Survey of Crop Pests & Diseases

Summary of survey methodology

Report version:	v1
Date:	20 September 2024
Reason for update:	n/a
Report relating to:	Methodologies used in the Survey of Crop Pests and Diseases
Crops:	Wheat and oilseed rape (OSR)

1. Field selection

Approximately 250-300 commercial fields of winter wheat and approximately 85-100 fields of winter oilseed rape are surveyed each year from across England and Wales. The survey does not include crops in Scotland or Northern Ireland. Farms are selected at random from the annual June agricultural census returns. Participation in the survey is voluntary and no scrutiny is applied to the responses.

The number of fields surveyed is proportional to the area of crop grown in the region so that regional data do not require weighting in order to provide estimates of national disease severity. Regions which are sparsely populated with either wheat or OSR have sometimes been oversampled to provide a more reliable estimate of disease levels. The stratification also ensures that the farms sampled are representative of the distribution of arable farm size in England.

2. Regions

Data are amalgamated and reported as regional means (Table 1). Counties residing in each reporting region are detailed in Table 2.

Table 1. Reporting regions for wheat and oilseed rape crops

East
East Midlands
North East
North West
South East
South West
West Midlands
Yorkshire & Humber
Wales

Table 2. English counties and their associated reporting regions

County (International Territory Level 2)	Reporting region (International Territory Level 1)
Bedfordshire and Hertfordshire	East
Berkshire, Buckinghamshire and Oxfordshire	South East
Cheshire	North West
Cornwall and Isles of Scilly	South West
Cumbria	North West

Derbyshire and Nottinghamshire	East Midlands
Devon	South West
Dorset and Somerset	South West
East Anglia	East
East Wales	Wales
East Yorkshire and Northern Lincolnshire	Yorkshire and The Humber
Essex	East
Gloucestershire, Wiltshire and Bath/Bristol area	South West
Greater Manchester	North West
Hampshire and Isle of Wight	South East
Herefordshire, Worcestershire and Warwickshire	West Midlands
Inner London - East	South East
Inner London - West	South East
Kent	South East
Lancashire	North West
Leicestershire, Rutland and Northamptonshire	East Midlands
Lincolnshire	East Midlands
Merseyside	North West
North Yorkshire	Yorkshire and The Humber
Northumberland, and Tyne and Wear	North East
Outer London - East and North East	South East
Outer London - South	South East
Outer London - West and North West	South East
Shropshire and Staffordshire	West Midlands
South Yorkshire	Yorkshire and The Humber
Surrey, East and West Sussex	South East
Tees Valley and Durham	North East
West Midlands	West Midlands
West Wales and The Valleys	Wales
West Yorkshire	Yorkshire and The Humber

3. Schedule of assessments

The schedule of assessments has remained broadly consistent during the survey. The timing of assessments is triggered by crop growth stage rather than calendar date. The growth stage at which each assessment is carried out, along with the approximate time of year, is shown in Figure 1 and Table 3. Assessments are listed in chronological order.
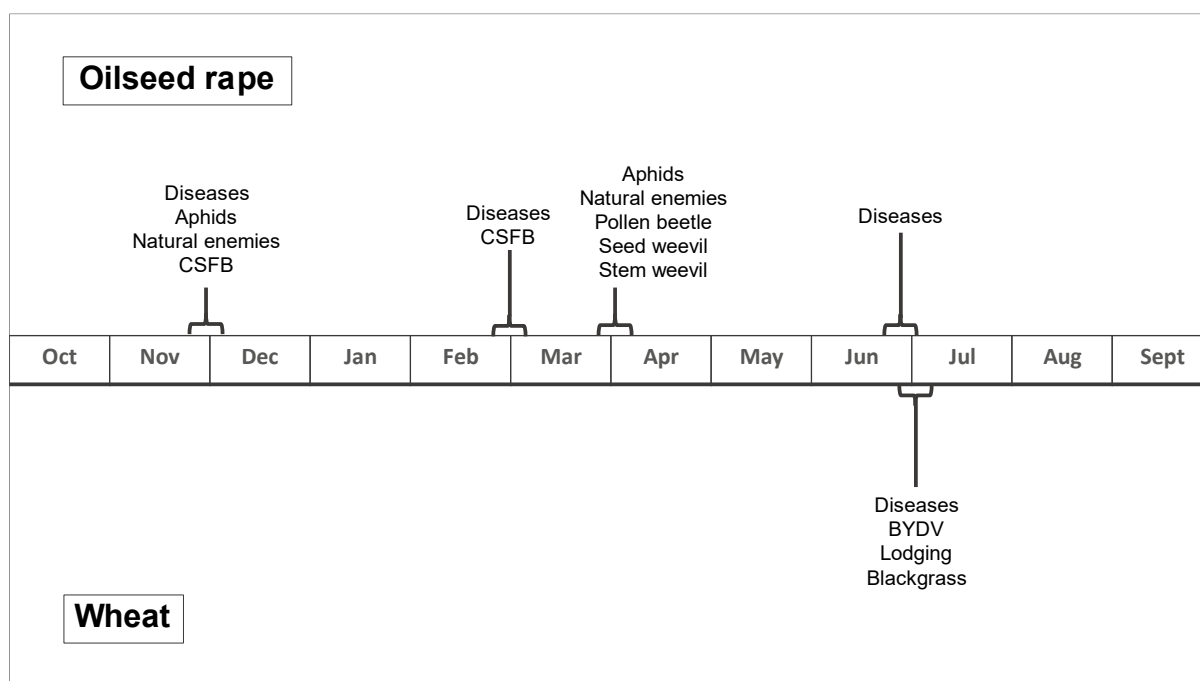
Figure 1. The current assessment timeline. Pointers show approximate timings in the year. Oilseed rape assessments are shown along the top row and wheat assessments are shown along the bottom row.

Table 3. Overview of the assessment timings

No.	Approximate date	Crop	Assessment(s)	Assess at crop growth stage
1	Mid-late Nov	Wheat	Aphids Natural enemies	GS 12-18 (one-eight leaves) BBCH 12-18
2	Late Nov – early Dec	OSR	Diseases Cabbage stem flea beetle Aphids Natural enemies	GS 1,5 -1,9 (mid-leaf production) BBCH 15-19
3	Late Feb - early March	OSR	Diseases Cabbage stem flea beetle	GS 2,2 – 2,5 (early stem extension) BBCH 32-35
4	Late March - early April	OSR	Aphids Natural enemies Pollen beetle Seed weevil Stem weevil	GS 3,3 - 3,7 (green – yellow bud) BBCH 52-59
5	Mid-late June	OSR	Diseases	GS 6,3 – 6,5 (pod ripening, green/brown seed) BBCH 80-85
6	Late June - Early July	Wheat	Diseases BYDV Lodging Blackgrass	GS 73-75 (early - medium milk) BBCH 73-75

4. Field sampling

Sample Officers select a random field from each farm to sample.

Wheat crops are sampled at GS 73-75 (early-medium milk) and sent to a central laboratory for assessment. 50 tillers are collected from separate random points along a diagonal traverse of the field, ensuring that each tiller is from a separate plant. The entire tiller including limited roots is sampled and kept intact. If a field has pure stands of more than one variety, the Sample Officer selects one variety by tossing a coin. If the crop is a blend then an equal number of tillers from each variety are sampled.

Oilseed rape crops are sampled on three occasions; at GS 1,5 -1,9 (mid-leaf production), GS 2,2 – 2,5 (early stem extension) and GS 6,3 – 6,5 (pod ripening, green/brown seed) and sent to a central laboratory for assessment. 30 whole plants are collected from separate random points along a diagonal traverse of the field. The entire plant including limited roots is sampled and kept intact. If a field has pure stands of more than one variety, the Sample Officer selects one variety by tossing a coin. If the crop is a blend then an equal number of plants from each variety are sampled.

5. Wheat disease assessment

Wheat crops are surveyed in summer, at GS 73-75 (early-medium milk) and 25 random tillers per field are assessed for disease. Values are kept separate for each tiller. Leaf 1 (flag leaf), leaf 2, leaf 3, leaf 4 (green leaf area only), stem and ear are inspected (Table 4).

Table 4. Overview of wheat diseases which are routinely assessed as part of the survey

Crop	Plant part	Disease	Pathogen	Scoring system
Wheat	Leaf	Septoria leaf blotch	*Zymoseptoria tritici*	% leaf area affected
Wheat	Leaf	Septoria nodorum	*Parastagonospora nodorum*	% leaf area affected
Wheat	Leaf	Microdochium spot	*Microdochium nivale & M. majus*	% leaf area affected
Wheat	Leaf	Ascochyta leaf scorch	*Didymella exitialis*	% leaf area affected
Wheat	Leaf	Yellow rust	*Puccinia striiformis*	% leaf area affected
Wheat	Leaf	Brown rust	*Puccinia triticina*	% leaf area affected
Wheat	Leaf	Powdery mildew	*Blumeria graminis*	% leaf area affected
Wheat	Leaf	Tan spot	*Pyrenophora tritici-repentis*	% leaf area affected
Wheat	Leaf	Leaf stripe	*Cephalosporium gramineum*	% leaf area affected
Wheat	Leaf	Green leaf area	Remaining green leaf area	% leaf area
Wheat	Stem	Eyespot	*Oculimacula yallundae & O. acuformis*	0-3 category
Wheat	Stem	Sharp eyespot	*Rhizoctonia cerealis*	0-3 category
Wheat	Stem	Fusarium on nodes	*Fusarium spp.*	0-3 category
Wheat	Stem	Fusarium on internodes	*Fusarium spp.*	0-3 category

Wheat	Roots	Take-all	*Gaeumannomyces tritici & G. avenae*	0-4 field patch score
Wheat	Ear	Glume blotch	*Parastagonospora nodorum*	% ear affected
Wheat	Ear	Microdochium	*Microdochium nivale & M. majus*	% ear affected
Wheat	Ear	Fusarium head blight	*Fusarium culmorum & F. graminearum*	% ear affected
Wheat	Ear	Fusarium poae	*Fusarium poae*	% ear affected
Wheat	Ear	Yellow rust	*Puccinia striiformis*	% ear affected
Wheat	Ear	Powdery mildew	*Blumeria graminis*	% ear affected
Wheat	Ear	Botrytis	*Botrytis cinerea*	% ear affected
Wheat	Ear	Sooty moulds	*Alternaria spp. & Cladosporium spp.*	% ear affected
Wheat	Ear	Bunt	*Tilletia tritici*	% ear affected
Wheat	Ear	Ergot	*Claviceps purpurea*	Count

5.1   Foliar diseases

All foliar diseases are scored as a percentage of the leaf area affected.

5.2   Stem diseases

5.2.1 Eyespot and sharp eyespot

Individual tillers are assessed for eyespot and sharp eyespot according to the key:

0 (Nil) = No lesions
1 (Slight) = Lesions girdling in total less than half the circumference of the stem
2 (Moderate) = Lesions girdling in total more than half the circumference of the stem
3 (Severe) = Lesions girdling more than half the circumference of the stem, with the tissue softened so that lodging would occur

5.2.2 Stem fusarium

From 1975 – 1989 individual tillers were assessed for stem fusarium according to the key:

a = No lesions
b = Nodal infection: dark brown/purple discolouration on lower nodes, usually with yellowing of associated leaf sheath
c = Internodal infection: vertical, streak-like, brown or black lesions or discolouration on lowest internodes
d = Nodal and internodal infection: both types of symptom occurring on same shoot

From 1990 onwards, individual tillers are assessed for nodal and internodal fusarium separately, according to the key:

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Nodal fusarium:

    0 (Nil) = No lesions

    1 (Slight) = Staining on one or more nodes but not covering the whole stem circumference

    2 (Moderate) = Staining on one or more nodes covering the whole stem circumference

    3 (Severe) = One or more nodes rotted, likely to cause lodging

Internodal fusarium:

    0 (Nil) = No lesions

    1 (Slight) = Slight streaks on stem base

    2 (Moderate) = General browning on stem base

    3 (Severe) = Stem base rotted, likely to cause lodging

5.3   Ear diseases

Ear diseases are scored as a percentage of the ear area affected, except for ergot which is a count of the number of ergots present in the ear.

Head blight scores include symptoms caused by a complex of fusarium species commonly found on the ear, including *F. graminearum, F. culmorum, F. avenaceum* and *F. tricinctum*. *Fusarium poae* is scored separately. Historically, symptoms caused by *Microdochium nivale* and *M. majus* were included under the 'Fusarium poae' score but from 2021 onwards microdochium has been scored separately.

5.3   Take-all

Take-all is scored on a 0-5 scale, at the field level. If white heads are seen the Sample Officer pulls up some of the affected plants and inspects the roots to confirm that take-all is the cause of the white head symptoms.

    0 = No take-all seen

    1 = A scatter of plants showing premature ripening

    2 = Occasional small patches of plants showing premature ripening (less than 5m across or less than 1% area of field)

    3 = Many small, or a few large areas affected (1-10% of the field area affected)

    4 = Many large areas affected (more than 10% of the field area affected)

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6. Oilseed rape disease assessment

Oilseed rape crops are surveyed in autumn (GS 1,5 -1,9 (BBCH 15-19)), spring ((GS 2,2 - 2,5 (BBCH 32-35)) and summer (GS 6,3 - 6,5 (BBCH 80-85) and 25 random plants per field are assessed for disease. Values are kept separate for each plant. Leaves, stems, pods and (limited) roots are inspected (Table 5).

Table 5. Overview of wheat diseases which are routinely assessed as part of the survey

Crop	Plant part	Disease	Pathogen	Scoring system
OSR	Leaves	Phoma A leaf spot	*Plenodomus lingam*	% leaf area affected
OSR	Leaves	Phoma B leaf spot	*Plenodomus biglobosa*	% leaf area affected
OSR	Leaves	Light leaf spot	*Pyrenopeziza brassicae*	% leaf area affected
OSR	Leaves	White leaf spot	*Mycosphaerella capsellae*	% leaf area affected
OSR	Leaves	Dark leaf spot	*Alternaria brassicae & A. brassicicola*	% leaf area affected
OSR	Leaves	Downy mildew	*Hyaloperonospora parasitica*	% leaf area affected
OSR	Leaves	Powdery mildew	*Erysiphe cruciferarum*	% leaf area affected
OSR	Leaves	Botrytis	*Botrytis cinerea*	% leaf area affected
OSR	Leaves	Ringspot	*Mycosphaerella brassicicola*	% leaf area affected
OSR	Stem	Phoma canker	*Plenodomus lingam*	0-4 category
OSR	Stem	Phoma stem lesions	*Plenodomus biglobosa*	0-4 category
OSR	Stem	Light leaf spot	*Pyrenopeziza brassicae*	% stem area affected
OSR	Stem	Alternaria	*Alternaria brassicae & A. brassicicola*	% stem area affected
OSR	Stem	Downy mildew	*Hyaloperonospora parasitica*	% stem area affected
OSR	Stem	Powdery mildew	*Erysiphe cruciferarum*	% stem area affected
OSR	Stem	Grey mould	*Botrytis cinerea*	0-4 category
OSR	Stem	Verticillium wilt	*Verticillium longisporum*	0-4 category
OSR	Stem	Sclerotinia stem rot	*Sclerotinia sclerotiorum*	0-4 category
OSR	Pods	Phoma pod spot	*Plenodomus lingam*	% pod area affected
OSR	Pods	Light leaf spot	*Pyrenopeziza brassicae*	% pod area affected
OSR	Pods	White leaf spot	*Mycosphaerella capsellae*	% pod area affected
OSR	Pods	Dark pod spot	*Alternaria brassicae & A. brassicicola*	% pod area affected
OSR	Pods	Downy mildew	*Hyaloperonospora parasitica*	% pod area affected
OSR	Pods	Powdery mildew	*Erysiphe cruciferarum*	% pod area affected
OSR	Pods	Grey mould	*Botrytis cinerea*	% pod area affected
OSR	Pods	Ringspot	*Mycosphaerella brassicicola*	% pod area affected
OSR	Pods	Sclerotinia	*Sclerotinia sclerotiorum*	% pod area affected
OSR	Roots	Clubroot	*Plasmodiophora brassicae*	0-4 category

6.1   Foliar diseases

All foliar diseases are scored as a percentage of the leaf area affected across the whole plant.

6.2   Stem diseases

Light leaf spot, alternaria, downy mildew and powdery mildew are assessed as the percentage of stem area affected.

Phoma canker, phoma stem lesions, sclerotinia, botrytis and verticillium wilt are assessed according to the key:

    0 = No disease
    1 = Less than half stem girdled by lesion (+/- penetration)
    2 = More than half stem girdled by lesion (+/-penetration)
    3 = Whole stem girdled by lesion (+/- penetration)
    4 = Plant dead

6.3   Pod diseases

All pod diseases are scored as the percentage of the pod area affected across the whole plant.

6.4   Root diseases

Individual plants are scored for clubroot according to the key:

    0 = roots healthy, no visible symptoms
    1 = slight symptoms, few small galls on lateral roots, tap root not affected
    2 = mild symptoms, galls on lateral roots, tap root not affected
    3 = moderate symptoms, galls on lateral and tap root
    4 = severe symptoms, tap root severely affected

7.   Disease data parameters

Disease data are expressed in three ways:

7.1   Crop incidence

Crop incidence is the percentage of surveyed fields that are affected by a specific disease. There is no threshold, if the disease is found in the surveyed field the crop is considered infected.
    e.g. Septoria was found in 82% of surveyed fields nationally.
    e.g. Light leaf spot was found in 50% of fields surveyed in the south-west region.

Crop incidence values are calculated:

Crop incidence = <u>No. fields with disease symptoms</u> *100
                total No. surveyed fields

Worked example:

Crop incidence = <u>163 fields with yellow rust on leaf 1</u> *100
                         250 surveyed fields

Therefore, crop incidence for yellow rust on leaf 1 = 65.2%

7.2   Plant incidence

Plant incidence is the percentage of plants within a field that are affected by a specific disease.
      e.g. Yellow rust was found on 24% of plants.
      e.g. 34% of plants in the east showed phoma leaf spot symptoms.

Plant incidence values are calculated:

Plant incidence = <u>No. plants within the sample showing disease symptoms</u> *100
                            total No. plants in the sample

Worked example:

Plant incidence = <u>8 samples with phoma leaf spot</u> *100
                                      25

Therefore, plant incidence for phoma leaf spot = 32%

7.3   Disease severity

Disease severity is the percentage of plant part affected by a specific disease.
      e.g. Nationally, brown rust covered 3% of leaf 2.
      e.g. 15% of the stem was covered with powdery mildew in the north-east.

7.3.1 Percentage plant part affected

Where disease has been scored as a percentage of the plant part affected then mean severity is calculated as a simple arithmetic mean across the 25 plants in the sample.

7.3.2 Category scales – disease severity index

Where disease has been scored according to a category scale then results are usually expressed as a disease index (0-100).

      e.g. Eyespot severity was 31%

Disease severity values are calculated:

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Disease index $\quad = \quad \dfrac{N1 + (N2 * 2) + (N3 * 3)}{\text{Number of plants in sample}} \quad x \quad \dfrac{100}{3}$

Where: N1 = Number of plants in the slight category (category 1)

N2 = Number of plants in the moderate category (category 2)

N3 = Number of plants in the severe category (category 3)

Worked example: out of 25 plants assessed for eyespot, 12 had no symptoms, 6 showed slight symptoms, 4 had moderate symptoms and 3 expressed severe symptoms.

Disease index $\quad = \quad \dfrac{6 + (4* 2) + (3 * 3)}{\text{Number of plants in sample}} \quad x \quad \dfrac{100}{3}$

Therefore, disease severity for eyespot = 30.7%

If a 0-4 category key is used the equation is adapted:

Disease index $\quad = \quad \dfrac{N1 + (N2 * 2) + (N3 * 3) + (N4 * 4)}{\text{Number of plants in sample}} \quad x \quad \dfrac{100}{4}$

Where: N1 = Number of plants in category 1

N2 = Number of plants in category 2

N3 = Number of plants in category 3

N4 = Number of plants in category 4

7.3.3 Category scales – plants affected in each category

Where disease has been scored according to a category scale it may be preferable to express results as the percentage of plants affected in each infection category, rather than converting the data to a severity index.

e.g. 24% of stems showed slight symptoms of eyespot

Worked example: out of 25 plants assessed for eyespot, 12 had no symptoms, 6 showed slight symptoms, 4 had moderate symptoms and 3 expressed severe symptoms.

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Slight eyespot = No. stems in category 1 (slight) * 100
                                    total No. stems in sample

Slight eyespot = 6 *100
                        25

Slight eyespot = 24%

7.3.4 Stem fusarium data collected 1975 – 1989

From 1975 – 1989 individual tillers were assessed for stem fusarium according to the key:

a = No lesions
b = Nodal infection: dark brown/purple discolouration on lower nodes, usually with yellowing of associated leaf sheath
c = Internodal infection: vertical, streak-like, brown or black lesions or discolouration on lowest internodes
d = Nodal and internodal infection: both types of symptom occurring on same shoot

Disease severity index data are not calculated for fusarium 1975 – 1989. Instead:

Total nodal fusarium = No. stems in category b + No. stems in category d * 100
                                        total No. stems in sample

Total internodal fusarium = No. stems in category c + No. stems in category d * 100
                                            total No. stems in sample

We note there are anomalies in the fusarium stem data in 1978 and 1979 and we caution against their inclusion in data analysis.

8. Collecting agronomic information

Agronomic and pesticide input information is collected for each surveyed field via a questionnaire that is completed at the end of the season (Appendix 1 and 2). Yield and fertilizer input data are not collected as part of the survey.

9. References

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Appendix 1. Wheat questionnaire

Winter Wheat Questionnaire

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If you have any difficulty in completing the information please contact your sample collector.

This questionnaire is being sent to you using an address list compiled from information collected as part of the June Survey of Agriculture. No disclosure of identities or addresses of farmers has been made to the team commissioning the despatch of the survey.

Sample No:.............................

1. Farmer's name and address:

....

....

....

....

Name of collector:

....

Office:.............. Tel:..............................

Date sampled: ....

Growth stage: ....

2. C/P/H No:...

3. Field name or number:...

4. Grid ref: ....

5. Area of field (ha): ....

6. Variety: ....

7. Was disease resistance a factor in selecting this variety?   Yes ☐ No ☐

8. Sow date ....

9. Previous crop: 2023 .... 2022 .... 2021 .... 2020 ....
[Please state whether winter (w) or spring (s) sown]

10a.   Cultivations   (tick   box)   **10b.** Previous crop debris (tick box)

Conventional plough	☐	Baled & removed	☐
Shallow plough	☐	Chopped & incorporated	☐
Reduced cultivation	☐	Nothing	☐
Direct drilled	☐		

Please return completed form to: pestanddiseasesurvey@adas.co.uk

🔒 ADAS processes personal data according to Data Protection Act 2018 (GDPR). For further information about how your data will be processed please contact the ADAS Project Manager

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Please record all seed treatments and sprayed inputs to the crop, i.e. **herbicides, fungicides, insecticides and growth regulators**. Please **do not** include adjuvants or trace elements.

Seed		**Sample No**: ....
☐ Farm saved	☐ Certified	**Farm**:...........................

Seed treatments

☐ None	☐ Difend	☐ Latitude XL	☐ Signal 300 ES
☐ Beret Gold	☐ Difend Extra	☐ Rancona i-mix	☐ Vibrance Duo
☐ Celest Extra	☐ Fountain	☐ Rancona 15 ME	
☐ Celest Trio	☐ Langis 300 ES	☐ Redigo	
☐ Conima	☐ Latitude	☐ Redigo Pro	

☐ Other (please specify)..

Was the crop irrigated? ... Yes ☐   No ☐

Pre-harvest glyphosate

Do you intend applying a pre-harvest glyphosate treatment: ☐ Yes ☐ No

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PLEASE COMPLETE THIS SHEET AS COMPREHENSIVELY AS POSSIBLE AS IT IS ONE OF THE MOST IMPORTANT PARTS OF THE SURVEY.

We are happy to receive printouts from farm management software as an alternative. If this is the preferred option please email the field print out .pdf to pestanddiseasesurvey@adas.co.uk

Please be assured that there will never be any scrutiny of the pesticide data in terms of regulation and **individual farm data will not be identified**.

Spray applications

Please record all pesticide and growth regulator sprays, use full brand name. Please state NONE if none used. Information for adjuvants and trace elements is not required.

Product	Dose	Application date	Growth stage
PRE-DRILLING			
1.			
2.			
PRE-EMERGENCE			
1.			
2.			

POST-EMERGENCE

Product	Spray type F (fungicide) H (herbicide) I (insecticide) G (growth regulator)	Dose	Application date	Growth stage
1.				
2.				

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Appendix 2. Oilseed rape questionnaire

Oilseed Rape Questionnaire

If you have any difficulty in completing the information please contact your sample collector.

This questionnaire is being sent to you using an address list compiled from information collected as part of the June Survey of Agriculture. No disclosure of identities or addresses of farmers has been made to the team commissioning the despatch of the survey.

Name of collector:..

Office................................Tel. No.......................................

Sample no..........................Date of sample.......................

Farmer ....   Field Identity: ....

Address:...   OS Grid reference (6fig.):............................

....

....

....

....

....

Area of field: ....
(please state whether ha or ac):

Please tick the box(es) which describes the most appropriate actions taken when applying your fungicides;

Variety: ....

You saw a disease problem yourself.   ☐

The sprays were part of a routine spray programme used whether a disease was present or not - as an insurance   ☐

Sowing date:......................................

You were advised to apply a spray.   ☐

Past cropping:

2023: ....   2022: ....   2021: ....   2020: ....

Distance from last year's rape crop: adjacent/distant *   ***delete as appropriate**

Cultivation / establishment technique:

Direct drill	☐	Auto cast	☐	Plough (Conventional)	☐
Sub cast	☐	Minimum tillage	☐	Shallow plough	☐

Please return completed form to: pestanddiseasesurvey@adas.co.uk

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DEFRA WINTER OILSEED RAPE: PEST AND DISEASE MONITORING

PESTICIDE QUESTIONNAIRE

Name of collector.......................................

Office.................................. Tel. No...................

Sample no............... Date of sample.............

Please give full product names wherever possible. If none applied please indicate by striking through box.

Seed Treatments

Full product name	(B)Broadcast (D) Drilled	Rate of application

Molluscicides

Date applied	Full product name	(B)Broadcast (D) Drilled	Rate of application

Pre-emergence and Foliar sprays. Please bracket together tank mixes.

Date applied	Growth stage applied; if unknown please indicate (L) Leaf production, (S) Stem extension, (B) Bud development, (F) Flowering, (P) Post flowering	Full product name	(F) Fungicide (I) Insecticide (H) Herbicide (GR) Growth regulator (D) Desiccant	Rate of application
1.				
2.				
3.				
4.				
5.				
6.				
7.				
8.				
9.				
10.				
11.				
12.				
13.				

Please return completed form by **31 August** to pestanddiseasesurvey@adas.co.uk

Department for Environment Food & Rural Affairs

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PEST & DISEASE SURVEY