes 2020 | | Legumes 2020 | 2018[1] | 2018[1] |
|---|---|---|---|---|---|
| | ha | % | kg | ha | kg |
| Unspecified Seed Treatment[2] | 197 | 8 | N/A | 0 | 0 |
| All seed treatments | **197** | **8** | **N/A** | **0** | **0** |
| **No Seed Treatment** | 2,269 | 92 | N/A | 2,268 | N/A |
| **Area grown** | 2,466 | | | 2,549 | |

(1) No formulations were recorded in 2018, please refer to the 2018 report[3]
(2) Refer to Appendix 3 for definitions
Please note: 92 per cent of legumes in 2020 had no seed treatment, the seed treatment information for the remaining 8 per cent was unspecified. Legumes includes field beans and dry harvest peas.
N/A = not applicable

## Table 15 Legume insecticide formulations - 2020

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

| Insecticides | Legumes 2020 | | Legumes 2020 | 2018[1] | 2018[1] |
|---|---|---|---|---|---|
| | ha | % | kg | ha | kg |
| Esfenvalerate | 91 | 4 | <0.5 | 0 | 0 |
| Lambda-cyhalothrin | 85 | 3 | <0.5 | 549 | 4 |
| **All insecticides** | **175** | **7** | **1** | **626** | **5** |
| Area grown | 2,466 | | | 2,549 | |

(1) For full list of formulations recorded in 2018 please refer to the 2018 report[1]
Note: legumes includes field beans and dry harvest peas.
No molluscicides were recorded on legumes.

## Table 16 Legume fungicide formulations - 2020

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

| Fungicides | Legumes 2020 | | Legumes 2020 | 2018[1] | 2018[1] |
|---|---|---|---|---|---|
| | ha | % | kg | ha | kg |
| Azoxystrobin | 772 | 31 | 123 | 524 | 58 |
| Boscalid/pyraclostrobin | 277 | 11 | 66 | 0 | 0 |
| Chlorothalonil/cyproconazole | 91 | 4 | 55 | 1,205 | 567 |
| Metconazole | 570 | 23 | 31 | 0 | 0 |
| Tebuconazole | 91 | 4 | 13 | 0 | 0 |
| **All fungicides** | **1,800** | **46** | **289** | **1,807** | **674** |
| Area grown | 2,466 | | | 2,549 | |

(1) For full list of formulations recorded in 2018 please refer to the 2018 report[1]
Note: legumes includes field beans and dry harvest peas

## Table 17 Legume herbicide/desiccant formulations - 2020

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

| Herbicides/desiccants | Legumes 2020 | | Legumes 2020 | 2018[1] | 2018[1] |
|---|---|---|---|---|---|
| | ha | % | kg | ha | kg |
| Bentazone | 242 | 10 | 244 | 0 | 0 |
| Carfentrazone-ethyl | 209 | 8 | 13 | 0 | 0 |
| Clomazone | 663 | 27 | 38 | 916 | 58 |
| Clomazone/pendimethalin | 617 | 25 | 630 | 78 | 85 |
| Cycloxydim | 140 | 6 | 41 | 116 | 23 |
| Glyphosate | 1,360 | 55 | 1,562 | 1,304 | 1,596 |
| Imazamox/pendimethalin | 1,250 | 51 | 1,057 | 1,412 | 1,483 |
| Pendimethalin | 563 | 23 | 393 | 339 | 339 |
| Propaquizafop | 163 | 7 | 10 | 159 | 11 |
| Quizalofop-p-ethyl | 112 | 5 | 6 | 0 | 0 |
| **All herbicides/desiccants** | **5,319** | **89** | **3,993** | **4,976** | **3,745** |
| Area grown | 2,466 | | | 2,549 | |

(1) For full list of formulations recorded in 2018 please refer to the 2018 report(1)
Note: legumes includes field beans and dry harvest peas

### Table 18 Compounds encountered in the arable survey for the first time in 2020

| Active substance | Type(1) | Area treated (ha) | Amount used (kg) |
|---|---|---|---|
| Aclonifen | H | 2,473 | 2,589 |
| *Bacillus amyloliquefaciens* strain MBI600 | S | 7,783 | N/A |
| Mefentrifluconazole | F | 49,782 | 3,798 |
| Penflufen | S | 3,916 | 292 |
| Spirotetramat | I | 1,298 | 76 |

(1) Pesticide type = F: Fungicide, H: Herbicide, I: Insecticide and S: Seed Treatment
N/A = not applicable

**Table 19 Mode of action/chemical group of insecticide/nematicide active substances on all arable crops - 2020**

Area (ha) and weight (kg) of active substances for all crops

| Mode of Action | Active Substance | Chemical Group | IRAC Group | Total Arable 2020 | Total Arable 2020 |
|---|---|---|---|---|---|
| | | | | ha | kg |
| Acetylcholinesterase (AChE) inhibitor | Oxamyl | Carbamate | 1A | 2,532 | 4,524 |
| | Fosthiazate | Organophosphorus | 1B | 744 | 1,873 |
| **All acetylcholinesterase (AChE) inhibitors** | | | | **3,276** | **6,397** |
| Sodium channel modulators | Alpha-cypermethrin | Pyrethroid | 3A | 324 | 3 |
| | Deltamethrin | Pyrethroid | 3A | 3,264 | 20 |
| | Esfenvalerate | Pyrethroid | 3A | 40,976 | 193 |
| | Lambda-cyhalothrin | Pyrethroid | 3A | 115,790 | 692 |
| | Tau-fluvalinate | Pyrethroid | 3A | 11,293 | 473 |
| **All sodium channel modulators** | | | | **171,647** | **1,381** |
| Nicotinic acetylcholine receptor (nAChR) competitive modulators | Acetamiprid | Neonicotinoid | 4A | 8,689 | 408 |
| | Thiacloprid | Neonicotinoid | 4A | 14,054 | 1,282 |
| **All nicotinic acetylcholine receptor (nAChR) competitive modulators** | | | | **22,743** | **1,690** |
| Other mode of action | | | | | |
| Voltage-dependent sodium channel blocker | Indoxacarb | Oxadiazines | 22A | 503 | 12 |
| Inhibitors of acetyl CoA carboxylase | Spirotetramat | Tetramic acid | 23 | 1,298 | 76 |

**Cont…**

## Table 19 Mode of action/chemical group of insecticide/nematicide active substances on all arable crops – 2020 continued

Area (ha) and weight (kg) of active substances for all crops

| Mode of Action | Active Substance | Chemical Group | IRAC Group | Total Arable 2020 | Total Arable 2020 |
|---|---|---|---|---|---|
| | | | | ha | kg |
| Chordontonal organ modulators - undefined target site | Flonicamid | Pyridine compound | 29 | 8,033 | 634 |
| **All other modes of action** | | | | **9,834** | **722** |
| **All insecticides** | | | | **207,500** | **10,190** |
| Area grown | | | | 496,000 | |

Note: Active substances have been grouped by their mode of action. Full details on mode of action classification can be found on the Insecticide Resistance Action Committee (IRAC) webpage[9]

## Table 20 Mode of action/chemical group of fungicide active substances on all arable crops - 2020

Area (ha) and weight (kg) of active substances for all crops

| Mode of Action | Active Substance | Group Name | Chemical Group | FRAC Group | Total Arable 2020 | Total Arable 2020 |
|---|---|---|---|---|---|---|
| | | | | | ha | kg |
| Cytoskeleton and motor proteins | Thiophanate-methyl | Methyl benzimidazole carbamates | Thiophanate | 1 | 488 | 147 |
| | Zoxamide | Benzamides | Toluamides | 22 | 7,565 | 1,024 |
| | Fluopicolide | Benzamide | Pyridinylmethyl-benzamide | 43 | 21,309 | 2,097 |
| | Metrafenone | Aryl-phenyl-ketones | Benzophenone | 50 | 8,360 | 627 |
| **All cytoskeleton and motor proteins** | | | | | **37,722** | **3,896** |
| Respiration | Benzovindiflupyr | SDHI | Pyrazole-4-carboxamides | 7 | 20,157 | 955 |
| | Bixafen | SDHI | Pyrazole-4-carboxamides | 7 | 147,361 | 5,855 |
| | Boscalid | SDHI | Pyrazole-carboxamides | 7 | 55,399 | 10,034 |
| | Fluopyram | SDHI | Pyridinyl-ethyl-benzamides | 7 | 14,231 | 1,253 |
| | Fluxapyroxad | SDHI | Pyrazole-4-carboxamides | 7 | 149,659 | 6,580 |
| | Isopyrazam | SDHI | Pyrazole-4-carboxamides | 7 | 23,149 | 1,846 |
| | Penthiopyrad | SDHI | Pyrazole-4-carboxamides | 7 | 3,968 | 460 |
| | Azoxystrobin | Qo inhibitors | Methoxy-acrylates | 11 | 39,627 | 5,844 |
| | Dimoxystrobin | Qo inhibitors | Oxazolidine-diones | 11 | 2,886 | 216 |
| | Fluoxastrobin | Qo inhibitors | Dihydro-dioxazines | 11 | 93,034 | 3,793 |

**Cont…**

**Table 20 Mode of action/chemical group of fungicide active substances on all arable crops – 2020 continued**

Area (ha) and weight (kg) of active substances for all crops

| Mode of Action | Active Substance | Group Name | Chemical Group | FRAC Group | Total Arable 2020 | Total Arable 2020 |
|---|---|---|---|---|---|---|
| | | | | | ha | kg |
| | Kresoxim-methyl | Qo inhibitors | Oximino-acetates | 11 | 1,246 | 60 |
| | Pyraclostrobin | Qo inhibitors | Methoxy-carbamates | 11 | 61,368 | 5,367 |
| | Trifloxystrobin | Qo inhibitors | Oximino-acetates | 11 | 188,945 | 8,456 |
| | Amisulbrom | Qi inhibitor | Sulfamoyl-triazole | 21 | 21,372 | 1,832 |
| | Cyazofamid | Qi inhibitor | Cyano-imidazole | 21 | 65,128 | 5,173 |
| | Fluazinam | Phenylpyridinamine | 2,6-dinitro-anilines | 29 | 10,603 | 3,046 |
| | Ametoctradin | Qo inhibitor, stigmatellin binding type | Triazolo-pyrimidylamine | 45 | 17,060 | 4,041 |
| **All respiration** | | | | | **915,192** | **64,810** |
| Amino acids and protein synthesis | Cyprodinil | Anilino - pyrimidines | Anilino - pyrimidines | 9 | 29,489 | 5,999 |
| Signal transduction | Proquinazid | Aza-naphthalenes | Quinazolinone | 13 | 22,968 | 562 |
| Lipid synthesis and membrane integrity | Propamocarb hydrochloride | Carbamate | Carbamate | 28 | 32,586 | 31,679 |
| | Oxathiapiprolin | OSBPI oxysterol binding protein homologue inhibition | Piperidinyl-thiazole-isoxazolines | 49 | 20,004 | 252 |
| **All lipid synthesis and membrane integrity** | | | | | **105,047** | **38,492** |

**Cont…**

## Table 20 Mode of action/chemical group of fungicide active substances on all arable crops – 2020 continued

Area (ha) and weight (kg) of active substances for all crops

| Mode of Action | Active Substance | Group Name | Chemical Group | FRAC Group | Total Arable 2020 | Total Arable 2020 |
|---|---|---|---|---|---|---|
| | | | | | ha | kg |
| Sterol biosynthesis in membranes | Bromuconazole | DeMethylation inhibitor | Triazoles | 3 | 7,125 | 1,067 |
| | Cyproconazole | DeMethylation inhibitor | Triazoles | 3 | 14,813 | 663 |
| | Difenoconazole | DeMethylation inhibitor | Triazoles | 3 | 334 | 29 |
| | Epoxiconazole | DeMethylation inhibitor | Triazoles | 3 | 136,789 | 8,412 |
| | Mefentrifluconazole | DeMethylation inhibitor | Triazoles | 3 | 49,782 | 3,798 |
| | Metconazole | DeMethylation inhibitor | Triazoles | 3 | 30,584 | 1,057 |
| | Prochloraz | DeMethylation inhibitor | Imidazoles | 3 | 18,901 | 4,113 |
| | Prothioconazole | DeMethylation inhibitor | Triazolinthiones | 3 | 649,780 | 55,142 |
| | Tebuconazole | DeMethylation inhibitor | Triazoles | 3 | 253,503 | 20,554 |
| | Fenpropidin | Morpholines | Piperidines | 5 | 159 | 3 |

**Cont…**

**Table 20 Mode of action/chemical group of fungicide active substances on all arable crops – 2020 continued**

Area (ha) and weight (kg) of active substances for all crops

| Mode of Action | Active Substance | Group Name | Chemical Group | FRAC Group | Total Arable 2020 | Total Arable 2020 |
|---|---|---|---|---|---|---|
| | | | | | ha | kg |
| | Fenpropimorph | Morpholines | Morpholines | 5 | 22,557 | 4,046 |
| | Spiroxamine | Morpholines | Spiroketal-amines | 5 | 124,811 | 21,711 |
| **All sterol biosynthesis in membranes** | | | | | **1,309,138** | **120,595** |
| Cell wall biosynthesis | Benthiavalicarb | Carboxylic acid amides | Valinamide carbamate | 40 | 18,815 | 661 |
| | Benthiavalicarb isopropyl | Carboxylic acid amides | Valinamide carbamate | 40 | 13,330 | 373 |
| | Dimethomorph | Carboxylic acid amides | Cinnamic acid amides | 40 | 36,280 | 6,287 |
| | Mandipropamid | Carboxylic acid amides | Mandelic acid amides | 40 | 33,393 | 4,951 |
| **All cell wall biosynthesis** | | | | | **101,817** | **12,271** |
| Unknown mode of action | Cyflufenamid | Phenyl-acetamide | Phenyl-acetamide | U06 | 34,845 | 292 |
| | Cymoxanil | Cyanoacetamide-oxime | Cyanoacetamide-oxime | 27 | 144,746 | 14,063 |
| **All unknown mode of action** | | | | | **179,591** | **14,354** |

**Cont…**

**Table 20 Mode of action/chemical group of fungicide active substances on all arable crops – 2020 continued**

Area (ha) and weight (kg) of active substances for all crops

| Mode of Action | Active Substance | Group Name | Chemical Group | FRAC Group | Total Arable 2020 | Total Arable 2020 |
|---|---|---|---|---|---|---|
| | | | | | ha | kg |
| Chemicals with multi-site activity | Mancozeb | Dithio-carbamate | Dithio-carbamate | M03 | 147,177 | 177,335 |
| | Chlorothalonil | Chloronitrile | Chloronitrile | M05 | 197,153 | 102,278 |
| | Folpet | Phthalimide | Phthalimide | M04 | 238,529 | 111,963 |
| | Copper oxychloride | Inorganic | Inorganic | NC | 2,274 | 412 |
| **All chemicals with multi-site activity** | | | | | **585,133** | **391,987** |
| **All fungicides** | | | | | **3,286,098** | **652,967** |
| **Sulphur** | | | | | **9,188** | **38,423** |
| Area grown | | | | | 496,000 | |

Note: Active substances have been grouped by their mode of action. Full details on mode of action classification can be found on the Fungicide Resistance Action Committee (FRAC) webpage(10)

## Table 21 Mode of action/chemical group of herbicide/desiccant active substances on all arable crops – 2020

Area (ha) and weight (kg) of active substances for all crops

| Mode of Action | Active substance | Chemical Group | HRAC Group | Total Arable 2020 | Total Arable 2020 |
|---|---|---|---|---|---|
| | | | | ha | kg |
| Inhibition of acetyl CoA carboxylase | Clodinafop-propargyl | Aryloxyphenoxy-propionates (FOPs) | 1 | 8,150 | 203 |
| | Fenoxaprop-p-ethyl | Aryloxyphenoxy-propionates (FOPs) | 1 | 11,930 | 665 |
| | Fluazifop-p-butyl | Aryloxyphenoxy-propionates (FOPs) | 1 | 1,785 | 154 |
| | Propaquizafop | Aryloxyphenoxy-propionates (FOPs) | 1 | 9,242 | 517 |
| | Quizalofop-p-ethyl | Aryloxyphenoxy-propionates (FOPs) | 1 | 8,357 | 292 |
| | Quizalofop-p-tefuryl | Aryloxyphenoxy-propionates (FOPs) | 1 | 3,714 | 95 |
| | Clethodim | Cyclohexanediones (DIMs) | 1 | 444 | 34 |
| | Cycloxydim | Cyclohexanediones (DIMs) | 1 | 648 | 214 |
| | Pinoxaden | Phenylpyrazoline | 1 | 38,865 | 1,127 |
| **All Inhibition of acetyl CoA carboxylase** | | | | **83,135** | **3,300** |
| Inhibition of EPSP synthase | Glyphosate | Glycine | 9 | 185,281 | 159,509 |
| **All inhibition of EPSP synthase** | | | | **185,281** | **159,509** |

**Cont…**

## Table 21 Mode of action/chemical group of herbicide/desiccant active substances on all arable crops – 2020 continued

Area (ha) and weight (kg) of active substances for all crops

| Mode of Action | Active substance | Chemical Group | HRAC Group | Total Arable 2020 | Total Arable 2020 |
|---|---|---|---|---|---|
| | | | | ha | kg |
| Inhibition of photosynthesis at photosystem II (- histidine 215 binders) | Bentazone | Benzothiadiazinone | 6 | 242 | 244 |
| | Bromoxynil | Nitriles | 6 | 2,034 | 372 |
| Inhibition of photosynthesis at photosystem II (- serine 264 binders) | Chlorotoluron | Ureas | 5 | 16,943 | 8,014 |
| | Metobromuron | Ureas | 5 | 11,676 | 12,697 |
| | Metribuzin | Triazinones | 5 | 24,846 | 10,759 |
| **All inhibition of photosynthesis at photosystem II** | | | | **55,741** | **32,085** |
| Inhibition of VLCFAs | Dimethenamid-p | α-chloroacetamides | 15 | 3,313 | 1,135 |
| | Metazachlor | α-chloroacetamides | 15 | 23,145 | 15,515 |
| | Flufenacet | α-oxyacetamides | 15 | 108,363 | 15,746 |
| | Prosulfocarb | Thiocarbamates | 15 | 14,128 | 20,506 |
| | Tri-allate | Thiocarbamates | 15 | 484 | 481 |
| **All inhibition of VLCFAs** | | | | **149,434** | **53,382** |
| Inhibition of microtubule assembly | Pendimethalin | Dinitroanilines | 3 | 101,839 | 79,943 |
| | Propyzamide | Benzamides | 3 | 12,826 | 8,766 |
| **All inhibition of microtubule assembly** | | | | **114,665** | **88,709** |

**Cont…**

**Table 21 Mode of action/chemical group of herbicide/desiccant active substances on all arable crops – 2020 continued**

Area (ha) and weight (kg) of active substances for all crops

| Mode of Action | Active substance | Chemical Group | HRAC Group | Total Arable 2020 | Total Arable 2020 |
|---|---|---|---|---|---|
| | | | | ha | kg |
| Photosystem-i-electron diversion | Diquat | Pyridiniums | 22 | 1,183 | 355 |
| **All photosystem-i-electron diversion** | | | | **1,183** | **355** |
| Inhibition of protoporphyrinogen oxidase | Bifenox | Diphenyl ethers | 14 | 673 | 323 |
| | Carfentrazone-ethyl | N-phenyl-triazolinones | 14 | 28,222 | 1,406 |
| | Flumioxazine | N-phenyl-imides | 14 | 220 | 7 |
| | Pyraflufen-ethyl | Phenylpyrazoles | 14 | 29,733 | 440 |
| **All inhibition of protoporphyrinogen oxidase** | | | | **58,849** | **2,176** |
| Inhibition of acetolactate synthase | Imazamox | Imidazolinones | 2 | 2,249 | 100 |
| | Amidosulfuron | Sulfonylureas | 2 | 4,852 | 99 |
| | Iodosulfuron-methyl-sodium | Sulfonylureas | 2 | 24,761 | 50 |
| | Mesosulfuron-methyl | Sulfonylureas | 2 | 21,427 | 179 |
| | Metsulfuron-methyl | Sulfonylureas | 2 | 196,954 | 642 |
| | Rimsulfuron | Sulfonylureas | 2 | 3,472 | 37 |
| | Sulfosulfuron | Sulfonylureas | 2 | 108 | 2 |
| | Thifensulfuron-methyl | Sulfonylureas | 2 | 202,049 | 4,214 |
| | Tribenuron-methyl | Sulfonylureas | 2 | 145,426 | 1,179 |

**Cont…**

## Table 21 Mode of action/chemical group of herbicide/desiccant active substances on all arable crops – 2020 continued

Area (ha) and weight (kg) of active substances for all crops

| Mode of Action | Active substance | Chemical Group | HRAC Group | Total Arable 2020 | Total Arable 2020 |
|---|---|---|---|---|---|
| | | | | ha | kg |
| | Florasulam | Triazolopyrimidine - type 1 | 2 | 92,626 | 278 |
| | Propoxycarbazone-sodium | Triazolinones | 2 | 567 | 11 |
| | Pyroxsulam | Triazolopyrimidine - type 2 | 2 | 5,418 | 101 |
| **All inhibition of acetolactate synthase ALS** | | | | **699,910** | **6,892** |
| Auxin mimics | Dicamba | Benzoates | 4 | 28,472 | 1,672 |
| | 2,4-D | Phenoxy-carboxylates | 4 | 2,596 | 2,262 |
| | 2,4-DB | Phenoxy-carboxylates | 4 | 3,657 | 4,042 |
| | Aminopyralid | Pyridine-carboxylates | 4 | 2,939 | 25 |
| | Clopyralid | Pyridine-carboxylates | 4 | 13,619 | 968 |
| | Dichlorprop-p | Phenoxy-carboxylates | 4 | 2,620 | 948 |
| | Fluroxypyr | Pyridyloxy-carboxylates | 4 | 199,866 | 20,145 |
| | Halauxifen-methyl | Pyridine-carboxylates | 4 | 108,318 | 425 |
| | MCPA | Phenoxy-carboxylates | 4 | 12,496 | 7,850 |
| | Mecoprop-p | Phenoxy-carboxylates | 4 | 107,010 | 59,995 |
| | Picloram | Phenoxy-carboxylates | 4 | 3,088 | 52 |
| | Quinmerac | Quinoline-carboxylates | 4 | 6,267 | 1,417 |
| **All auxin mimics** | | | | **490,948** | **99,800** |

**Cont…**

## Table 21 Mode of action/chemical group of herbicide/desiccant active substances on all arable crops – 2020 continued

Area (ha) and weight (kg) of active substances for all crops

| Mode of Action | Active substance | Chemical Group | HRAC Group | Total Arable 2020 | Total Arable 2020 |
|---|---|---|---|---|---|
| | | | | ha | kg |
| Inhibition of deoxy-d-xyulose phosphate synthase | Clomazone | Isoxazolidinone | 13 | 18,642 | 1,157 |
| **All inhibition of deoxy-d-xyulose phosphate synthase** | | | | **18,642** | **1,157** |
| Inhibition of phytoene desaturase | Diflufenican | Phenyl ethers | 12 | 154,902 | 9,015 |
| | Flurtamone | Diphenyl heterocycles | 12 | 597 | 36 |
| | Picolinafen | Phenyl ethers | 12 | 74,220 | 2,351 |
| **All inhibition of phytoene desaturase** | | | | **229,720** | **11,402** |
| Inhibition of solanesyl diphosphate synthase | Aclonifen | Diphenyl ether | 32 | 2,473 | 2,589 |
| **All inhibition of solanesyl diphosphate synthase** | | | | **2,473** | **2,589** |
| **All herbicides** | | | | **2,089,980** | **461,356** |
| Area grown | | | | 496,000 | |

Note: Active substances have been grouped by their mode of action. Full details on mode of action classification and details of the 2020 MOA revision can be found on the Herbicide Resistance Action Committee (HRAC) webpage[11]

## Table 22 Principal active substances by area treated

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

| | Active substance | Type(1) | 2020 | 2018 | % change |
|---|---|---|---|---|---|
| **1** | Prothioconazole | S/F | 873 | 677 | 29 |
| **2** | Tebuconazole | S/F | 454 | 381 | 19 |
| **3** | Folpet | F | 239 | 22 | 993 |
| **4** | Chlormequat | G | 228 | 201 | 13 |
| **5** | Thifensulfuron-methyl | H | 202 | 169 | 20 |
| **6** | Fluroxypyr | H | 200 | 163 | 22 |
| **7** | Chlorothalonil | F | 197 | 551 | -64 |
| **8** | Metsulfuron-methyl | H | 197 | 178 | 11 |
| **9** | Trifloxystrobin | F | 189 | 149 | 27 |
| **10** | Glyphosate | H | 185 | 166 | 11 |
| **11** | Trinexapac-ethyl | G | 181 | 148 | 22 |
| **12** | Diflufenican | H | 155 | 155 | 0 |
| **13** | Fluxapyroxad | F | 150 | 169 | -12 |
| **14** | Bixafen | F | 147 | 85 | 73 |
| **15** | Mancozeb | F | 147 | 94 | 56 |
| **16** | Tribenuron-methyl | H | 145 | 121 | 20 |
| **17** | Cymoxanil | F | 145 | 90 | 61 |
| **18** | Epoxiconazole | F | 137 | 276 | -50 |
| **19** | Spiroxamine | F | 125 | 73 | 72 |
| **20** | Lambda-cyhalothrin | I | 116 | 118 | -2 |
| **21** | Flufenacet | H | 108 | 87 | 25 |
| **22** | Halauxifen-methyl | H | 108 | 84 | 29 |
| **23** | Mecoprop-p | H | 107 | 126 | -15 |
| **24** | Metconazole | F/G | 106 | 26 | 305 |
| **25** | Pendimethalin | H | 102 | 130 | -22 |
| **26** | Fludioxonil | S | 95 | 72 | 32 |
| **27** | Fluoxastrobin | F | 93 | 81 | 16 |
| **28** | Florasulam | H | 93 | 87 | 7 |
| **29** | Picolinafen | H | 74 | 87 | -15 |
| **30** | Ferric phosphate | M | 68 | 26 | 163 |
| **31** | Cyazofamid | F | 65 | 55 | 19 |
| **32** | Pyraclostrobin | F | 61 | 70 | -12 |
| **33** | Prohexadione-calcium | G | 61 | 62 | -2 |
| **34** | 2-chloroethylphosphonic acid | G | 59 | 58 | 2 |
| **35** | Boscalid | F | 55 | 59 | -7 |
| **36** | Mepiquat chloride | G | 51 | 57 | -11 |
| **37** | Mefentrifluconazole | F | 50 | 0 | N/A |
| **38** | Imazalil | S | 50 | 105 | -53 |
| **39** | Ipconazole | S | 47 | 102 | -54 |
| **40** | Esfenvalerate | I | 41 | 31 | 31 |
| **41** | Azoxystrobin | F | 40 | 33 | 18 |
| **42** | Pinoxaden | H | 39 | 48 | -19 |
| **43** | Dimethomorph | F | 36 | 43 | -16 |
| **44** | Cyflufenamid | F | 35 | 49 | -29 |
| **45** | Mandipropamid | F | 33 | 33 | 2 |
| **46** | Propamocarb hydrochloride | F | 33 | 21 | 56 |
| **47** | Pyraflufen-ethyl | H | 30 | 7 | 345 |
| **48** | Cyprodinil | F | 29 | 35 | -16 |
| **49** | Dicamba | H | 28 | 40 | -28 |
| **50** | Carfentrazone-ethyl | H | 28 | 21 | 34 |

(1) Pesticide type = F: Fungicide, G: Growth regulator, H: Herbicide, I: Insecticide, M: Molluscicide, S: Seed treatment. N/A = not applicable.

## Table 23 Principal active substances by weight

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

| | Active substance | Type(1) | 2020 | 2018 | % change |
|---|---|---|---|---|---|
| **1** | Mancozeb | F | 177 | 113 | 58 |
| **2** | Chlormequat | G | 165 | 164 | 1 |
| **3** | Glyphosate | H | 160 | 135 | 18 |
| **4** | Folpet | F | 112 | 10 | 1,039 |
| **5** | Chlorothalonil | F | 102 | 265 | -61 |
| **6** | Pendimethalin | H | 80 | 97 | -18 |
| **7** | Mecoprop-p | H | 60 | 68 | -12 |
| **8** | Prothioconazole | F/S | 59 | 47 | 26 |
| **9** | Sulphur | F | 38 | 3 | 1,344 |
| **10** | Propamocarb hydrochloride | F | 32 | 19 | 69 |
| **11** | Spiroxamine | F | 22 | 13 | 66 |
| **12** | Tebuconazole | F/S | 21 | 22 | -5 |
| **13** | Prosulfocarb | H | 21 | 8 | 161 |
| **14** | Fluroxypyr | H | 20 | 17 | 18 |
| **15** | Flufenacet | H | 16 | 13 | 24 |
| **16** | Metazachlor | H | 16 | 19 | -16 |
| **17** | Cymoxanil | F | 14 | 8 | 77 |
| **18** | Metobromuron | H | 13 | 8 | 61 |
| **19** | Metribuzin | H | 11 | 11 | -3 |
| **20** | Boscalid | F | 10 | 12 | -13 |
| **21** | Diflufenican | H | 9 | 9 | 3 |
| **22** | 2-chloroethylphosphonic acid | G | 9 | 10 | -15 |
| **23** | Propyzamide | H | 9 | 5 | 82 |
| **24** | Trifloxystrobin | F | 8 | 6 | 34 |
| **25** | Epoxiconazole | F | 8 | 17 | -52 |
| **26** | Ferric phosphate | M | 8 | 3 | 135 |
| **27** | Mepiquat chloride | G | 8 | 7 | 9 |
| **28** | Chlorotoluron | H | 8 | 6 | 43 |
| **29** | MCPA | H | 8 | 6 | 27 |
| **30** | Fluxapyroxad | F | 7 | 8 | -20 |
| **31** | Dimethomorph | F | 6 | 8 | -17 |
| **32** | Cyprodinil | F | 6 | 6 | 0 |
| **33** | Trinexapac-ethyl | G | 6 | 5 | 13 |
| **34** | Bixafen | F | 6 | 4 | 54 |
| **35** | Azoxystrobin | F | 6 | 5 | 15 |
| **36** | Pyraclostrobin | F | 5 | 5 | 3 |
| **37** | Cyazofamid | F | 5 | 4 | 18 |
| **38** | Mandipropamid | F | 5 | 5 | 4 |
| **39** | Oxamyl | I | 5 | 5 | -10 |
| **40** | Thifensulfuron-methyl | H | 4 | 4 | 12 |
| **41** | Prochloraz | F | 4 | 8 | -48 |
| **42** | Fenpropimorph | F | 4 | 23 | -82 |
| **43** | 2,4-DB | H | 4 | 6 | -31 |
| **44** | Ametoctradin | F | 4 | 5 | -18 |
| **45** | Flutolanil | S | 4 | 2 | 77 |
| **46** | Maleic hydrazide | G | 4 | 1 | 394 |
| **47** | Mefentrifluconazole | F | 4 | 0 | N/A |
| **48** | Fluoxastrobin | F | 4 | 3 | 25 |
| **49** | Fluazinam | F | 3 | 5 | -33 |
| **50** | Aclonifen | H | 3 | 0 | N/A |

(1) Pesticide type = F: Fungicide, G: Growth regulator, H: Herbicide, I: Insecticide, M: Molluscicide, S: Seed treatment. N/A = not applicable.

### Table 24 Total arable crop, comparison with previous years

Pesticide usage in 2016, 2018 and 2020, area treated with formulations and active substances (a.s) and the weight (kg) applied

| | 2016 | | | 2018 | | | 2020 | | |
|---|---|---|---|---|---|---|---|---|---|
| | **Formulations** | **a.s.** | **Weight** | **Formulations** | **a.s.** | **Weight** | **Formulations** | **a.s.** | **Weight** |
| | **ha** | **ha** | **kg** | **ha** | **ha** | **kg** | **ha** | **ha** | **kg** |
| Insecticides/nematicides | 198,964 | 198,964 | 12,428 | 202,792 | 202,792 | 8,616 | 199,483 | 207,500 | 10,190 |
| Molluscicides | 68,645 | 68,645 | 7,843 | 75,033 | 75,033 | 8,716 | 88,431 | 84,493 | 9,223 |
| Fungicides | 2,239,796 | 3,550,384 | 660,809 | 2,128,624 | 3,273,378 | 636,729 | 2,128,892 | 3,233,754 | 646,406 |
| Sulphur | 11,879 | 11,879 | 37,467 | 1,562 | 1,562 | 2,662 | 9,188 | 9,188 | 38,423 |
| Herbicides/desiccants | 1,383,643 | 1,997,906 | 533,728 | 1,349,368 | 1,983,129 | 448,425 | 1,407,866 | 2,089,980 | 461,356 |
| Growth regulators | 497,456 | 596,763 | 212,489 | 454,237 | 548,541 | 190,656 | 507,946 | 590,582 | 194,429 |
| Seed treatments | 451,389 | 926,172 | 25,150 | 420,451 | 747,314 | 15,997 | 451,037 | 720,003 | 12,072 |
| **All pesticides** | **4,851,771** | **7,350,712** | **1,489,914** | **4,632,066** | **6,831,748** | **1,311,801** | **4,792,843** | **6,935,500** | **1,372,098** |
| Total area grown (ha) | 494,167 | | | 489,309 | | | 496,631 | | |

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

## Table 25 Cereals, comparison with previous years

Pesticide usage in 2016, 2018 and 2020, area treated with formulations and active substances (a.s) and the weight (kg) applied

| | 2016 | | | 2018 | | | 2020 | | |
|---|---|---|---|---|---|---|---|---|---|
| | **Formulations** | **a.s.** | **Weight** | **Formulations** | **a.s.** | **Weight** | **Formulations** | **a.s.** | **Weight** |
| | **ha** | **ha** | **kg** | **ha** | **ha** | **kg** | **ha** | **ha** | **kg** |
| Insecticides | 75,473 | 75,473 | 1,447 | 78,127 | 78,127 | 385 | 63,269 | 63,269 | 291 |
| Molluscicides | 18,520 | 18,520 | 2,436 | 29,439 | 29,439 | 3,322 | 22,608 | 22,608 | 2,141 |
| Fungicides | 1,762,377 | 2,879,227 | 463,707 | 1,710,838 | 2,659,346 | 450,428 | 1,619,439 | 2,496,062 | 390,727 |
| Sulphur | 8,412 | 8,412 | 22,980 | 1,339 | 1,339 | 2,261 | 9,135 | 9,135 | 38,254 |
| Herbicides/desiccants | 1,163,254 | 1,759,278 | 421,484 | 1,130,538 | 1,739,063 | 336,584 | 1,190,313 | 1,850,821 | 357,315 |
| Growth regulators | 488,976 | 582,317 | 204,053 | 448,775 | 537,939 | 188,943 | 501,530 | 580,099 | 189,739 |
| Seed treatments | 399,608 | 845,878 | 13,815 | 365,829 | 666,313 | 8,435 | 402,746 | 671,712 | 7,091 |
| **All pesticides** | **3,916,621** | **6,169,106** | **1,129,922** | **3,764,885** | **5,711,567** | **990,358** | **3,809,039** | **5,693,705** | **985,558** |
| Area grown (ha) | 432,077 | | | 425,674 | | | 434,443 | | |

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

## Table 26 Potatoes comparison with previous years

Pesticide usage in 2016, 2018 and 2020, area treated with formulations and active substances (a.s.) and the weight (kg) applied

| | 2016 | | | 2018 | | | 2020 | | |
|---|---|---|---|---|---|---|---|---|---|
| | **Formulations** | **a.s.** | **Weight** | **Formulations** | **a.s.** | **Weight** | **Formulations** | **a.s.** | **Weight** |
| | **ha** | **ha** | **kg** | **ha** | **ha** | **kg** | **ha** | **ha** | **kg** |
| Insecticides/nematicides | 78,719 | 78,719 | 10,166 | 90,685 | 90,685 | 7,675 | 102,686 | 102,686 | 9,097 |
| Molluscicides | 33,432 | 33,432 | 3,506 | 21,676 | 21,676 | 2,955 | 41,906 | 41,906 | 4,945 |
| Fungicides | 370,696 | 506,007 | 175,215 | 306,927 | 441,298 | 166,694 | 398,601 | 578,939 | 240,046 |
| Sulphur | 265 | 265 | 424 | 0 | 0 | 0 | 0 | 0 | 0 |
| Herbicides/desiccants | 121,927 | 124,952 | 49,369 | 113,567 | 117,357 | 43,202 | 111,948 | 117,387 | 40,830 |
| Growth regulators | 2,515 | 2,515 | 7,338 | 323 | 323 | 775 | 1,277 | 1,277 | 3,830 |
| Seed treatments | 24,828 | 27,973 | 11,014 | 25,048 | 25,048 | 7,239 | 25,150 | 25,150 | 4,888 |
| **All pesticides** | **632,381** | **773,863** | **257,032** | **558,227** | **696,387** | **228,539** | **681,568** | **867,346** | **303,635** |
| Area grown (ha) | 27,526 | | | 27,359 | | | 28,298 | | |

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

## Table 27 Oilseed rape, comparison with previous years

Pesticide usage in 2016, 2018 and 2020, area treated with formulations and active substances (a.s) and the weight (kg) applied

| | 2016 | | | 2018 | | | 2020 | | |
|---|---|---|---|---|---|---|---|---|---|
| | **Formulations** | **a.s.** | **Weight** | **Formulations** | **a.s.** | **Weight** | **Formulations** | **a.s.** | **Weight** |
| | **ha** | **ha** | **kg** | **ha** | **ha** | **kg** | **ha** | **ha** | **kg** |
| Insecticides | 43,782 | 43,782 | 805 | 33,353 | 33,353 | 551 | 41,369 | 41,369 | 801 |
| Molluscicides | 16,234 | 16,234 | 1,846 | 23,917 | 23,917 | 2,439 | 19,980 | 19,980 | 2,138 |
| Fungicides | 100,681 | 154,974 | 19,361 | 109,052 | 169,723 | 18,933 | 99,321 | 156,585 | 15,344 |
| Sulphur | 2,973 | 2,973 | 12,995 | 223 | 223 | 401 | 53 | 53 | 169 |
| Herbicides/desiccants | 90,409 | 104,526 | 56,768 | 100,286 | 120,243 | 64,895 | 97,013 | 115,057 | 59,219 |
| Growth regulators | 5,965 | 11,931 | 1,098 | 5,139 | 10,279 | 938 | 4,603 | 9,206 | 859 |
| Seed treatments | 26,789 | 52,157 | 298 | 29,574 | 55,953 | 323 | 22,944 | 22,944 | 93 |
| **All pesticides** | **286,833** | **386,577** | **93,171** | **301,544** | **413,690** | **88,480** | **285,283** | **365,194** | **78,623** |
| Area planted (ha) | 30,142 | | | 32,735 | | | 30,793 | | |

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

# Appendix 2 – Survey statistics

## Census and sample information

### Table 28 Regional distribution of arable crops in 2020

Census area (ha) of arable crops grown in Scotland

| | H&I(1) | C&O(1) | Moray Firth | Abdn(1) | Angus | East Fife | Lothian | C. Low-lands(1) | Tweed Valley | S. Uplands(1) | Solway | Scotland 2020 | Scotland 2018 | % change |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Winter barley | 158 | 191 | 1,656 | 13,367 | 6,491 | 3,276 | 3,730 | 4,286 | 6,028 | 939 | 2,969 | 43,091 | 37,542 | 15 |
| Spring barley | 4,269 | 7,388 | 39,906 | 77,312 | 47,392 | 13,799 | 13,216 | 28,790 | 15,861 | 3,523 | 7,245 | 258,702 | 250,476 | 3 |
| Wheat | 61 | * | 3,872 | 8,111 | 21,439 | 12,816 | 15,494 | 8,099 | 19,603 | 1,050 | 2,976 | 93,538 | 99,778 | -6 |
| Winter oats | 4 | * | 91 | 610 | 1,138 | 1,843 | 388 | 648 | 2,546 | 512 | 200 | 7,984 | 8,439 | -5 |
| Spring oats | 465 | 2,331 | 2,140 | 5,103 | 3,462 | 3,378 | 1,391 | 3,869 | 3,101 | 334 | 424 | 26,000 | 23,661 | 10 |
| Winter rye | * | 0 | 774 | 902 | 1,245 | 486 | 89 | 389 | 733 | 0 | 515 | 5,137 | 5,786 | -11 |
| Triticale | * | 0 | * | 114 | * | 0 | 0 | 152 | 86 | * | * | 448 | 956 | -53 |
| Winter oilseed rape | * | 0 | 1,813 | 7,048 | 7,827 | 1,575 | 3,528 | 1,445 | 6,739 | * | 276 | 30,373 | 32,284 | -6 |
| Spring oilseed rape(2) | * | 0 | * | 51 | 170 | 77 | * | 84 | * | 0 | * | 537 | 454 | 18 |
| Seed potatoes | 182 | 21 | 1,688 | 2,280 | 5,551 | 405 | 121 | 1,195 | 495 | * | * | 12,003 | 12,092 | -1 |
| Ware potatoes | 124 | 33 | 952 | 469 | 7,785 | 2,333 | 1,440 | 1,293 | 1,630 | 1 | 233 | 16,294 | 15,268 | 7 |
| Field beans | * | 0 | 60 | * | 155 | 325 | 496 | 289 | 610 | 0 | 197 | 2,138 | 2,034 | 5 |
| Dry harvest peas | * | * | * | 84 | 61 | * | * | * | * | * | 0 | 328 | 515 | -36 |
| Lupins | * | * | 0 | * | * | 0 | 0 | * | 0 | 0 | 0 | 17 | * | N/A |
| Mixed grain | 38 | * | * | * | 0 | 0 | 0 | * | 0 | 0 | 0 | 41 | 18 | 130 |
| **Totals** | **5,329** | **9,994** | **52,987** | **115,456** | **102,790** | **40,376** | **39,987** | **50,556** | **57,526** | **6,537** | **15,092** | **496,631** | **489,309** | **1** |

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

## Table 29 Distribution of arable sample - 2020

Number of holdings surveyed in each region and size group

| Size (ha) | H&I[1] | C&O[1] | Moray Firth | Abdn[1] | Angus | East Fife | Lothian | C. Low-lands[1] | Tweed Valley | S. Uplands [1] | Solway | Scotland |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 0.1-19.99 | 3 | 4 | 2 | 5 | 2 | 0 | 1 | 2 | 1 | 0 | 1 | **21** |
| 20-49.9 | 1 | 1 | 5 | 13 | 7 | 1 | 1 | 4 | 2 | 1 | 4 | **40** |
| 50-99.9 | 2 | 2 | 10 | 19 | 15 | 9 | 5 | 7 | 4 | 1 | 2 | **76** |
| 100-149.9 | 0 | 2 | 8 | 8 | 16 | 5 | 6 | 8 | 7 | 1 | 1 | **62** |
| 150+ | 1 | 1 | 15 | 13 | 33 | 7 | 12 | 6 | 22 | 2 | 1 | **113** |
| **All sizes** | **7** | **10** | **40** | **58** | **73** | **22** | **25** | **27** | **36** | **5** | **9** | **312** |

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

## Table 30 Sampled area - 2020

Area (ha) of arable crops grown in sample

| Size (ha) | H&I[1] | C&O[1] | Moray Firth | Abdn[1] | Angus | East Fife | Lothian | C. Low-lands[1] | Tweed Valley | S. Uplands [1] | Solway | Scotland |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 0.1-19.99 | 19 | 30 | 22 | 55 | 21 | 0 | 6 | 16 | 6 | 0 | 8 | **182** |
| 20-49.9 | 25 | 20 | 137 | 428 | 221 | 32 | 43 | 128 | 59 | 31 | 102 | **1,227** |
| 50-99.9 | 95 | 120 | 732 | 1,301 | 1,040 | 658 | 370 | 478 | 237 | 65 | 119 | **5,216** |
| 100-149.9 | 0 | 248 | 959 | 983 | 1,803 | 452 | 624 | 901 | 833 | 142 | 114 | **7,060** |
| 150+ | 188 | 178 | 3,227 | 3,243 | 6,743 | 1,927 | 2,680 | 1,069 | 5,515 | 617 | 227 | **25,614** |
| **All sizes** | **328** | **596** | **5,077** | **6,012** | **9,828** | **3,069** | **3,723** | **2,593** | **6,649** | **855** | **570** | **39,298** |

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

## Table 31 Census area - 2020

Area (ha) of arable crops grown in Scotland

| Size (ha) | H&I(1) | C&O(1) | Moray Firth | Abdn(1) | Angus | East Fife | Lothian | C. Low-lands (1) | Tweed Valley | S. Uplands(1) | Solway | Scotland |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 0.1-19.99 | 1,569 | 3,434 | 2,817 | 7,350 | 2,564 | 928 | 1,065 | 4,644 | 1,191 | 645 | 2,819 | **29,026** |
| 20-49.9 | 1,390 | 2,076 | 7,697 | 18,011 | 10,177 | 3,414 | 2,526 | 9,781 | 2,946 | 1,358 | 5,208 | **64,584** |
| 50-99.9 | 1,508 | 2,146 | 11,361 | 30,167 | 20,459 | 8,972 | 7,363 | 12,655 | 7,740 | 1,274 | 3,717 | **107,362** |
| 100-149.9 | * | 1,099 | 10,435 | 18,566 | 18,183 | 8,986 | 7,652 | 8,445 | 10,246 | 1,487 | 1,471 | **87,061** |
| 150+ | * | 1,239 | 20,677 | 41,362 | 51,407 | 18,075 | 21,381 | 15,030 | 35,403 | 1,773 | 1,878 | **208,597** |
| **All sizes** | **5,329** | **9,994** | **52,987** | **115,456** | **102,790** | **40,376** | **39,987** | **50,556** | **57,526** | **6,537** | **15,092** | **496,631** |

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

## Table 32 Raising factors - 2020

| Size (ha) | H&I(1) | C&O(1) | Moray Firth | Abdn(1) | Angus | East Fife | Lothian | C. Low-lands(1) | Tweed Valley | S. Uplands(1) | Solway |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 0.1-19.99 | 83.0032 | 115.9885 | 130.8913 | 132.8928 | 120.7340 | N/A | 180.7589 | 283.8625 | 214.9729 | N/A | 352.3250 |
| 20-49.9 | 54.9597 | 103.5863 | 56.2180 | 42.0898 | 46.0612 | 107.2708 | 58.4746 | 76.4361 | 49.5731 | 44.0104 | 50.9972 |
| 50-99.9 | 15.8468 | 17.8171 | 15.5282 | 23.1788 | 19.6786 | 13.6360 | 19.9001 | 26.4691 | 32.6872 | 19.4728 | 31.1540 |
| 100-149.9 | N/A | 4.4306 | 10.8756 | 18.8790 | 10.0828 | 19.8835 | 12.2638 | 9.3700 | 12.3056 | 10.4983 | 12.9232 |
| 150+ | 1.9724 | 6.9776 | 6.4068 | 12.7529 | 7.6237 | 9.3792 | 7.9795 | 14.0601 | 6.4196 | 2.8756 | 8.2799 |

(1) H&I = Highlands & Islands, C&O = Caithness & Orkney, Abdn = Aberdeen, C. Lowlands = Central Lowlands, S. Uplands = Southern Uplands
N/A = not applicable

## Table 33 First and second adjustment factors - 2020

| | H&I(1) | C&O(1) | Moray Firth | Abdn(1) | Angus | East Fife | Lothian | C. Low-lands(1) | Tweed Valley | S. Uplands(1) | Solway | ADJ2 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Winter barley | N/A | N/A | 1.1937 | 1.5248 | 0.9623 | 0.9047 | 1.1526 | 0.6188 | 0.9542 | 1.1023 | 1.0160 | 1.0081 |
| Spring barley | 1.0404 | 1.3217 | 0.9624 | 0.8992 | 0.9478 | 1.1851 | 0.7872 | 1.0380 | 0.8931 | 0.9824 | 0.7051 | 1.0000 |
| Total wheat | N/A | 0.1440 | 0.6983 | 1.3786 | 1.1610 | 0.8136 | 1.2076 | 0.9745 | 1.0009 | 1.4303 | 2.3832 | 1.0006 |
| Winter oats | N/A | N/A | N/A | 0.7299 | 0.8478 | 1.3921 | N/A | N/A | 1.0562 | 1.5582 | N/A | 1.2009 |
| Spring oats | 0.8459 | 0.5432 | 1.9862 | 1.4886 | 0.6904 | 0.9418 | 0.4765 | 0.6860 | 1.1885 | N/A | N/A | 1.0300 |
| Winter rye | N/A | N/A | N/A | 0.3804 | N/A | 0.9792 | N/A | N/A | 0.8585 | N/A | N/A | 2.4224 |
| Spring oilseed rape | N/A | N/A | N/A | N/A | 0.4656 | N/A | N/A | N/A | N/A | N/A | N/A | 3.0972 |
| Winter oilseed rape | N/A | N/A | 1.0953 | 1.3765 | 0.8918 | 1.0475 | 1.6737 | 1.6513 | 1.1419 | 0.3601 | 0.4426 | 1.0001 |
| Seed potatoes | 1.7314 | N/A | 1.7430 | 0.8905 | 1.2223 | 7.4342 | N/A | 2.1069 | 0.8640 | 0.4992 | N/A | 1.0148 |
| Ware potatoes | 1.5216 | N/A | 1.0713 | 0.9215 | 1.0518 | 1.6986 | 1.2667 | 10.4816 | 1.8680 | N/A | 10.4918 | 1.0021 |
| Dry harvest peas | N/A | N/A | N/A | N/A | N/A | N/A | 0.0887 | N/A | N/A | N/A | N/A | 10.9364 |
| Field beans | N/A | N/A | N/A | N/A | 0.7366 | 3.5074 | 0.7912 | 0.7688 | 0.9502 | N/A | N/A | 1.1395 |

(1) H&I = Highlands & Islands, C&O = Caithness & Orkney, Abdn = Aberdeen, C. Lowlands = Central Lowlands, S. Uplands = Southern Uplands
N/A = not applicable

## Response rates

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

### Table 34 Response rate

| | 2020 | % total |
|---|---|---|
| Target sample | 350 | 100 |
| | | |
| **Total achieved** | **312** | **89** |
| | | |
| Total number of refusals/non-contact | 162 | |
| **Total number of farms approached** | **474** | |

## Financial burden to farmers

In order to minimise the burden on farmers and to comply with the restrictions imposed by COVID-19, the survey team used non-visit methods of collection such as email, post or telephone call.

To determine the total burden that the 2020 arable crop survey placed on those providing the information, the surveyors recorded the time that 287 respondents spent providing the data during the surveys. This sample represents 92 per cent of growers surveyed. The median time taken to provide the information was 20 minutes.

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

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

(* using median "Full Time Gross" hourly pay for Scotland of £15.62)[(12)]

The total financial burden to all growers resulting from participation in the 2020 arable crop survey was calculated to be £1,624.

## Appendix 3 – Definitions and notes

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

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

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

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

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

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

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

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

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

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

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

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

13) **Area treated** is the basic area of a crop treated with a given pesticide multiplied by the number of treatments that area received. These terms are synonymous with “spray area” and “spray hectare” which have appeared in

previous reports.  For example, if a field of five hectares gets sprayed with the same fungicide twice, the basic area is five hectares, and the treated area is 10 hectares.

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

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

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

17)  The **June Agricultural Census**(13) is conducted annually by the Scottish Government's Rural and Environmental Science Analytical Services (RESAS).  The June Agricultural Census collects data on land use, crop areas, livestock and the number of people working on agricultural holdings.  For this report the June Agricultural Census was used to draw a sample of farmers growing the relevant crops to participate in the survey.

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

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

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

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

22) Data from the 2016[4] and 2018[3] surveys are provided for comparison purposes in some of the tables, although it should be noted that there may be minor differences in the range of crops surveyed, together with changes in areas of each of the crops grown. Changes from previous surveys are described in Appendix 4. When comparisons are made between surveys it is important to consider changes in the area of crop grown. In order to take this into account, comparisons have been made on a per hectare grown basis, i.e. the number of hectares that have been sprayed (treated hectares) has been divided by the area of crop grown for each survey, and the weight (kilograms) applied has also been divided by the area of crop grown. This is to enable like for like comparisons between surveys, so that changes in pesticide use patterns are not masked by changes in crop area.

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

24) There were a limited number of holdings with winter rye sampled. Therefore, no details of pesticide use on winter rye is reported separately, however it is included in the totals for 'all cereals' in the pesticide usage tables.

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

26) Integrated pest management The sustainable use directive and the equivalent retained EU law[2] defines IPM as; "'integrated pest management' means careful consideration of all available plant protection methods and subsequent integration of appropriate measures that discourage the development of populations of harmful organisms and keep the use of plant protection products and other forms of intervention to levels that are economically and ecologically justified and reduce or minimise risks to human health and the environment. 'Integrated pest management' emphasises the growth of a healthy crop with the least possible disruption to agro-ecosystems and encourages natural pest control mechanisms."

# Appendix 4 – Survey methodology

## Sampling and data collection

Using the June 2020 Agricultural Census[13], a sample was drawn representing arable cultivation in Scotland. The country was divided into 11 land-use regions (Figure 31). Each sample was stratified by these land-use regions and according to holding size. The sampling fractions used within both regions and size groups were based on the areas of relevant crops grown rather than number of holdings, so that smaller holdings would not dominate the sample.

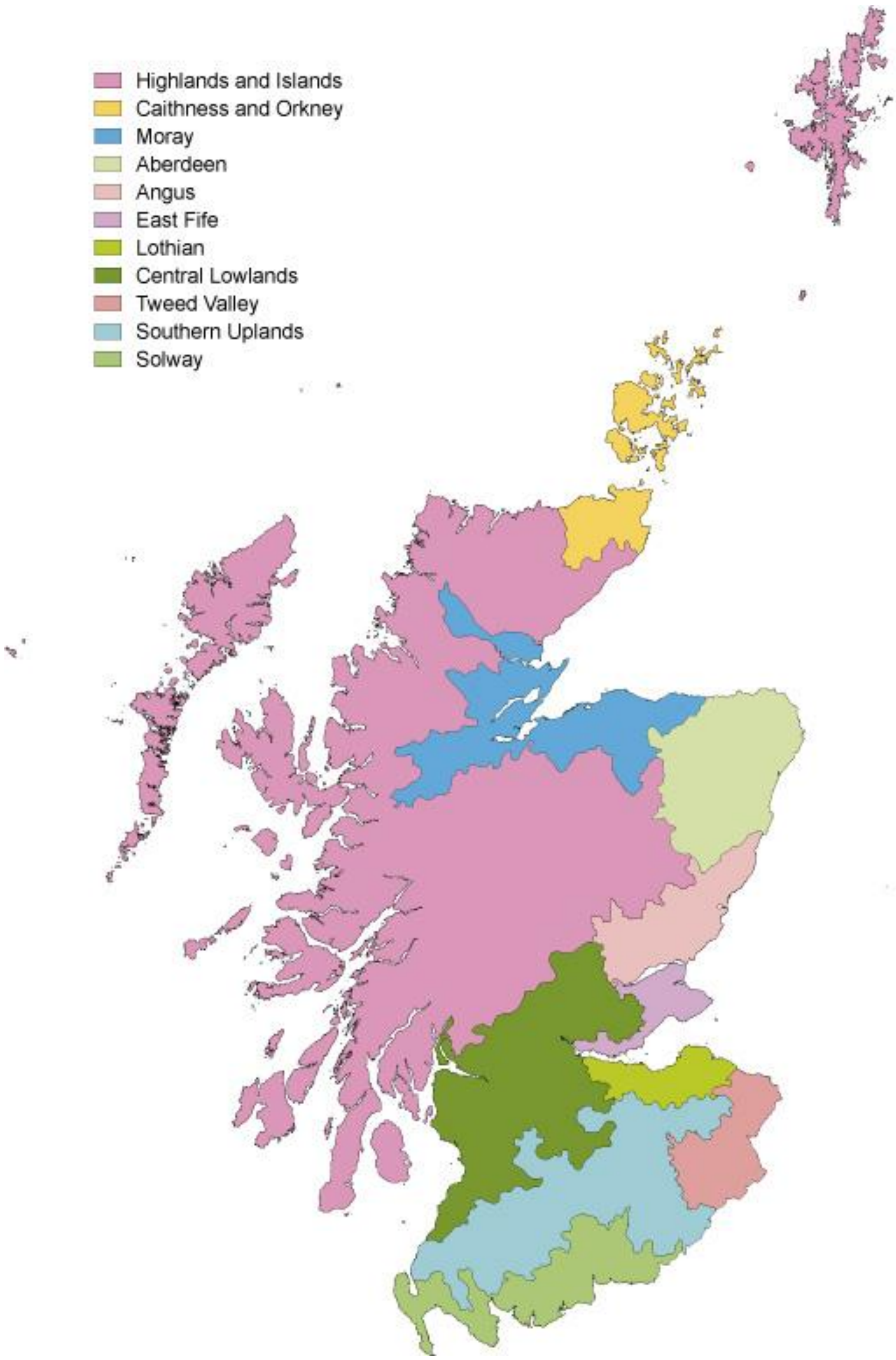
The survey covered pesticide applications to arable crops where all or the majority of the growing season was in 2020. As well as recording treatments applied directly to the crop, data was also collected on land preparation treatments prior to sowing or planting the crop.

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 312 holdings growing arable crops (Table 29). These holdings represent eight per cent of the total crop area grown.

## Raising factors

National pesticide use was estimated by ratio raising. This is a standard statistical technique for producing estimates from a sample. It is the same methodology used by the other UK survey teams and has been used for all historical datasets produced by the Pesticide Survey Unit, allowing comparability over time. The sample data were multiplied by raising factors (Tables 32). These factors were calculated by comparing the sampled area to the areas recorded in the Agricultural Census within each region and size group. An adjustment (Table 33) 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 was necessary for some crops which were present in the population but were not encountered in the sample in some strata.

## Figure 31 Land use regions of Scotland[14]



## Changes from previous years

There are changes which should be noted when comparing the 2020 data with the previous survey.

All data in 2020 had to be collected using non-visit methods such as by phone interview or by email due to restrictions imposed by the COVID-19 pandemic. In previous years data was collected by a combination of personal interview during a visit to the holding and/or by phone/email. This change in data collection method may have impacted the number and type of respondents. Every effort was made to achieve a robust sample. This additional effort and change in data collection method resulted in a delay to the publication date.

This report presents information about grower adoption of Integrated Pest Management (IPM). IPM data was not collected during the 2018 survey. The data presented represents the second in the series of surveys of IPM measures on arable crops, first collected alongside the 2016 arable crops

## Data quality assurance

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

## Main sources of bias

The use of a random stratified sample is an appropriate survey methodology. A stratified random sample, grouped by farm size and region, is used to select holdings used in this survey. Sampling within size groups is based on area rather than numbers of holdings, so that smaller size groups are not over-represented in the sample. The pesticide survey may be subject to measurement bias as it is reliant on farmers/growers recording data accurately. As this survey is not compulsory it may also subject to non-response bias, as growers on certain farm/holding types may be more likely to respond to the survey than others. Reserve lists of holdings are held for each stratum to allow non-responding holdings to be replaced with similar holdings.

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

## Appendix 5 – Standard errors

The figures presented in this report are produced from surveying a sample of holdings rather than a census of all the holdings in Scotland. Therefore, the figures are estimates of the total pesticide use for Scotland and should not be interpreted as exact. To give an idea of the precision of estimates, the report includes relative standard errors (RSE) (Table 35). 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 35) for both total pesticide use by area treated and for weight applied. Larger relative standard errors mean that the estimates are less precise. A relative standard error of zero per cent would be achieved by a census. A relative standard error of 100 per cent indicates that the error in the survey is of the same order as the measurement. Relative standard errors may be reduced with larger sample sizes. However, larger relative standard errors can also result from greater variability in pesticide use among holdings.

The RSE for estimates of total pesticide use on arable crops (Table 35) was three per cent for area and four per cent for weight, compared with three per cent for area and weight in 2018. For constituent crop groups, the RSE varied from two to 24 per cent for area and three to 37 per cent for weight, varying with sample size and uniformity of pesticide regime encountered. For spring oilseed rape and dry harvest peas, a standard error could not be calculated due to too few active ingredients being recorded; therefore, pesticide estimates for these crops should be treated with caution. Higher standard errors mean that there is more uncertainty associated with estimates of pesticide use.

## Table 35 Relative standard errors - 2020

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

| | Area SE (%) | Weight SE (%) |
|---|---|---|
| **Winter barley[(1)]** | 9 | 10 |
| **Spring barley** | 4 | 5 |
| **Wheat (winter and spring)[(1)]** | 6 | 5 |
| **Winter oats[(1)]** | 10 | 14 |
| **Spring oats[(1)]** | 18 | 18 |
| **Winter rye[(1)]** | 2 | 3 |
| **Winter oilseed rape** | 9 | 10 |
| **Spring oilseed rape[(2)]** | NC | NC |
| **Seed potatoes** | 10 | 12 |
| **Maincrop potatoes** | 20 | 25 |
| **Dry harvest peas[(2)]** | NC | NC |
| **Field beans[(1)]** | 24 | 37 |
| **All pesticides** | **3** | **4** |

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

## Appendix 6 – Integrated Pest Management

It is a requirement of the retained EU law Directive 2009/128/EC of the European Parliament and of the Council[(15)] (equivalent to the EU Sustainable use of Pesticides Directive 2009/128/EC) that member states should promote low pesticide input pest management, in particular Integrated Pest Management (IPM). The Directive defines IPM as follows "'integrated pest management' means careful consideration of all available plant protection methods and subsequent integration of appropriate measures that discourage the development of populations of harmful organisms and keep the use of plant protection products and other forms of intervention to levels that are economically and ecologically justified and reduce or minimise risks to human health and the environment. 'Integrated pest management' emphasises the growth of a healthy crop with the least possible disruption to agro-ecosystems and encourages natural pest control mechanisms."

Information about the uptake of IPM measures by Scottish growers was collected alongside the 2020 arable crops pesticide usage survey. IPM data have previously been collected and published for all crop groups in our cycle of pesticide usage surveys (vegetable crops 2015 & 2019, protected edible crops 2015 & 2019, arable crops 2016, soft fruit crops 2016 and fodder crops 2017). Our intention is to monitor IPM uptake in each crop sector every four years. This 2020 IPM survey represents the second in the series of surveys of IPM measures on arable crops, allowing the adoption of IPM techniques to be monitored. These datasets will be used as an indicator of the success of Scottish Government funded IPM research, knowledge transfer and promotion activities.

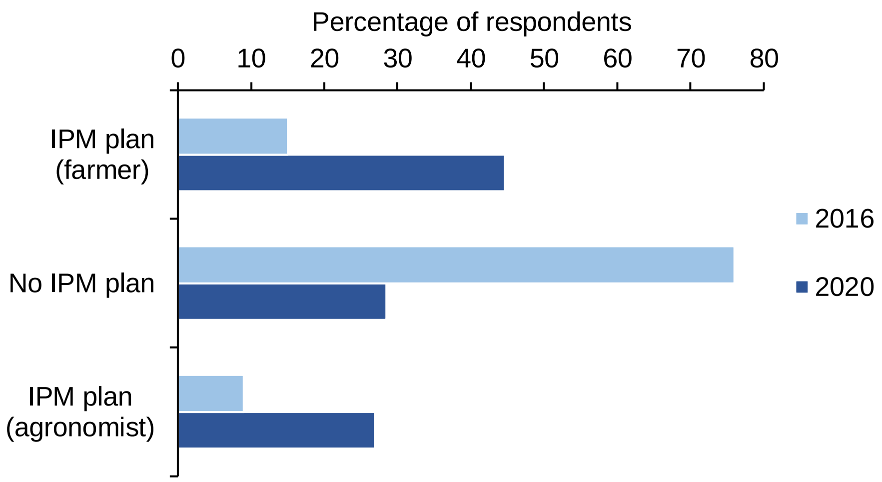
Unlike the other statistics in this report, the figures reported in this section are not raised to produce national estimates but represent only the responses of those surveyed. The IPM sample, whilst smaller than that sampled for the pesticide usage survey, provides a good representation of Scottish regions and farm size groups.

Pearson chi-square tests were used to assess statistical evidence for changes, with permutation tests used when expected values were five or less. When comparing between 2016 and 2020, any evidence of a statistical change in the proportion of growers reporting under a category is indicated by a p-value. Any other notable differences that might indicate a direction of travel are also recorded in the text. If no comparison is made, then the responses recorded are similar between 2016 and 2020.

In total IPM data was collected from 242 growers representing 248 holdings and collectively growing 32,083 ha of crops. This sample represented six per cent of Scotland's 2020 arable crop area. Of these growers, 72 per cent had an IPM plan (45 per cent completed their own IPM plan and 27 per cent had a plan completed by their agronomist) and 29 per cent did not have an IPM plan (Figure 32). There is very strong evidence that the proportion of growers completing an IPM plan has increased from the 2016 survey where 24 per cent of growers had a plan (p-value <0.001). Using an IPM plan helps growers to make the best possible, and most sustainable, use of all available methods for pest control.

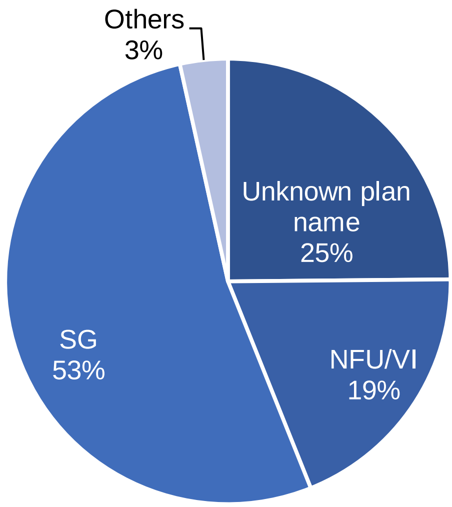
Since the 2016 survey, the requirement to complete an IPM plan has been added to the most widely used UK farm assurance schemes; for example, farmers certified with Red Tractor are required to complete the NFU/VI IPM plan. Scottish farm businesses certified by Scottish Quality Crops (SQC Ltd) must complete an IPM plan, a biodiversity plan and a soil testing plan[16].

### Figure 32 IPM: Percentage of respondents with an IPM plan 2016-2020




Although more plans were completed in 2020, there was no change in the proportions of plans completed by growers and by agronomist, with around 62 per cent of IPM plans completed by growers and 38 per cent completed by agronomists in 2020 and 2016. Of those growers who had an IPM plan in 2020, either completed themselves or by their agronomist, 53 per cent used the Scottish Government IPM plan, 19 per cent used the NFU/VI plan and 4 per cent used other plans (Figure 33). A quarter of responses, 25 per cent, said they or their agronomist had completed a plan but were not sure which plan it was.

## Figure 33 IPM: Type of IPM plan - 2020




Note: Others include Agrii, Accura, Gatekeeper, LEAF

Farmers were asked about their IPM activities in relation to three categories; risk management, pest monitoring and pest control. Information was collected about all activities each grower conducted in relation to these categories and the responses are reported in the following sections. The term ‘pest’ is used throughout to denote diseases, weeds and invertebrate pests.

### Risk management

IPM programmes aim to prevent or reduce the risk of pests becoming a threat by minimising the likelihood of damage occurring that will require subsequent control. Table 36 presents an overview of the risk management measures adopted by those growers surveyed. In both 2020 and 2016, all growers sampled reported that they implemented at least one measure associated with an IPM risk management approach. There was evidence for an increase in the proportion of growers reporting the implementation of two of the risk management questions between 2016 and 2020, including cultivation at sowing to reduce pest risk and soil testing.

### Table 36 IPM: Summary of responses to risk management questions 2016-2020

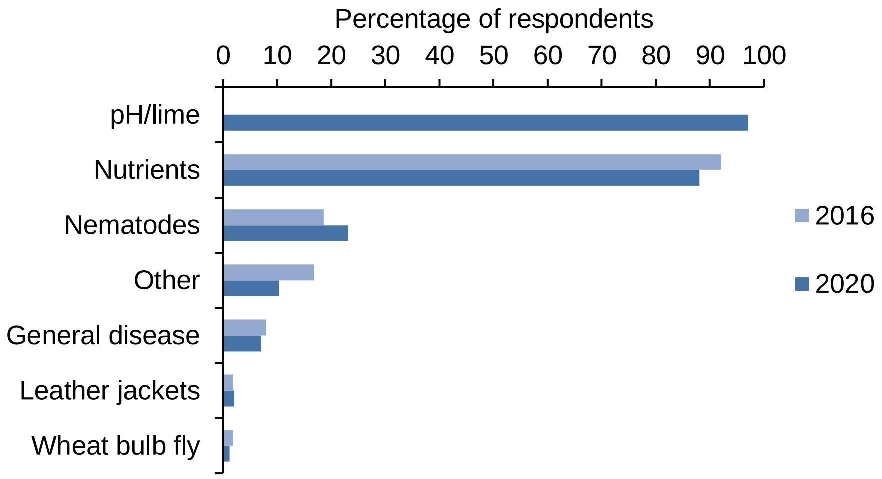
| Risk management activity | Percentage positive response | |
|---|---|---|
| | 2020 | 2016 |
| Crop rotation | 88 | 88 |
| Soil testing | 100 | 96 |
| Cultivation of seed bed to reduce pest risk | 92 | 93 |
| Cultivation at sowing to reduce pest risk | 64 | 44 |
| Varietal or seed choice to reduce pest risk | 93 | 93 |
| Catch and cover cropping | 34 | 27 |
| Protection or enhancement of beneficial organism populations | 90 | 88 |
| Cleaning machinery between fields | 72 | N/A |
| **Any risk management** | **100** | **100** |

Note: In 2016 growers were not directly asked about cleaning machinery between fields.
N/A = not applicable

Eighty-eight per cent of growers in both 2020 and 2016 used crop rotation to reduce the risk of pest damage. Rotation breaks the link between pathogen and host, reducing pest population build-up. It can also improve soil fertility and structure, and consequently crop vigour.

Evidence was found for an increase in the proportion of growers responding positively to testing their soil (p-value 0.003), although this is a modest increase (100 per cent in 2020 compared with 96 per cent in 2016) (Table 36). Soil testing allows growers to make informed decisions about the inputs required and optimal crop choice for their land. Most testing encountered in 2020 was for pH or lime (97 per cent). This was the biggest change observed from 2016, however, growers were not asked directly about testing soil for pH or insects in 2016, therefore these responses are underestimated in 2016 and classified under 'Other' (Figure 34). There was a decrease in 2020 in the proportions of growers testing for nutrients (92 per cent in 2016 to 88 per cent in 2020). There was an increase in 2020 for testing for nematodes (19 per cent to 23 per cent). In 2020, similar proportions of growers tested for leatherjackets (two per cent), soil borne disease (eight per cent in 2016 to seven per cent in 2020) and wheat bulb fly (two per cent in 2016 to one per cent in 2020).

## Figure 34 IPM: Soil testing 2016-2020

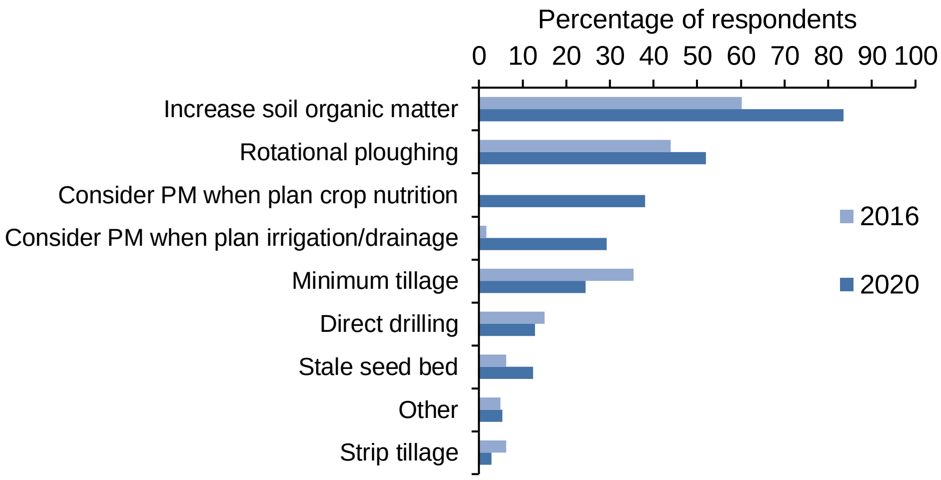



Note: In 2016 growers were not directly asked about testing for pH or lime. However, pH testing was recorded under 'Other' in 2016. Therefore the 2016 data are underestimated.
'Other' in 2020 included tests for club-root, wireworm, rhizoctonia, powdery scab, organic matter testing, worm and slug counts
'Other' in 2016 included pH, sulphur and eelworm

The majority of growers in 2020 (92 per cent) and in 2016 (93 per cent) reported that they managed their seed bed agronomy to improve crop performance and reduce pest risk (Table 36). In 2020, 83 per cent of growers increased soil organic matter which was an increase from 60 per cent in 2016. Twelve per cent in 2020 used a stale seedbed for weed management compared with six per cent in 2016 (Figure 35). Stale seed beds allow weeds to germinate before sowing the next crop; these are often treated with a herbicide, depleting the seed bank, and resulting in lower weed pressure, and potentially pesticide use in the succeeding crop. Twenty-nine per cent of growers considered pest management when planning irrigation and drainage, an increase from two per cent in 2016, however this was not directly asked in 2016 and was captured under 'Other'. Thirty-eight per cent of growers also considered pest management when planning crop nutrition however this question was not asked directly in 2016 and cannot be compared. Other methods employed by growers in 2020 included using non-inversion techniques such as minimum tillage (24 per cent) and direct drilling (13 per cent) and 52 per cent using rotational ploughing. These techniques can preserve organic matter in the soil. For comparison in 2016, 35 per cent carried out minimum tillage, 15 per cent direct drilling and 44 per cent rotational ploughing. In 2020, other seed bed cultivation techniques captured during the survey included consolidating seed beds and cultural control (rolling, power harrowing, discing stubbles and application of hen manure) primarily for the control of slugs but also for leatherjackets. In 2016, other techniques included considering pest management when planning irrigation, using a straw rake, shallow cultivations or rolling to control slugs.

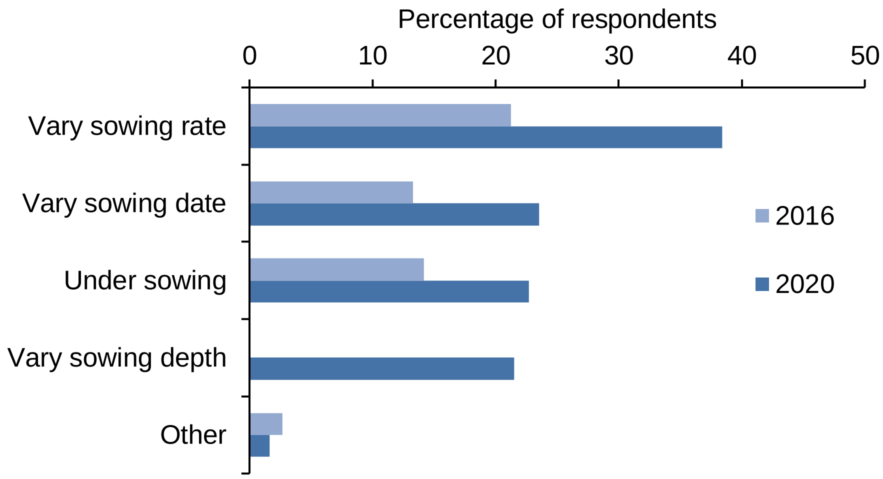
In 2020, 64 per cent of growers amended cultivation methods at sowing with the aim of increasing crop success, a significant increase from the 44 per cent recorded in 2016 (Table 36). Thirty-eight per cent varied the sowing rate, 24 per cent varied the sowing date and 23 per cent used under sowing in 2020 (Figure 36). In 2016, 21 per cent varied the sowing rate, 13 per cent varied the sowing date and 14 per cent used under sowing, all less than in 2020. Twenty-one per cent varied the sowing depth in 2020, however this question was not directly asked in 2016 so cannot be compared. Two per cent used other cultivation methods at sowing in 2020, similar to 2016 (three per cent). Other techniques in 2020 included changing the orientation of sowing and switching to winter cropping rather than in spring due to leatherjackets. In 2016, other included drilling headlands after crop to reduce slugs, considering pest management when planning nutrition and sowing deeper when crows are a problem.

### Figure 35 IPM: Seed bed cultivations 2016-2020




Note: ‘Other’ in 2020 includes cultivations to control slugs such as rolling, harrowing, applying hen manure and discing stubbles. Also power harrowing to control leatherjackets and burying weed seed
‘Other’ in 2016 includes considering pest management when planning irrigation, using a straw rake, shallow cultivations or rolling to control slugs
PM = pest management.

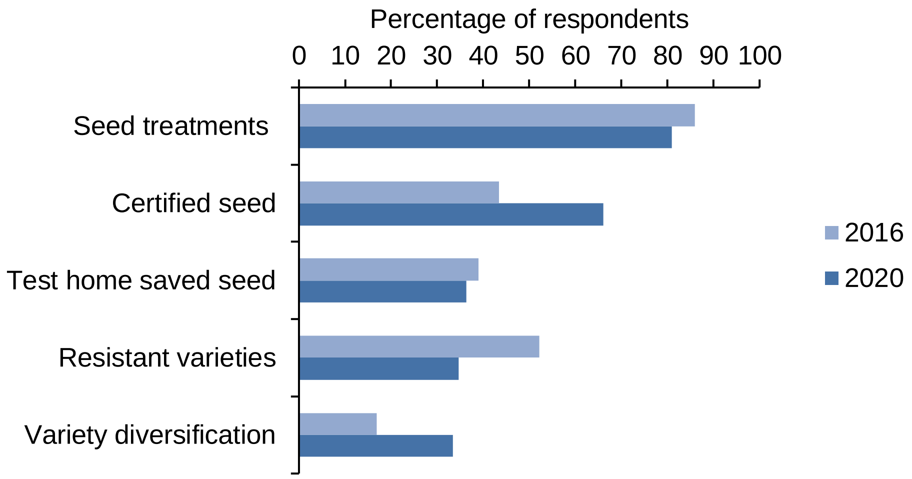
## Figure 36 IPM: Cultivations at sowing 2016-2020




Note: 'Other' in 2020 includes changing the orientation of sowing and winter cropping rather than in spring due to leatherjackets
'Other' in 2016 includes drilling headlands after crop to reduce slugs, considering pest management when planning nutrition and sowing deeper when crows are a problem.
In 2016 growers were not specifically asked about varying sowing depth.

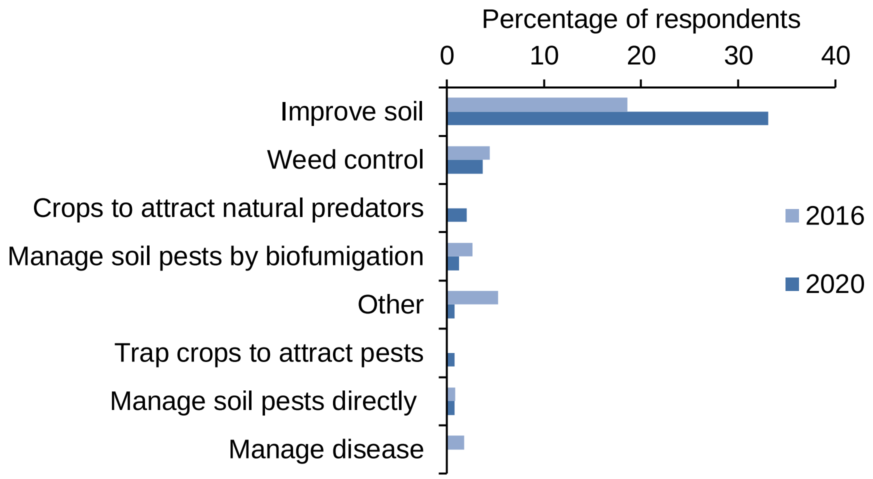
The majority (93 per cent) of growers in 2020 and 2016 considered risk management when selecting seeds and/or varieties (Table 36). In 2020 there were decreases in the proportions of growers using seed treatments, resistant varieties and testing home saved seed when compared to 2016 (Figure 37). Eighty-one per cent of growers used seed treatments, both pesticide seed treatments to protect seedlings at crop emergence (80 per cent) and growth promotors to improve crop establishment (16 per cent). Thirty-five per cent selected pest resistant varieties to reduce damage and the need for pesticide input, 66 per cent used certified seed and 36 per cent tested home saved seed. Thirty-three per cent of growers used diversification of varieties to increase overall crop resilience to pests and environmental stresses.

**Figure 37 IPM: Variety and seed choice 2016-2020**




Thirty-four per cent of growers sowed catch or cover crops in 2020, a small increase from 27 per cent in 2016 (Table 36). In 2020, 33 per cent of growers used cover and catch crops such as clover and phacelia to improve soil quality, an increase of 14 per cent from 2016 (Figure 38). Four per cent were used to suppress weeds, two per cent used crops such as oilseed radish to attract natural predators, one per cent used crops such as mustard with bio-fumigation properties and one per cent used crops to manage soil pests directly. One per cent used trap crops to attract pests. In 2020, other techniques highlighted were cover crops to prevent winter runoff and soil erosion as well as companion crops. Other techniques in 2016 included Ecological Focus Area, catch crop, companion crop and stopping runoff from soil.

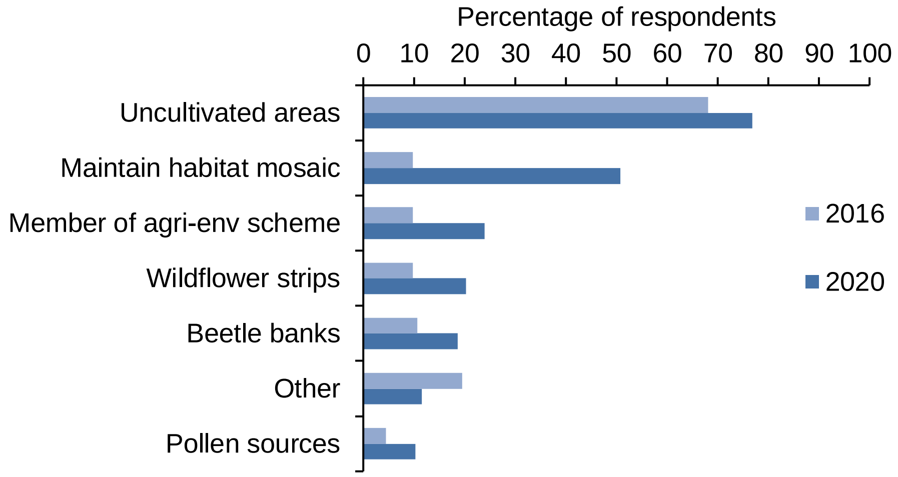
### Figure 38 IPM: Catch and cover cropping 2016-2020




Note: In 2020, 'Other' techniques highlighted were cover crops to prevent winter runoff and soil erosion as well as companion crops.
'Other' techniques in 2016 included Ecological Focus Area catch crop, companion crop, stopping runoff from soil.
In 2016, growers were not specifically asked about using crops to attract natural predators.

Finally, 90 per cent of growers stated that they adopted techniques to protect or enhance populations of beneficial organisms, similar to 88 per cent in 2016 (Table 36). In 2020 there were increases in all of the categories which were surveyed in 2016 (Figure 39). Seventy-seven per cent left uncultivated areas, including leaving margins, headlands, headlands and other areas wild and using buffer strips to increase biodiversity. Fifty-one per cent maintained a habitat mosaic including planting and maintaining hedgerows, tree planting and wetland restoration. Ten per cent planted pollen sources and 20 per cent planted wildflower strips. Nineteen per cent had beetle banks. Twenty-four per cent took part in an agri-environment scheme, with the main scheme reported as the Scottish Government agri-environment climate scheme (AECS). A number of other actions to support beneficial organism populations were also reported in 2020. These additional measures included planting wild bird seed, leaving winter stubbles and not using insecticides. Other categories in 2016 included maintaining hedging and wetland areas.

## Figure 39 IPM: Protection and enhancement of beneficial organism populations 2016-2020




Note: In 2020, 'Other' activities included planting wild bird seed, leaving winter stubbles and not using insecticides
In 2016, growers were not specifically asked about maintaining habitat mosaic or beetle banks. However, these were recorded under 'Other' in 2016. Therefore, responses will be under reported in 2016.

### Pest monitoring

In IPM, pests are monitored both to determine whether control is economically justified and to effectively target control options. IPM programmes aim to monitor and identify pests, so that appropriate control decisions can be made in conjunction with action thresholds. Table 37 presents an overview of the pest monitoring measures adopted by the growers surveyed in 2016 and 2020. The responses show little change between 2016 and 2020. In both years, all of the growers sampled (100 per cent) reported they implemented at least one pest monitoring measure.

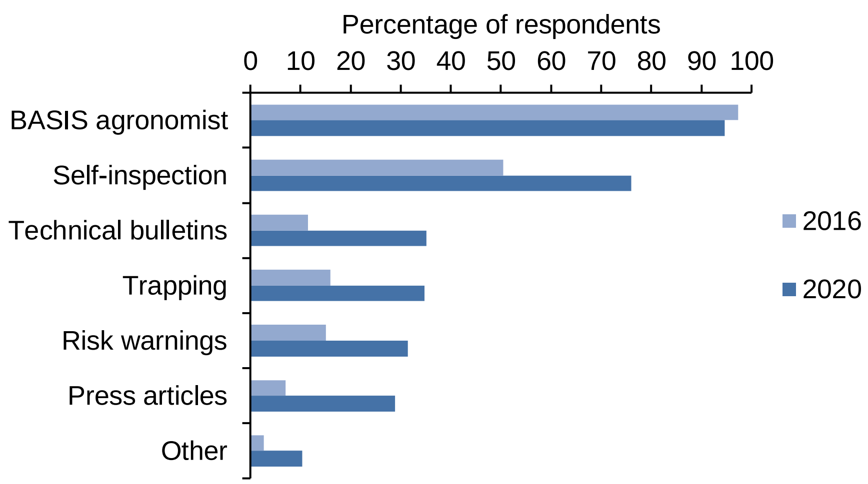
## Table 37 IPM: Summary of responses to pest monitoring questions 2016-2020

| **Pest monitoring activity** | **Percentage positive response** | |
|---|---|---|
| | **2020** | **2016** |
| Setting action thresholds for crops | 71 | 68 |
| Monitor and identify pests | 100 | 100 |
| Use of specialist diagnostics | 53 | 58 |
| Regular monitoring of crop growth stage | 98 | 99 |
| **Any pest monitoring activity** | **100** | **100** |

All growers surveyed reported that they regularly monitored and identified pests and 98 per cent regularly monitored crop growth stages (Table 37). Most growers (71 per cent) also used action thresholds when monitoring pest populations. Over half (53 per cent) reported that they used specialist diagnostics to identify pests.

Pest monitoring information was primarily gained by seeking advice from a BASIS qualified agronomist (95 per cent in 2020 and 97 per cent in 2016) (Figure 40). There was an increase in the proportion of growers using self-inspection of crops to collect information from 50 per cent in 2016 to 76 per cent in 2020. In 2020 there were increases in the use of risk warnings, technical bulletins and press articles (31, 35 and 29 per cent of growers respectively). Trapping was used by 35 per cent of growers (primarily for slugs), an increase from 16 per cent in 2016. Other methods of pest monitoring reported in 2020 included using phone applications, using weather data to estimate risk, using local information from other farmers/growers and using the internet to monitor/identify pests. In 2016 other methods only included information from local farmers and growers.

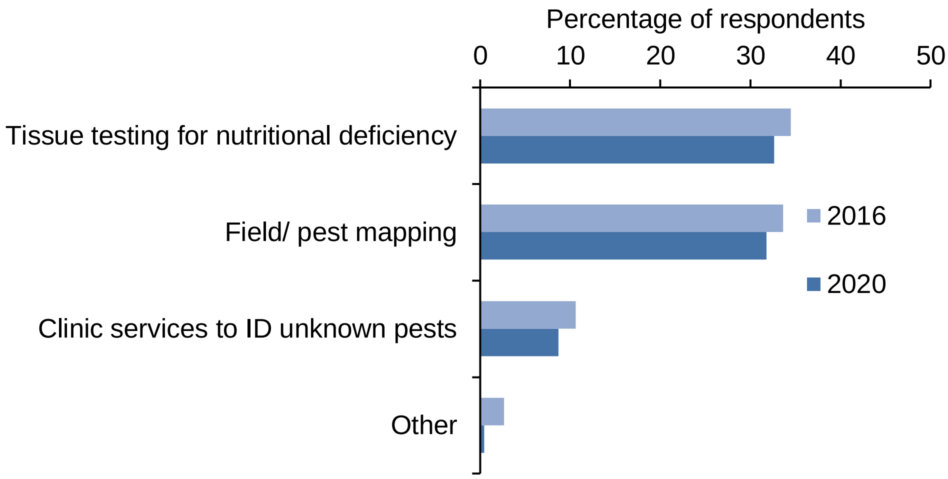
### Figure 40 IPM: Monitoring and identifying pests 2016-2020




Note: ‘Other’ included using weather data to estimate risk, using local information from other farmers/growers and using the internet or phone apps to monitor/identify pests.
‘Other’ in 2016 only included information from local farmers and growers.

Fifty-three per cent of respondents also used specialist diagnostics when dealing with pests that were more problematic to identify or monitor in 2020 (Table 37). Thirty-three per cent used tissue testing for nutritional deficiencies. Thirty-two per cent of growers used field or pest mapping (predominately field mapping which includes soil mapping) to aid crop monitoring (Figure 41). Nine per cent of growers used clinic services to identify unknown pests. All of these categories were very similar to the responses in 2016 (34, 35 and 11 per cent respectively).

### Figure 41 IPM: Use of specialist diagnostics 2016-2020




Note: ‘Other’ in 2020 included calculating Green Area Index (GAI)
‘Other’ in 2016 included using nitrogen sensors for variable rate application, and using applications on phone

## Pest control

If monitoring, identification, and action thresholds indicate that pest control is required, and preventive methods are no longer effective or available, IPM programs evaluate the best control method in relation to effectiveness and risk. Control programmes incorporate non-chemical methods alongside, or instead of, chemical control. Use of chemical pest control should be as targeted as possible and the risk of resistance development should be minimised. The effectiveness of the control programme should be reviewed regularly to gauge success and improve their regime as necessary. Table 38 presents an overview of the pest control measures adopted by the growers surveyed. Of the holdings sampled in 2020, two per cent were organic, the same proportion as in 2016.

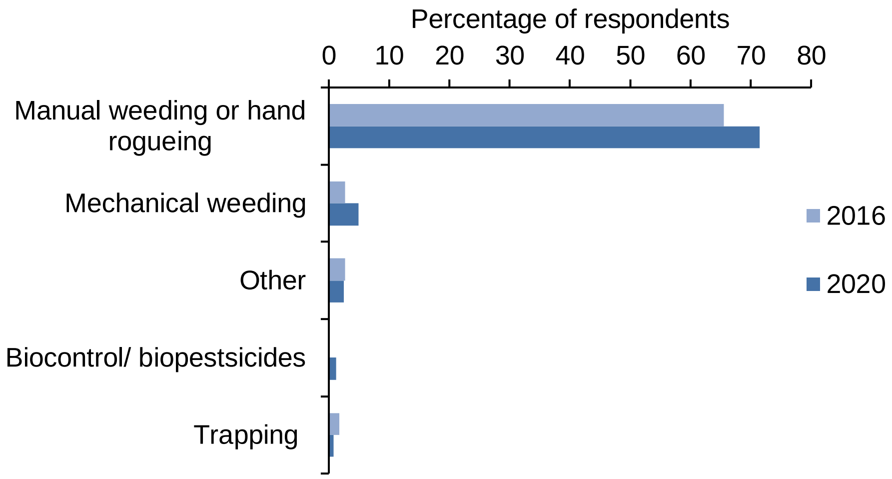
All of the growers sampled in 2020 and in 2016 adopted at least one IPM pest control activity. There is an increase in 2020 on the use of non-chemical control, targeted pesticide application and following anti-resistance strategies. There was evidence for an increase in the proportion of positive responses to targeted pesticide application techniques (p-value = 0.005) and very strong evidence for an increase in the proportion of positive responses to implementing anti-resistance strategies (p-value < 0.001).

**Table 38 Summary of responses to pest control questions 2016-2020**

| Pest control activity | Percentage positive response | |
|---|---|---|
| | 2020 | 2016 |
| Non-chemical control used in partnership or instead of chemical control | 74 | 68 |
| Targeted pesticide application | 85 | 73 |
| Follow anti-resistance strategies | 91 | 73 |
| Monitor success of crop protection methods | 98 | 100 |
| **Any pest control activity** | **100** | **100** |

Seventy-four per cent of growers reported that they used non-chemical control in partnership or instead of chemical control, a small increase from 68 per cent in 2016 (Table 38). The most common non-chemical method employed in 2020 was manual weeding or hand rogueing used by 71 per cent of respondents, an increase from 65 per cent in 2016 (Figure 42). Hand rogueing was primarily to control wild oats, but control of brome, ragwort and volunteers was also recorded. A range of physical control methods, which prevent pest access to the crop, were also used. Trapping was used by one per cent of growers in 2020 and two per cent in 2016. The use of biocontrol and biopesticides was encountered in one per cent of surveyed holdings. Other methods of non-chemical control used in 2020 were using straw mulches, applying mineral oil to potato crops to prevent virus transmission and use of biostimulants. Other non-chemical methods used in 2016 included growing winter oilseed rape under nets and mechanically removing slug eggs.

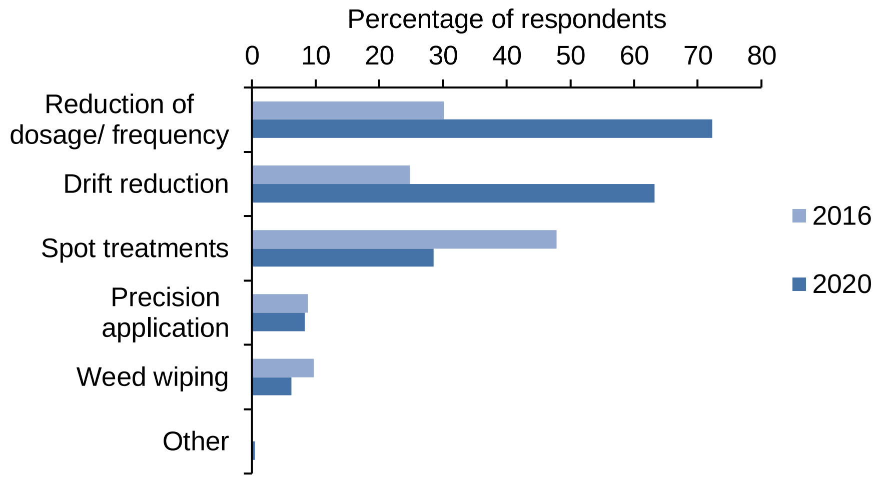
## Figure 42 IPM: Non-chemical control 2016-2020




Note: 'Other' in 2020 includes using straw mulches, applying mineral oil to potato crops and use of biostimulants.
'Other' in 2016 included growing winter oilseed rape under nets and mechanically removing slug eggs

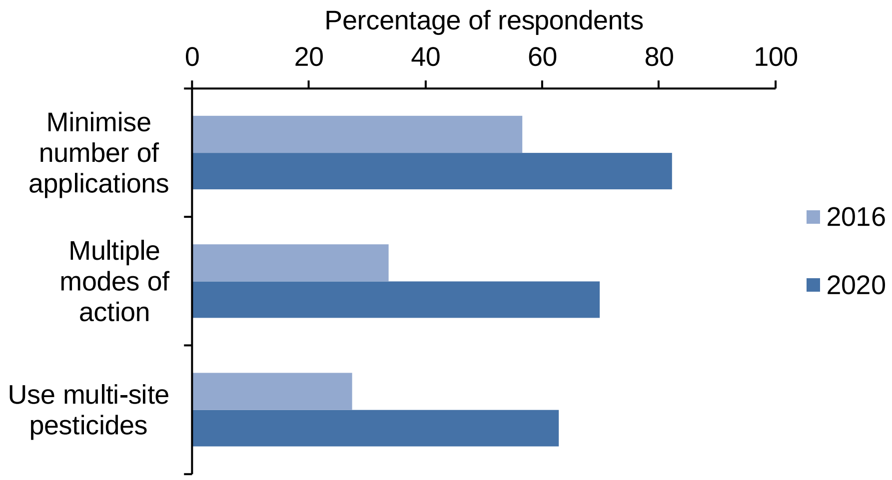
Eighty-five per cent of growers in 2020 stated that they targeted their pesticide applications to reduce pesticide use, an increase from 73 per cent in 2016 (Table 38). The most common method, used by 72 per cent of growers in 2020, was reducing the dosage or frequency of pesticide applications, an increase from 30 per cent in 2016 (Figure 43). Sixty-three per cent of growers targeted pesticide application by using drift reduction apparatus, an increase from 25 per cent in 2016. Precision application methods, such as the use of GPS were used by eight per cent of growers, similar to the proportion recorded in 2016 (nine per cent). Spot treatments (applying only to the affected area) were used by 29 per cent of growers in 2020, compared to 48 per cent in 2016 to combat weeds including docks, thistles, wild oats and couch. The use of weed wiping (direct herbicide application to weeds taller than the host crop), decreased from 10 per cent in 2016 to six per cent in 2020. Other methods used for targeting pesticide application in 2020 included downloading specific resistance action guidelines for crops to ensure only effective active substances were applied.

## Figure 43 IPM: Targeted pesticide application 2016-2020



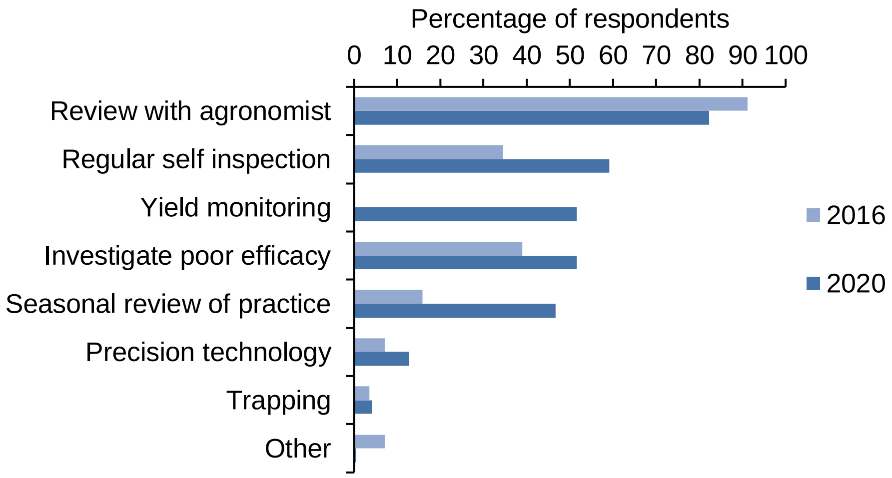

In addition, 91 per cent of growers in 2020 stated that they followed anti resistance strategies, an increase from 73 per cent in 2016 (Table 38). Anti-resistance strategies are used to minimise the risk of development of pest resistance. In 2020, 82 per cent of growers stated they minimised the number of pesticide applications used, an increase from 57 per cent in 2016 (Figure 44). Seventy per cent of growers in 2020 used a range of pesticides with multiple modes of action, an increase from 34 per cent in 2016. Sixty-three per cent of growers used pesticides with multi-site modes of action, compared to only 27 per cent in 2016. This is despite the loss of chlorothalonil from the market in 2020 which was the principal multi-site active used on arable crops.

## Figure 44 IPM: Types of anti-resistance strategies 2016-2020




An important aspect of IPM is monitoring the success of risk management and crop protection practices to continually improve regimes. Ninety-eight per cent of growers in 2020 stated that they monitored the success of their crop protection measures, similar to the proportion in 2016 (100 per cent) (Table 38). Between 2016 and 2020, there has been a decrease in the proportion of growers having a regular review with their agronomist and an increase in the proportion using regular self-inspection to monitor their crop protection success. In 2020, 82 per cent of growers had a regular review with their agronomist to monitor crop protection success, a decrease from 91 per cent in 2016 and 59 per cent of growers conducted regular self-inspections of their crops, an increase from 35 per cent in 2016. There was a similar increase in the use of self-inspection to monitor and identify pests from 2016 to 2020 (Figure 45). However, the majority of respondents in both years sought advice from a BASIS qualified agronomist for pest monitoring and identification. Seasonal review of practice, investigating causes of poor efficacy and use of precision technology were used by a larger proportion of growers in 2020 compared to 2016 (47, 52 and 13 per cent respectively in 2020 and 16, 39 and seven per cent in 2016). Trapping was used on four per cent of holdings in 2020 and in 2016. Other methods recorded for monitoring success in 2020 included comparisons with trial plots where pesticides are not applied. Other methods recorded in 2016 includes measuring success by examining the results of harvest and comparing with historic yields and independent trials. This was directly asked in the 2020 survey where 52 per cent of growers said they used yield monitoring to monitor the success of crop protection methods.

## Figure 45 IPM: Monitoring success of crop protection measures 2016 - 2020




Note: In 2020, 'Other' includes trial plot where pesticide is not applied
In 2016 'Other' includes measuring success by examining the results of harvest and comparing with historic yields and independent trials
In 2016, growers were not specifically asked about yield monitoring

## Acknowledgements

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

## References

1. Food and Environment Protection Act 1985: http://www.legislation.gov.uk/ukpga/1985/48 [Accessed 26 Oct 2021]

2. Regulation (EC) 1185/2009: Regulation (EC) No 1185/2009 of the European Parliament and of the Council of 25 November 2009 concerning statistics on pesticides (Text with EEA relevance) (legislation.gov.uk) [Accessed 26 Oct 2021]

3. Wardlaw, J., Davis, C., Monie, C. & Reay, G. (2019) Pesticide Usage in Scotland, Arable Crops 2018, Scottish Government: https://www.sasa.gov.uk/document-library/arable-crops-and-potato-stores-2018 [Accessed 26 Oct 2021]

4. Monie, C., Reay, G. & Wardlaw, J. (2017) Pesticide Usage in Scotland, Arable Crops 2016, Scottish Government https://www.sasa.gov.uk/document-library/arable-crops-and-potato-stores-2016 [Accessed 26 Oct 2021]

5. Met Office UK and regional series - Met Office [Accessed 26 Oct 2021]

6. SRUC Crop Protection report. East edition. Issue 19/14. 15 August 2019

7. Farm Advisory Service. Potatoes Update - Mid August 2020 | Helping farmers in Scotland | Farm Advisory Service (fas.scot) [Accessed 26 Oct 2021]

8. Pelletwise Metaldehyde Stewardship Scheme https://www.getpelletwise.co.uk/ [Accessed 26 Oct 2021]

9. Insecticide Resistance Action Committee (IRAC) http://www.irac-online.org/ [Accessed 26 Oct 2021]

10. Fungicide Resistance Action Committee (FRAC) http://www.frac.info/home [Accessed 26 Oct 2021]

11. Herbicide Resistance Action Committee (HRAC)

http://hracglobal.com/ [Accessed 26 Oct 2021]

12. Annual Survey of Hours and Earnings (ASHE) 2020 (Table 3.5a) https://www.ons.gov.uk/employmentandlabourmarket/peopleinwork/earningsandworkinghours/datasets/regionbyoccupation2digitsocashetable3 [Accessed 26 Oct 2021]

13. Agricultural Statistics, Scotland 2020. HMSO, Edinburgh 2020

14. Wood, H.J. An Agricultural Atlas of Scotland. George Gill and Sons, London, 1931.

15. Directive 2009/128/EC of the European Parliament and of the Council (Retained EU law equivalent to the EU Sustainable Use Directive (2009/128/EC), Directive 2009/128/EC of the European Parliament and of the Council of 21 October 2009 establishing a framework for Community action to achieve the sustainable use of pesticides (Text with EEA relevance) (legislation.gov.uk) [Accessed 26 Oct 2021]

16. Scottish Quality Crops Manual https://www.sqcrops.co.uk/uploaded/documents/1603703574.pdf [Accessed 26 Oct 2021]

# Pesticide Usage in Scotland

# Potato Stores 2020

**G. Reay, C. Davis, C. Monie & J. Wardlaw**

SASA

Roddinglaw Road, Edinburgh, Scotland, EH12 9FJ

psu@sasa.gov.scot

www.sasa.gov.uk/pesticides

## Executive summary

This report presents information from a survey of pesticide use on stored potatoes harvested in Scotland in 2020. Data were collected from 81 growers, who collectively cultivated 33 per cent of the area of potatoes grown in Scotland. Pesticide use in potato stores was recorded for crops grown for seed production and for consumption (ware potatoes). Ratio raising was used to produce estimates of national pesticide usage from the sample data.

The overall estimated quantity of potatoes stored in 2020 was 987,615 tonnes (as of end of November). There has been a significant change in survey estimation methodology which must be taken into account when comparing storage data from this survey and previous surveys. When this methodological change is accounted for, the total tonnes stored in 2020 is 13 per cent higher than in the previous survey in 2018. Seed potato storage increased by 25 per cent to ca. 391,100 tonnes, influenced by slower domestic and non-EU seed sales. Ware potato storage increased by six per cent to ca. 596,400 tonnes when compared to the previous survey. This increase in storage is also possibly influenced by covid restrictions, which depressed consumer demand for ware potatoes during 2020.

Sixty per cent of seed and 86 per cent of ware potatoes sampled in 2020 were stored in refrigerated stores. The majority of the remaining stores were ambient ventilated stores. All the potatoes surveyed were stored in boxes.

The proportion of seed potatoes treated with a pesticide in 2020 was 39 per cent, this is within the range of estimated use in previous surveys (28 per cent treated in 2018 and 47 per cent treated in 2016 and 2014). However, the proportion of stored ware potatoes treated with a pesticide was six per cent, approximately half that of the 13 per cent in 2018 and 11 per cent in 2016.

As in 2018, the principal pesticide encountered on seed potatoes was the fungicide imazalil applied to an estimated 38 per cent of the stored crop for control of a range of tuber diseases. The only other pesticide encountered was the fungicide thiabendazole, applied to four per cent.

The principal pesticide used on ware potatoes in 2020 was the growth regulator ethylene applied to an estimated four per cent of the stored ware crop, compared with eight per cent in 2018 and one per cent in 2016. This is the first survey since the withdrawal of the growth regulator Chlorpropham which had a final use of date of 8$^{th}$ October 2020. Chlorpropham had been the principal active substance in 2018 and 2016 (applied to 11 and 17 per cent respectively). The sprout suppressant spearmint oil was applied to an estimated two per cent of the stored ware potato crop in both 2020 and 2018. Less than 0.5 per cent of the stored crop was treated with a fungicide in 2020.

## Introduction

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

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

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

The Scottish Pesticide Usage reports have been designated as Official Statistics since August 2012 and as National Statistics since October 2014. The Chief Statistician (Roger Halliday) acts as the statistics Head of Profession for the Scottish Government and has overall responsibility for the quality, format, content and timing of all Scottish Government national statistics publications, including the pesticide usage reports. 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 the survey unit webpage:

http://www.sasa.gov.uk/pesticides/pesticide-usage

### 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 2020 pesticide usage section summarises pesticide use on stored potatoes in 2020. Appendix 1 presents estimated pesticide usage data. Appendix 2 summarises survey statistics including census and holding information, raising factors and the financial burden to farmers. Appendix 3 defines many of the terms used throughout the report. Appendix 4 describes the methods used during sampling, data collection and analysis as well as measures undertaken to avoid bias and reduce uncertainty. Any changes in method from previous survey years are also explained.

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

## General trends

### Scottish potato storage

The total estimated quantity of potatoes stored in Scotland in 2020 was 987,615 tonnes. This is 11 per cent less than that reported in 2018[(3)] (1,105,891 tonnes) and 13 per cent less than in 2016[(4)] (1,140,286 tonnes). However, there has been a significant change in survey methodology which must be taken into account when comparing data from this survey and previous surveys (see Appendix 4 – changes from previous years for further information). The new method significantly reduces the estimated proportion of potatoes held in store. Had the new method been applied in 2018 the estimated quantity of potatoes stored in Scotland in 2018 would have been 875,687 tonnes. Therefore, the estimated quantity of potatoes stored in Scotland in 2020 was actually 13 per cent higher than in 2018 (Figure 1).

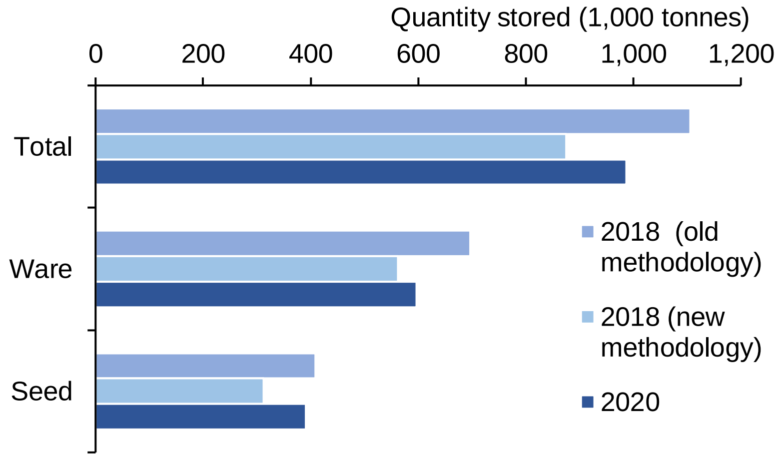
The quantity of seed potatoes stored in 2020 was estimated to be 391,208 tonnes (Table 1). Had the new methodology used in the current survey been applied in the previous survey in 2018, this would represent a 25 per cent increase in seed stored between 2020 and 2018 (Figure 1). AHDB reported that domestic and non-EU seed sales were very slow in 2020 resulting in higher storage figures as of the end of November as growers were unsure of their planting intentions as they held off to see what the impact of covid measures would be (AHDB pers.comm.). However, seed growers in Scotland were encouraged to export seed to the EU and NI early before these markets closed to them on the 1st of January 2021 following EU exit, although this only equates to approximately 15,500 tonnes (SPCS, SASA pers.comm.).

The estimated quantity of ware potatoes stored in 2020 was 596,407 tonnes. Had the new methodology been applied in the previous survey, there would have been an estimated 562,894 tonnes of ware potatoes stored in 2018. Therefore, there was an estimated six per cent increase in stored ware potatoes between 2018 and 2020 (Figure1). This increase in storage is possibly influenced by covid restrictions which depressed consumer demand for ware potatoes during 2020. Data from AHDB suggest overall GB grower held potato stocks, as at the end of November 2020 were up 4.7 per cent on the 5 year average (2015-2019)[(5)].

As in 2018, all potatoes surveyed in 2020 were stored in boxes. In previous surveys, very few bulk stores were encountered (<0.5 per cent of stored crops in 2016). Seed crops were mainly held in refrigerated stores (60 per cent) with the remainder in ambient ventilated stores (39 per cent) and a very small proportion in unventilated stores (<0.5 per cent). The majority of seed crops were also held in refrigerated stores in 2018 and 2016 (67 and 61 per cent respectively).

Ware potatoes were mostly refrigerated in 2020 (86 per cent) with the remaining 14 per cent in ambient ventilated stores. In previous surveys a very small proportion was encountered in unventilated stores (<0.5% in 2018). The proportion of ware potatoes held in refrigerated stores appears to be increasing with 86 per cent in 2020 compared to 80, 77 and 66 per cent of ware tubers held in refrigerated stores in 2018, 2016 and 2014 respectively.

### Figure 1 Estimated total potato storage in Scotland 2018-2020



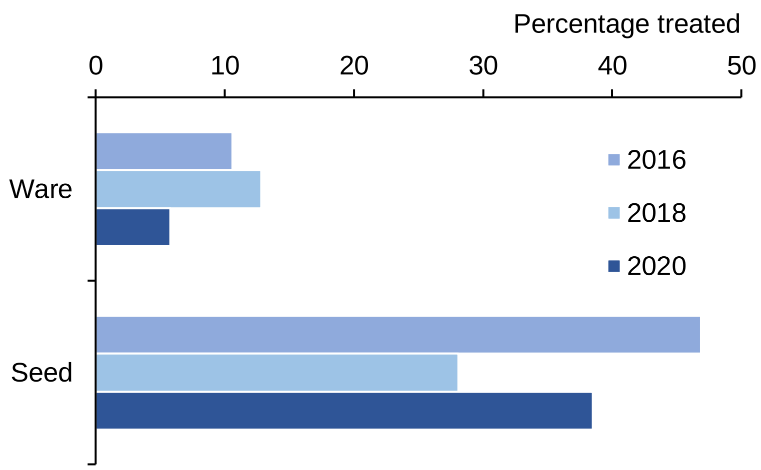

Please note, there has been a significant change in survey methodology which must be taken into account when comparing data from 2020 and previous surveys, see Appendix 4 for further information. The above figure presents the estimated total potato storage in Scotland for 2018 using both the previous and current methodology for comparison purposes.

## Pesticide usage

### Seed potatoes

The proportion of seed potatoes treated with a pesticide in 2020 was 39 per cent. This is within the range of estimated use in previous surveys (28 per cent treated in 2018 and 47 per cent treated in 2016 and 2014) (Figure 2). Pesticide use on seed potatoes in 2018 was considered to be low, with the assumption that this was influenced by the good quality of seed potatoes harvested that year.

**Figure 2 Percentage of stored potatoes treated with pesticides in Scotland 2016-2020**

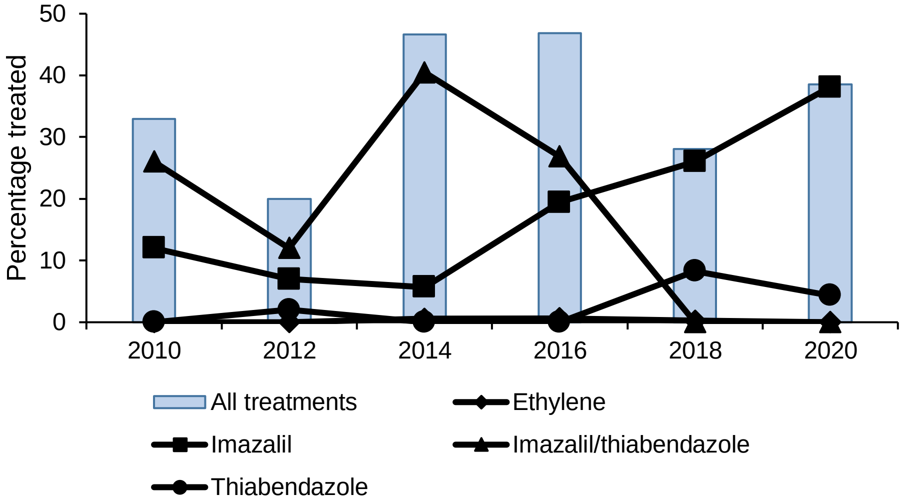



All of the pesticides used in seed potato stores in 2020 were fungicides (Figure 3, Table 2). In 2020 the most commonly used fungicide was imazalil applied to 38 per cent of the seed crops and thiabendazole applied to four per cent. In 2018, the most commonly used fungicide was also imazalil applied to 26 per cent of the crop and thiabendazole applied to eight per cent of the crop.

Prior to 2018 the most commonly used fungicide was a formulation of imazalil/thiabendazole which was applied to 27 per cent of stored seed in 2016 and 40 per cent in 2014. This imazalil/thiabendazole formulation lost approval in 2015 and had a final use date of June 2017. Since then, imazalil and thiabendazole have been applied as single active substance products in seed stores. Whilst imazalil use has increased over time, thiabendazole has not, this may be influenced by the occurrence of resistance to thiabendazole in some storage diseases[6].

Unlike previous surveys, where a small proportion (<1 per cent) of stored seed potatoes were treated with ethylene, no ethylene was recorded on stored seed potatoes in 2020. In these previous surveys, ethylene use on seed potatoes was only encountered in one commercial store which is no-longer operating. Ethylene, which is generated from ethanol, is not approved as a plant protection product for stored seed potatoes. However, it is approved as a commodity substance for plant growth regulation for post-harvest crops under COPR[7].

## Figure 3 Percentage of stored seed potatoes treated with a pesticide in Scotland 2010-2020



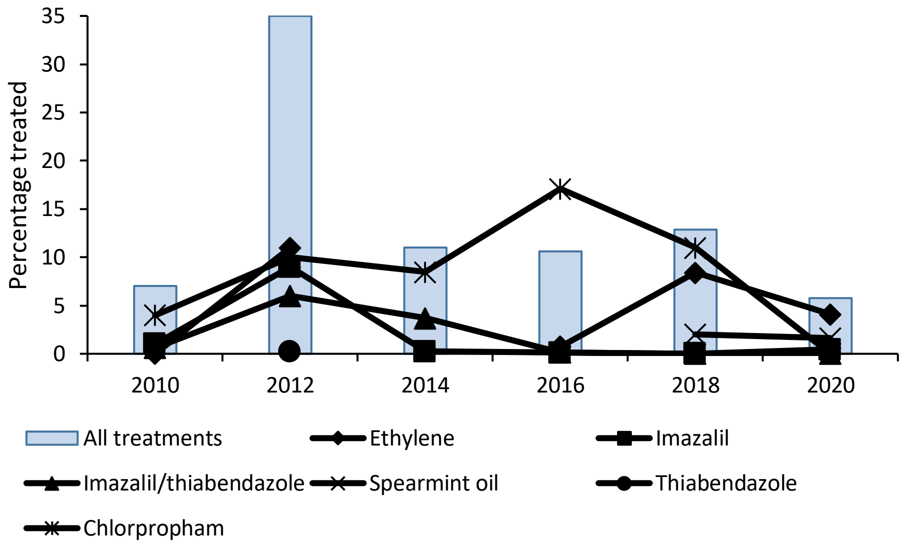

## Ware potatoes

The proportion of stored ware potatoes treated with a pesticide was six per cent, less than half that of the 13 per cent in 2018 and 11 per cent in 2016 (Figure 2). This may have been influenced by the reduced number of approved products available following the loss of the growth regulator active substance chlorpropham.

Less than 0.5 per cent of the stored crop was treated with a fungicide in 2020. Overall, the quality of crops lifted in Scotland was good in 2020 and the disease risk was generally low[8]. Historically, with the exception of 2012, which was an outlier, less than five per cent of stored ware potatoes have been treated with a fungicide over the last decade.

Almost all the pesticide used in ware stores were growth regulators (>99 per cent, Figure 4). This is the first survey since the withdrawal of Chlorpropham which had a final use of date of 8th October 2020. Chlorpropham had been the principal active substance in 2018 and 2016 (applied to 11 and 17 per cent respectively). Ethylene was applied to an estimated four per cent of the stored ware potato crop in 2020, compared with eight per cent in 2018 and one per cent in 2016. Spearmint oil, which is a sprout suppressant applied as a fog in store was applied to an estimated two per cent of the stored ware potato crop in both 2020 and 2018. Therefore, the loss of chlorpropham does not appear to have increased the use of other growth regulators in store during 2020. However, an increase in the use of maleic hydrazide, applied as a field treatment to prevent sprouting during storage was recorded in the 2020 Pesticide Usage in Arable Crop report. Maleic hydrazide was applied to eight per cent of the ware crop in 2020, compared to two per cent in 2018. Although it should be noted that the use of growth regulators has shown variation over time, as have the compounds encountered (Figure 4) and it is difficult to interpret trends within this data series.

**Figure 4 Percentage of stored ware potatoes treated with a pesticide in Scotland 2010-2020**



## 2020 Potato storage and pesticide usage

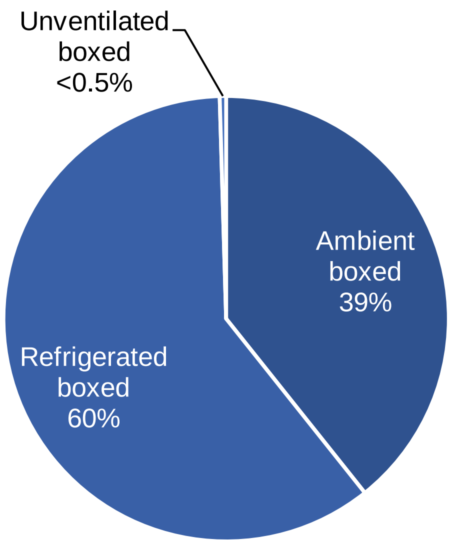
### Seed potatoes

- An estimated 391,208 tonnes of seed potatoes were stored in Scotland in 2020, compared with an estimated 312,793 tonnes stored in 2018 (calculated using new survey methodology)
- Sixty per cent of seed potatoes were stored in refrigerated stores, 39 per cent in ambient ventilated stores and less than one per cent in unventilated stores (Figure 5)
- All seed potatoes sampled in 2020 were stored in boxes
- Overall, 39 per cent of seed potatoes received a pesticide treatment in store
- The percentage of seed potatoes receiving an in-store pesticide treatment was 41 per cent in ambient ventilated stores and 37 per cent in refrigerated stores. No treatments were recorded on unventilated stores (Table 1)
- Two fungicides (imazalil and thiabendazole) were encountered in seed potatoes (summary below)
- Imazalil and thiabendazole are applied as sprays to tubers.
- Reasons for use were supplied for 81 per cent of the crop which was treated with fungicides. Twenty-five per cent for dry rot, 23 per cent for unidentified storage diseases 14 per cent for gangrene, 13 per cent for skin spot and six per cent for silver scurf

Summary of estimated pesticide use on seed potatoes in store:

| Pesticide formulation | Total tonnes treated | % Treated |
|---|---|---|
| **Imazalil** | 149,138 | 38 |
| **Thiabendazole** | 17,041 | 4 |

**Figure 5 Seed potato storage by type – 2020**



## Ware potatoes

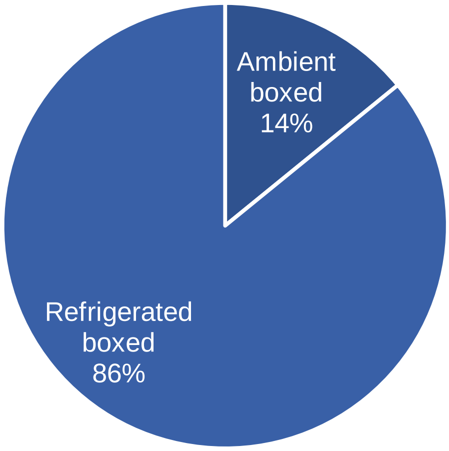
- An estimated 596,407 tonnes of ware potatoes were stored in Scotland in 2020. This is a six per cent increase compared with the estimated 562,894 tonnes stored in 2018 (calculated using new survey methodology)
- Eighty-six per cent of ware potatoes were stored in refrigerated stores and 14 per cent were stored in ambient ventilated stores. No ware potatoes were encountered during the 2020 survey in unventilated stores (Figure 6)
- All ware potatoes sampled were stored in boxes
- Six per cent of ware potatoes received a pesticide treatment in store
- The percentage of ware potatoes receiving an in-store pesticide treatment was six and one per cent in refrigerated stores and ambient ventilated stores respectively (Table 1)
- Two fungicides (thiabendazole & imazalil) and two growth regulators (ethylene & spearmint oil) were encountered in ware potato stores (summary below)
- Thiabendazole and imazalil are applied as a spray to tubers. Ethylene is applied as a gas, and spearmint oil is applied as a fog to stores.
- Reasons for use were supplied for five per cent of the crop which was treated with fungicides. Three per cent for dry rot and two per cent for general disease control
- The only specified reason for use of growth regulators was sprout suppression

Summary of estimated pesticide use on ware potatoes in store:

| Pesticide formulation | Total tonnes treated | % Treated |
|---|---|---|
| **Ethylene** | 24,497 | 4 |
| **Imazalil**(1) | 2,617 | 0.4 |
| **Spearmint oil** | 9,704 | 2 |
| **Thiabendazole** | 8 | 0.001 |

(1) This formulation is not approved on ware potatoes. It was applied to seed crops which were later reclassified as ware.

**Figure 6 Ware potato storage by type – 2020**



# Appendix 1 – Estimated application tables

## Table 1 Potatoes stored, and proportion treated, by storage type - 2020

| | Store Type | | | Total |
|---|---|---|---|---|
| | Unventilated | Ventilated | Refrigerated | |
| **Seed** | | | | |
| **Tonnes stored** | 1,813 | 153,721 | 235,674 | 391,208 |
| **% type** | 0.5% | 39% | 60% | |
| | | | | |
| **Basic tonnes treated** | 0 | 63,629 | 87,000 | 150,629 |
| **% treated** | N/A | 41% | 37% | 39% |
| | | | | |
| **Ware** | | | | |
| **Tonnes stored** | 0 | 84,227 | 512,180 | 596,407 |
| **% type** | N/A | 14% | 86% | |
| | | | | |
| **Basic tonnes treated** | 0 | 1,241 | 33,233 | 34,474 |
| **% treated** | N/A | 1% | 6% | 6% |
| | | | | |
| **All stored potatoes** | | | | |
| **Tonnes stored** | 1,813 | 237,948 | 747,854 | 987,615 |
| **% type** | 0.2% | 24% | 76% | |
| | | | | |
| **Basic tonnes treated** | 0 | 64,870 | 120,233 | 185,103 |
| **% treated** | N/A | 27% | 16% | 19% |

N/A = not applicable

## Table 2 Potato storage treatment formulations by storage type – 2020

| | Store Type | | | Total tonnes treated | % Treated |
|---|---|---|---|---|---|
| | Unventilated | Ventilated | Refrigerated | | |
| **Seed** | | | | | |
| **Imazalil** | 0 | 62,883 | 86,254 | 149,137 | 38 |
| **Thiabendazole** | 0 | 2,041 | 14,999 | 17,040 | 4 |
| **Basic tonnes treated(2)** | 0 | 63,629 | 87,000 | 150,629 | 39 |
| **Ware** | | | | | |
| **Ethylene** | 0 | 0 | 24,497 | 24,497 | 4 |
| **Imazalil(1)** | 0 | 1,237 | 1,380 | 2,617 | 0.4 |
| **Spearmint oil** | 0 | 0 | 9,704 | 9,704 | 2 |
| **Thiabendazole** | 0 | 4 | 4 | 8 | 0.001 |
| **Basic tonnes treated(2)** | 0 | 1,241 | 33,233 | 34,474 | 6 |

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

## Table 3 Potato storage treatment active substances – 2020

| | Tonnes treated | kg |
|---|---|---|
| **Seed Potatoes** | | |
| **Imazalil** | 149,138 | 2,003 |
| **Thiabendazole** | 17,041 | 509 |
| **Ware** | | |
| **Ethylene** | 24,497 | N/A(1) |
| **Imazalil** | 2,617 | 31 |
| **Spearmint oil** | 9,704 | 684 |
| **Thiabendazole** | 8 | 0.3 |

N/A = not applicable
(1) The mass of ethylene used cannot be estimated (refer to Appendix 3 – definitions and notes)

## Table 4 Potato cultivation and storage, comparison with previous surveys – 2020

| | Crop | 2018 (estimated using old methodology) | 2018 (estimated using new methodology) | 2020 |
|---|---|---|---|---|
| **Area grown (ha)(1)** | Seed | 12,092 | 12,092 | 12,003 |
| | Ware | 15,268 | 15,268 | 16,294 |
| **Tonnes stored(2)** | Seed | 408,870 | 312,793 | 391,208 |
| | Ware | 697,021 | 562,894 | 596,407 |

(1) This is the census area of the crops intended to be grown for seed and ware production. Some of the seed crop was reclassified as ware post-harvest
(2) Please note, there has been a significant change in survey methodology which must be taken into account when comparing data from 2020 and previous surveys, see Appendix 4 for further information

## Table 5 Percentage of stored potatoes treated, comparison with previous surveys – 2020

| | Crop | 2016 | 2018 | 2020 |
|---|---|---|---|---|
| **Total tonnage treated (%)** | Seed | 47 | 28 | 39 |
| | Ware | 11 | 13 | 6 |

# Appendix 2 – Survey statistics

## Census and sample information

### Table 6 Distribution of sampled potato stores - 2020

Number of potato growers sampled in each region

| Region | | Number of stores |
|---|---|---|
| **North:** | Highlands & Islands, Caithness & Orkney, Moray Firth and Aberdeen | 15 |
| **Angus** | | 40 |
| **Central:** | East Fife, Central Lowlands and Lothian | 18 |
| **South:** | Tweed Valley, Southern Uplands and Solway | 8 |
| **Scotland** | | 81 |

### Table 7 Distribution of stored potatoes in sample - 2020

Quantity (tonnes) of potatoes sampled in each region

| Crop | North | Angus | Central | South | Scotland |
|---|---|---|---|---|---|
| **Seed potatoes** | 35,908 | 68,525 | 20,762 | 8,925 | **134,120** |
| **Ware potatoes** | 40,707 | 114,041 | 90,651 | 67,494 | **312,893** |
| **Total** | **76,615** | **182,566** | **111,413** | **76,419** | **447,013** |

### Table 8 Distribution of sampled areas – 2020

Areas (ha) of potatoes sampled in each region

| Crop | North | Angus | Central | South | Scotland |
|---|---|---|---|---|---|
| **Seed potatoes** | 940 | 2,126 | 773 | 285 | **4,124** |
| **Ware potatoes** | 908 | 1,667 | 1,515 | 1,205 | **5,294** |
| **Total** | **1,847** | **3,792** | **2,288** | **1,490** | **9,418** |

### Table 9 Distribution of census areas – 2020

Areas (ha) of potato crops grown in Scotland

| Crop | North | Angus | Central | South | Scotland |
|---|---|---|---|---|---|
| **Seed potatoes** | 4,171 | 5,551 | 1,721 | 560 | **12,003** |
| **Ware potatoes** | 1,579 | 7,785 | 5,066 | 1,864 | **16,294** |
| **Total** | **5,750** | **13,336** | **6,787** | **2,424** | **28,297** |

### Table 10 Raising factors – 2020

| Region | Seed | Ware |
|---|---|---|
| **North** | 4.4392 | 1.7397 |
| **Angus** | 2.6112 | 4.6714 |
| **Central** | 2.2255 | 3.3449 |
| **South** | 1.9656 | 1.5468 |

### Table 11 First adjustment factors for ware potatoes – 2020

| Region | Ware |
|---|---|
| **North** | 1.1924 |
| **Angus** | 0.9405 |
| **Central** | 0.9663 |
| **South** | 1.0043 |

### Table 12 Second adjustment factors – 2020

| Crop | Adjustment Factor |
|---|---|
| **Seed** | 0.9730 |
| **Ware** | 0.6065 |

## Financial burden to farmers

To minimise the burden on farmers and to comply with COVID-19 restrictions, the survey team used non-visit methods of collection such as email, post, or telephone call.

To determine the total burden that the 2020 Potato Storage survey placed on those providing the information, the surveyors recorded the time that 78 respondents spent providing the data during the surveys.  This sample represents 96 per cent of growers surveyed.  The median time taken to provide the information was 10 minutes.

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

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

(* using median “Full Time Gross” hourly pay for Scotland of £15.62)[13]

The total financial burden to all growers resulting from participation in the 2020 Potato Storage survey was calculated to be £210.87.

## Appendix 3 - Definitions and notes

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

18) In this report each estimated use of each pesticide is reported in three formats; tonnes treated with pesticide formulations (mixture of active substances in a product) and of individual active substances and quantities of active substance applied (Table 2 formulation data, Table 3 for active substance treated tonnes and quantity data). All three different formats are provided to satisfy the needs of all data users and allow them to assess pesticide use trends. Some users may be interested in use of pesticide products which contain a number of active substances, thus formulation data would be required. Other users are interested in particular active substances which may be formulated on their own or in combination with other active substances. Therefore, active substance data would be required. In addition, both quantity and tonnes treated with pesticides are important indicators of changes in use over time. Only single active substance formulations were encountered in 2020.

19) The **June Agricultural Census**(10) is conducted annually by the Scottish Government's Rural and Environmental Science Analytical Services (RESAS). The June Agricultural Census collects data on land use, crop areas, livestock and the number of people working on agricultural holdings. For this report the June Agricultural Census was used to draw a sample of growers growing the relevant crops to participate in the survey

20) 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(11). These are the areas which the sampled areas are raised to. Please see Appendix 4 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.

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

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

23) Data from the 2018(3) and 2016(4) surveys are provided for comparison purposes in some of the tables and figures. It should be noted that there may be changes in areas of seed and ware potatoes grown between survey years. Also, when comparisons are made between surveys it is important to take into account that there may be changes in quantity of potatoes stored.

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

# Appendix 4 – Survey methodology

## Sampling and data collection

The sample of farms used for this survey was the same as that for the Arable Crops 2020 survey. Using the June 2020 Agricultural Census[10], a sample was drawn representing arable cultivation in Scotland. The country was divided into 11 land-use regions (Figure 8). Each sample was stratified by these land-use regions and according to holding size. The holding size groups were based on the total area of arable crops grown. The sampling fractions used within both regions and size groups were based on the areas of relevant crops grown rather than number of holdings, so that smaller holdings would not dominate the sample.

Data relating to pesticide use in potato stores were collected from all potato growers encountered in the arable sample, either during an on-farm or telephone interview, or via e-mail. In instances where the potato land was let, and storage was on a separate holding, the potato grower was contacted individually to obtain storage details. Data were collected for all potatoes stored by these growers, not just for those crops grown on the holdings sampled. Therefore, the sample of stored potatoes relates to a greater area of potato cultivation than that for which field pesticide treatments were collected in the 2020 arable pesticide survey report. In total, data were collected from 81 growers. The crops grown by these growers represent 33 per cent of the total 2020 potato crop census area.

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

## Raising factors

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

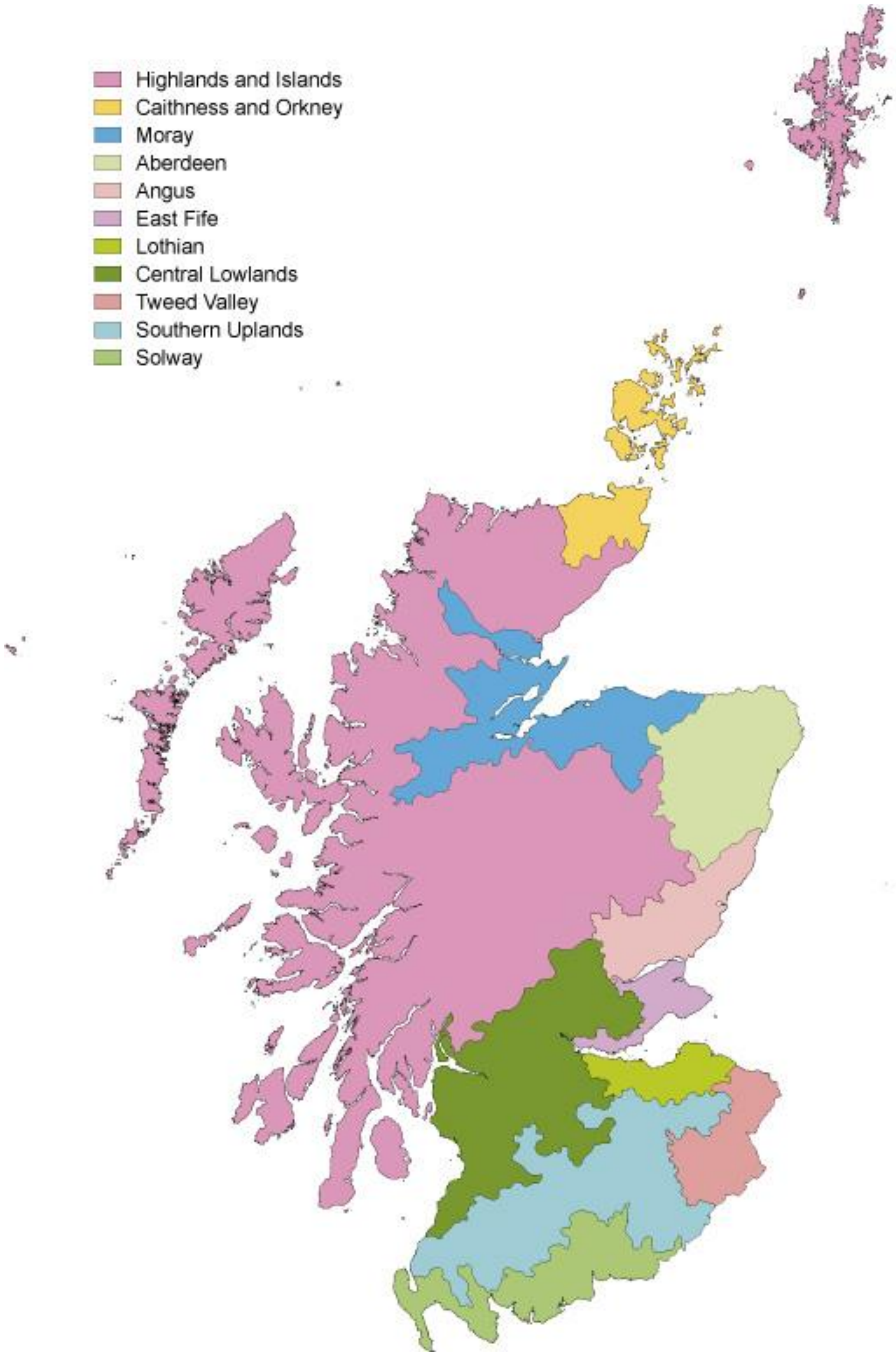
Due to the low numbers of potatoes grown and sampled in some geographic regions, stored data were amalgamated into four regions to allow more robust estimation of pesticide use: the North (Highlands & Islands, Caithness & Orkney, Moray Firth and Aberdeen), Angus (the main potato growing area in

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

### Changes from previous years

There has been a significant change in survey methodology which must be taken into account when comparing data from this survey and previous surveys. During the statistical estimation of national pesticide use on stored crops from the sample surveyed (see raising factor section) an adjustment is made to align the survey estimates of total tonnes stored with production estimates provided by AHDB potatoes. In the 2016 and 2018 surveys total storage tonnage was estimated from ADHB total potato production data, which were then adjusted by a standard estimation of the proportion of crops routinely held in store. This year, for the first time, AHDB was able to provide estimated tonnage of Scottish potato stocks held in store at the end of November. This is significantly less than the historic estimated proportion of potatoes held in store. AHDB reported that 95.7 per cent of GB seed production was held in store at the end of November. This percentage was applied to the 2020 Scottish Seed production figure (obtained using data from the Scottish Seed Potato Classification Scheme) to calculate the Scottish seed and ware storage figures. Had this new method been employed in 2018, this would have reduced the 2018 storage estimates by 23 per cent for seed potatoes and 19 per cent for ware potatoes. It is thought this new method will provide more accurate estimates of potato storage than the previous method which may have slightly overestimated Scottish Storage in the past. This change brings us in line with the method used for the UK Pesticide Use in Potato Store report. It should be noted however that the AHDB end of November stock figure is based on grower stock and excludes storage by processers etc. Please note whilst the new methodology impacts the estimates for the tonnes stored it does not impact the per cent of crop treated. No comparisons have been made in this survey to tonnes treated in previous surveys, discussion only relates to the per cent of crop treated.

**Figure 7 Land use regions of Scotland[11]**



## Acknowledgements

Thanks are due to all the growers who provided the information for this report. Thanks are also due to Alice Jones (AHDB) for information on Scottish potato production and Jackie Hughes (SASA) for editorial assistance. In addition, the authors are grateful for the support from Lewis Ridley and colleagues at Fera Science Ltd, Paul Gavin at the Scottish Government's Agricultural Census Analysis Team and to Adrian Roberts of Biomathematics & Statistics Scotland for support.

## References

1. Food and Environment Protection Act 1985: http://www.legislation.gov.uk/ukpga/1985/48 [Accessed 08 Oct 2021]

2. Regulation (EC) 1185/2009: Regulation (EC) No 1185/2009 of the European Parliament and of the Council of 25 November 2009 concerning statistics on pesticides (Text with EEA relevance) (legislation.gov.uk) [Accessed 08 Oct 2021]

3. Reay, G., Davis, C., Monie, C., & Wardlaw, J. (2019) Pesticide usage in Scotland: Potato stores 2018. Scottish Government https://www.sasa.gov.uk/document-library/arable-crops-and-potato-stores-2018 [Accessed 08 Oct 2021]

4. Hughes, J., Monie, C., Reay, G., & Wardlaw, J. (2017) Pesticide usage in Scotland: Potato stores 2016. Scottish Government https://www.sasa.gov.uk/document-library/arable-crops-and-potato-stores-2016 [Accessed 08 Oct 2021]

5. AHDB end-Nov stocks report https://ahdb.org.uk/news/end-of-nov-stocks-report [Accessed 08 Oct 2021]

6. SRUC Technical Note (2010) TN630 Potato Storage Diseases tn630-potato-storage.pdf (sruc.ac.uk) [Accessed 08 Oct 2021]

7. Control of Pesticides Regulations 1986: http://www.legislation.gov.uk/uksi/1986/1510/contents/made [Accessed 08 Oct 2021]

8. AHDB Potato Lifting Report: Week Ending – 20 October 2020 AHDB Potato lifting Report 2 - WE 20 10 2020.pdf (windows.net) [Accessed 08 Oct 2021]

9. Annual Survey of Hours and Earnings (ASHE) 2020 (Table 3.5a) https://www.ons.gov.uk/employmentandlabourmarket/peopleinwork/earningsandworkinghours/datasets/regionbyoccupation2digitsocashetable3 [Accessed 08 Oct 2021]

10. Agricultural Statistics, Scotland 2020. HMSO, Edinburgh 2020.

11. Wood, H.J. An Agricultural Atlas of Scotland. George Gill and Sons, London, 1931.

**A National Statistics Publication for Scotland**

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

Designation can be interpreted to mean that the statistics: meet identified user needs; are produced, managed and disseminated to high standards; and are explained well.

**Correspondence and enquiries**
For enquiries about this publication please contact:
Craig Davis,
Science and Advice for Scottish Agriculture (SASA),
Telephone: 0131 244 6364,
e-mail: psu@sasa.gov.scot

For general enquiries about Scottish Government statistics please contact:
Office of the Chief Statistician, Telephone: 0131 244 0442,
e-mail: statistics.enquiries@gov.scot

**How to access background or source data**

The data collected for this statistical publication:

☐ are available in more detail through Scottish Neighbourhood Statistics

☐ are available via an alternative route

☒ may be made available on request, subject to consideration of legal and ethical factors. Please contact psu@sasa.gov.uk for further information.

☐ cannot be made available by Scottish Government for further analysis as Scottish Government is not the data controller.

**Complaints and suggestions**

If you are not satisfied with our service or have any comments or suggestions, please write to the Chief Statistician, 3WR, St Andrews House, Edinburgh, EH1 3DG, Telephone: (0131) 244 0302, e-mail statistics.enquiries@gov.scot

If you would like to be consulted about statistical collections or receive notification of publications, please register your interest at www.gov.scot/scotstat

Details of forthcoming publications can be found at www.gov.scot/statistics

ISBN 978-1-80201-635-2 (Web only)

**Crown Copyright**

You may use or re-use this information (not including logos) free of charge in any format or medium, under the terms of the Open Government Licence. See: www.nationalarchives.gov.uk/doc/open-government-licence/

Scottish Government
Riaghaltas na h-Alba
gov.scot

© Crown copyright 2021

OGL

This publication is licensed under the terms of the Open Government Licence v3.0 except where otherwise stated. To view this licence, visit **nationalarchives.gov.uk/doc/open-government-licence/version/3** or write to the Information Policy Team, The National Archives, Kew, London TW9 4DU, or email: **psi@nationalarchives.gsi.gov.uk**.

Where we have identified any third party copyright information you will need to obtain permission from the copyright holders concerned.

This publication is available at **www.gov.scot**

Any enquiries regarding this publication should be sent to us at

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

ISBN: 978-1-80201-635-2 (web only)

Published by The Scottish Government, December 2021

Produced for The Scottish Government by APS Group Scotland, 21 Tennant Street, Edinburgh EH6 5NA
PPDAS975986 (12/21)