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Autumn Survey of wheat bulb fly incidence (2012–13)

by

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This is the autumn 2013 report of a 35 month project (RD-2011-3758) which started in August 2011. The work was funded by a contract for £21,450 from HGCA over 35 months.

CONTENTS

1. ABSTRACT

All cereals, except oats, can be attacked by wheat bulb fly. Eggs are laid in late summer in bare soil following fallows, set-aside or early-harvested crops such as vining peas, particularly if fields are cultivated between mid-July and mid-August. Fields cropped with root crops such as sugar beet, potatoes and onions are also favoured as egg laying sites as the pest can access bare soil between the rows. Wheat bulb fly is most prevalent in eastern England, the East Midlands and north-eastern England.

Egg numbers can be estimated by soil sampling and related to threshold levels of 250 eggs/m² (2.5 million eggs/ha) for late-autumn drilled crops, or 100 eggs/m² (1.0 million eggs/ha) for crops sown from late-November onwards.

A total of 30 fields were selected for sampling in September 2013 in areas prone to wheat bulb fly. A total of 15 sites were sampled in eastern England and 15 in northern England. The sites were chosen to represent some of the main preceding crops leading to a risk of wheat bulb fly damage in each area.

In autumn 2013, 7% of fields from the total of 30 surveyed in eastern and northern England contained egg numbers greater than 250/m². The overall risk in 2013 is the third lowest recorded since 1984 and well below the mean of 22% of sites over threshold for the period 1984-2013. In 1995 and 2012 there were also only 3% of sites above threshold and in 1994 only 6% of sites were above threshold.

Over all sites, the highest risk was after seed potatoes with a mean of 284 eggs/m^2 although only one site was sampled. The next highest risk was after potatoes with 158 eggs/m^2. All other crops had mean egg counts of less than 100 eggs/m^2. It seems likely that the low egg counts in 2012 combined with the cold, wet weather in January to March 2013 resulted in low numbers of larvae locating a host plant. The dry summer was also unfavourable for egg production and oviposition by adult flies. Egg numbers in the north were higher than in the east. The mean egg counts for these two regions were 129/m^2 and 76/m^2 respectively. In the north 14% of sites had egg numbers above the 250/m^2 threshold whereas in the east none of the sites were above this level.

Therefore, wheat bulb fly will probably pose a limited threat to crops sown before November in the 2013/14 season. Later sown or slow developing crops will still potentially be at risk if they have only one or two tillers at the time of wheat bulb fly egg hatch in January/February. For these crops a lower threshold of 100 eggs/m^2 or 1 million/ha is applicable. In both the East and North of England, 40% of monitored sites were above this level. These sites would benefit from an insecticide seed treatment.

2. TECHNICAL DETAIL

2.1. Introduction

All cereals, except oats, can be attacked by wheat bulb fly. Eggs are laid in late summer in bare soil following fallows, set-aside or early-harvested crops such as vining peas, particularly if fields are cultivated between mid-July and mid-August. Fields cropped with root crops such as sugar beet, potatoes and onions are also favoured as egg laying sites as the pest is able to access bare soil between the rows (Oakley, 2003). The pest is most prevalent in eastern England, the East Midlands and north-eastern England. In outbreak years, more widespread damage occurs.

Eggs are laid in late July and August in England and up to mid-September in Scotland and remain dormant throughout late autumn and early winter. The larvae hatch between January and March. Soon after hatching, the larvae invade shoots of cereal crops and the attacked shoots eventually die back to show 'deadheart' symptoms of damage.

The level of risk each year fluctuates greatly, due mainly to July and August rainfall (Young and Cochrane, 1993) and the harvest dates of the previous wheat crops. The longer crops remain in the ground, the longer adult flies have to feed on saprophytic fungi within the cereal ears and mature their eggs. Incidence generally increases following a wet harvest period such as in 2004 and is lowest after a hot, dry summer such as in 1995. The proportion of fields having an egg count greater than 250 eggs/m² threshold ranged from 3 to 44% in the period 1984–1999 (Oakley and Young, 2000) and 9–50% between 2000 and 2008 (Figure 1). The 2012/13 season had the equal lowest mean number of wheat bulb fly eggs since monitoring began in 1984. Only 3% of sites had more than the 250 million eggs/ha threshold. Consequently, 2012/13 was initially considered to be a low risk season for wheat bulb fly. This forecast was revised in January/February 2013 when it became clear that poor weather in autumn 2012 had delayed drilling and emergence of wheat crops. Wheat bulb fly larvae invade wheat tillers and their feeding results in tiller death and 'deadheart' symptoms. As many crops had only one or two shoots at the time of wheat bulb fly egg hatch they were considered particularly susceptible to the stem boring larvae of the pest. Ultimately, this threat failed to materialise probably because heavy rain, snow and freezing temperatures in January/February 2013 killed many larvae before they were able to locate a host plant.

There has been much speculation about the wheat bulb fly threat for the 2013/14 season. Poor establishment of crops following the poor growing conditions in autumn/spring 2012/13 resulted in a number of very patchy crops and potentially created more areas of bare soil where wheat bulb fly could lay its eggs. Therefore it has been argued that there will be high numbers of wheat bulb fly

eggs. The literature suggests that egg numbers tend to be highest when harvest is delayed by wet weather. This allows fungi to develop in wheat ears which provide a food source for adult wheat bulb flies. With an abundant source of food, it is thought that flies are then able to develop and lay more eggs than they could under drier conditions. As the 2013 harvest period was much drier in comparison with 2012 it might be expected that egg numbers will be low. Also as last year was such a low risk year it could be argued that this year will be similar as it will take populations time to recover from such a low level. Overall it is difficult to predict egg numbers and this highlights the value of the HGCA survey in that it provides valuable information to help risk assessment for a potentially very damaging pest. Publication in ADAS Crop Action also helps to widen the circulation of the final results.

Egg numbers can be estimated by soil sampling and related to threshold levels of 250 eggs/m² (2.5 million eggs/ha) for late-autumn drilled crops, or 100 eggs/m² (1.0 million eggs/ha) for crops sown from late-November onwards. At lower infestation levels, economic damage is less likely. Winter cereal crops sown from November onwards, or crops sown in spring before the end of March, are particularly vulnerable. Larvae attack shoots of wheat, barley and rye from January to April with yield loss depending on tiller density at the time of attack. Crops still at the single shoot stage in February are most vulnerable and may be completely destroyed (Young, 2000). Yield losses up to about 4 t/ha have been recorded following severe damage (Young and Ellis, 1996).

The options for control of wheat bulb fly have been reduced by pesticide reviews and withdrawals and are currently limited to a tefluthrin + fludioxinil seed treatment (Austral Plus), a cypermethrin seed treatment (Signal 300 ES) and a chlorpyrifos egg hatch spray. A single application of a dimethoate (Danadim Progress) can also be applied as a deadheart spray to kill the larvae in the plant. However, this is only permissible for product with the old MAPP number (12208) until March 2014. The new product (MAPP number 158970) does not have a WBF recommendation on the label. The future of dimethoate is also under review.

Seed treatment is the most effective option for later-sown crops, for example those at risk following crops such as potatoes, sugar beet, onions or red beet. Young (1992) demonstrated that November and December drillings of winter wheat were more vulnerable to wheat bulb fly damage than earlier sowings and are therefore more likely to benefit from the use of a preventive insecticidal seed treatment.

2.2. Materials and methods

A total of 30 fields were selected for sampling in September 2013 in areas prone to wheat bulb fly. A total of 15 sites were sampled in eastern England and 15 in northern England (Table 1). The

survey was stratified to represent some of the main preceding crops (Table 2) leading to a risk of wheat bulb fly damage in each area.

For each field sampled, 32 cores each of 7.2 cm diameter or 20 cores each of 10 cm diameter were taken to cultivation depth. Fields were sampled in a standard W sampling pattern. Wheat bulb fly eggs were extracted following soil washing and flotation in saturated magnesium sulphate. Egg numbers were expressed as number of eggs per m² (Tables 3–7).

Summary table 1. Location of sampling sites, by region and county.

Region	County	Number of fields sampled
Eastern England	Cambridgeshire	9
	North Lincolnshire	2
	Norfolk	2
	Suffolk	2
	Total	15
Northern England	North Lincolnshire	2
	East Yorkshire	7
	North Yorkshire	6
	Total	15

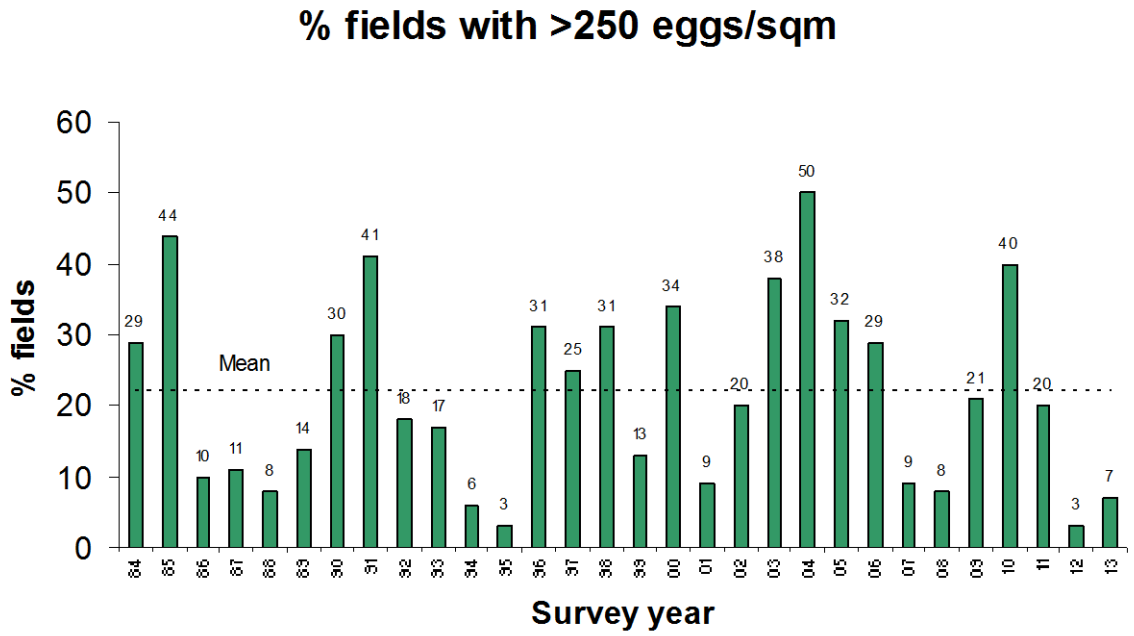
Table 2. Preceding crop or rotation for sampled fields.

Rotation	Eastern England	Northern England
Fallow	0	5
Onions	2	0
Oilseed rape	2	0
Peas (vining)	1	4
Potatoes	4	5
Seed potatoes	0	1
Sugar beet	6	0
Total	15	15

2.3. Results

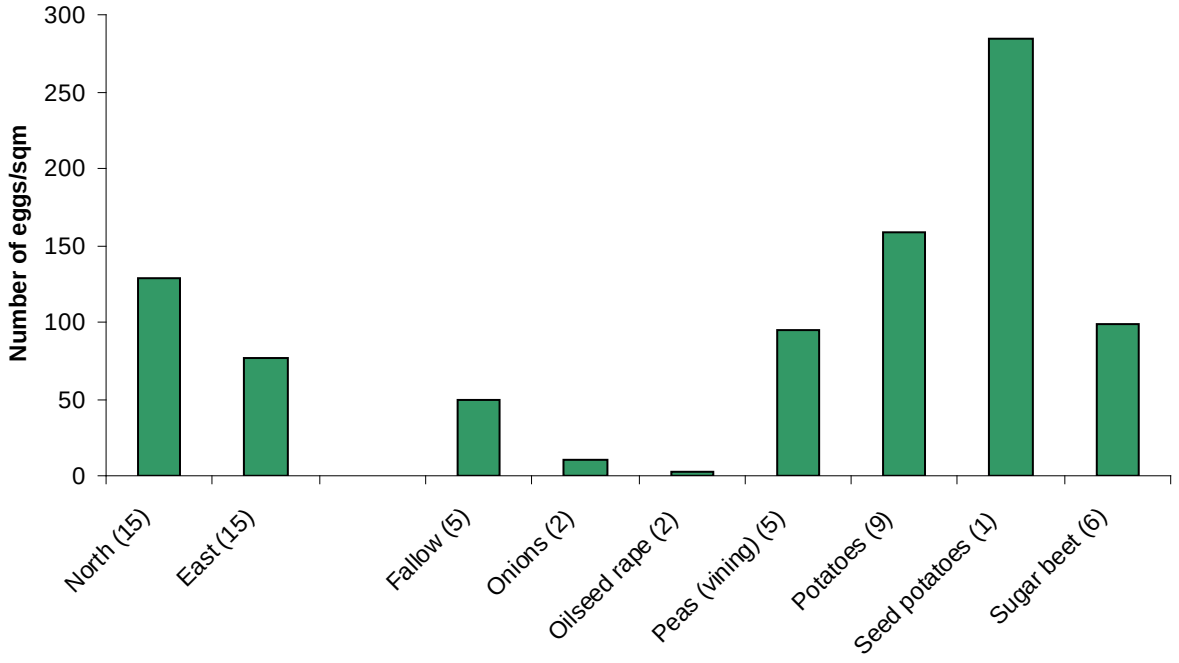
In autumn 2013, only 7% of fields from the total of 30 surveyed in eastern and northern England contained egg numbers greater than 250/m². The overall risk in 2013 is the third lowest recorded since 1984 and well below the mean of 22% of sites over threshold for the period 1984-2013. In 1995 and 2012 there were also only 3% of sites above threshold and in 1994 only 6% of sites were

above threshold. This is in stark contrast to 2010 when 40% of monitored sites were over threshold. It seems likely that the low egg counts in 2012 combined with the cold, wet weather in January to March 2013 resulted in low numbers of larvae locating a host plant. The dry summer was also unfavourable for egg production and oviposition by adult flies. Egg numbers in the north were higher than in the east. None of the sites sampled in the east had egg numbers above the 2.5 million/ha threshold whereas two sites were above this level in the north.



Summary figure 1. Wheat bulb fly annual risk levels 1984–2013 and overall mean.

Over all sites, the highest risk was after seed potatoes with a mean of 284 eggs/m^2 although only one site was sampled. The next highest risk was after potatoes with 158 eggs/m^2. All other crops had mean egg counts of less than 100 eggs/m^2



Summary figure 2. Average wheat bulb fly egg counts by region and proceeding crop in autumn 2013 (number of sites in brackets).

Eastern England

The mean egg number was 76/m² for sites sampled in eastern England. This is lower than in 2012 and much lower than the 179/m^2 and 309/m^2 recorded in 2011and 2010, respectively. Therefore, the potential for wheat bulb fly damage in eastern England is low and similar to 2012 and much reduced in comparison with 2010 and 2011. However, late sown crops which are likely to have few tillers at the time of egg hatch could still be at risk. The highest mean egg numbers over all crops samples were after vining peas (Summary Table 3) but this result should be treated with caution as only a single site was sampled. The highest egg population of 212/m² was after sugar beet in North Lincolnshire.

In eastern England, none of the sampled fields were in the high or very high infestation category (Summary Table 4). Overall, 40% of the fields sampled in eastern England contained egg populations in the moderate, high or very high infestation categories. This is lower than in 2012 (47%), 2010 (80%), 2009 (67%), 2008 (45%) and 2006 (50%) but higher than in 2007 (33%).

Summary Table 3. Mean number of eggs/m² and preceding crops in eastern England in autumn 2013 (range of egg populations in brackets).

Rotation or previous crop	Number of fields sampled	Mean number of eggs per m²
Onions	2	11
Oilseed rape	2	2
Peas (vining)	1	144
Potatoes	4	89
Sugar beet	6	99
Mean egg count		76 (0–212)

Summary Table 4. Infestation categories and preceding crops in eastern England in autumn 2013.

Rotation or previous crop	Number of fields by rotation and infestation category			
	Low (0-99 eggs/m²)	Moderate (100-249 eggs/m²)	High (250-500 eggs/m²)	Very high (> 500 eggs/m²)
Onions	2	0	0	0
Oilseed rape	2	0	0	0
Peas (vining)	0	1	0	0
Potatoes	2	2	0	0
Sugar beet	3	3	0	0
Total	9	6	0	0
% of fields by infestation category	60	40	0	0

Northern England

The mean egg number was 129/m² for sites sampled in northern England. This is approximately 63% higher than in 2012. The highest egg population of 561/m² recorded was in East Yorkshire after potatoes.

Summary Table 5. Numbers of eggs/m² and preceding crops in northern England in autumn 2013 (range of egg populations in brackets).

Rotation or previous crop	Number of fields sampled	Mean number of eggs per m²
Fallow	5	49
Peas (vining)	4	83
Potatoes	5	214
Seed potatoes	1	284
Mean egg count		129 (0 – 561)

In northern England, 7% of the sites were in the very high infestation category, 7% in the high infestation category, 26% in the moderate and 60% in the low category (Summary Table 6). Overall, 40% of sites were in moderate or above risk categories which is much higher than in 2012 (27%) but lower than in 2011, 2010 and 2009 when the equivalent figures were 60%, 60% and 47%, respectively.

Summary Table 6. Infestation categories and preceding crops in northern England in autumn 2013.

Rotation or previous crop	Number of fields by rotation and infestation category			
	Low (0-100 eggs/m²)	Moderate (100-250 eggs/m²)	High (250-500 eggs/m²)	Very high (> 500 eggs/m²)
Fallow	4	1	0	0
Peas (vining)	3	1	0	0
Potatoes	2	2	0	1
Seed potatoes	0	0	1	0
Total	9	4	1	1
% of fields by infestation category	60	26	7	7

2.4. Discussion

Egg populations above 250 eggs/m² present a risk of economic damage to late-autumn drilled wheat crops. Egg numbers above 100 eggs/m² justify the use of seed treatment on the latest-drilled crops of wheat or barley.

Only 7% of sites (2 sites out of 30) were over the 250/m^2 threshold (2.5 million eggs/ha). The overall risk in 2013 is the third lowest recorded since 1984. In 1995 and 2012 there were also only 3% of sites above threshold and in 1994 6% of sites were above this level. This is in stark contrast to 2010 when 40% of monitored sites were over threshold. It seems likely that the low egg counts in 2012 combined with the cold, wet weather in January to March 2013 resulted in low numbers of larvae locating a host plant. The dry summer was also unfavourable for egg production and oviposition by adult flies. Egg numbers in the north were higher than in the east. The mean egg counts for these two regions were 129/m^2 and 76/m^2, respectively.

Therefore, wheat bulb fly will probably pose a limited threat to crops sown before November. Later sown or slow developing crops will still potentially be at risk if they have only one or two tillers at the time of wheat bulb fly egg hatch in January/February. For these crops a lower threshold of

100 eggs/m^2 or 1 million/ha is applicable. In both the east and north of England, 40% of monitored sites were above this level. These sites would benefit from an insecticide seed treatment

A summary of control strategies for late-sown crops in relation to egg numbers in the soil are given in Table 7.

Table 7. Strategies for control of wheat bulb fly on late-autumn sown cereal crops.

Infestation category and egg count	Risk to untreated crops	Control strategy for late-sown crops
Low (less than 100 eggs per m^2)	Late-autumn and winter-sown crops may suffer damage	Option to use seed treatment on November–February-sown crops
Moderate (100–250 eggs per m^2)	Increased risk of damage	Seed treatment. Monitor progress of infestation in late winter.
High (250–500 eggs per m^2)	Damage likely	Seed treatment. Assess need for follow-up egg hatch or deadheart spray*
Very high (more than 500 eggs per m^2)	Damage highly likely	Seed treatment. Assess need for follow-up egg-hatch or deadheart sprays*. Additional control measures may be needed.

***** Deadheart sprays are only permissible with Danadim progress MAPP number 12208 until end March 2014

Chemical control

Seed treatments (tefluthrin + fludioxinil, Austral Plus or Cypermethrin, Signal 300 ES) is effective on late-sown crops (November onwards) and is the recommended treatment for late-autumn or winter sowings of wheat and barley made before the end of egg hatch in areas and rotations at risk from wheat bulb fly. Treated seed should be drilled at a recommended minimum depth of 3 cm in a firm, even seedbed. If egg counts indicate a high risk of wheat bulb fly damage (more that 250 eggs/m^2), a follow-up egg hatch or deadheart spray to the insecticidal seed treatment may be justified. It is important to note that seed treatments may not be sufficiently persistent to fully protect crops sown in September/October.

Chlorpyrifos egg hatch sprays are applied between the start of egg hatch in January and its peak in February or March. These are most likely to be justified on high risk fields where egg numbers are above 2.5 million/ha. In recent years, egg hatch progress has been monitored by ADAS on behalf of sponsors from the agrochemical industry which has enabled spray treatments to be applied at optimum spray timings.

Remember that new guidelines for the application of the insecticide chlorpyrifos have been issued by a consortium of approval holders of the chemical (Dow AgroSciences, Headland Agrochemicals and Makhteshim Agan) in a bid to safeguard future use of products containing the active ingredient. These guidelines have been implemented as part of the **'Chlorpyrifos: Say NO to DRIFT'** campaign which has been set up to prove industry support for its continued use under challenging regulatory conditions. It calls for users to adopt new application guidelines aimed at achieving 100% uptake of low-drift nozzles for all applications and extended buffer zones.

They advise that if you intend to use an egg hatch spray from 1st January 2012, the following guidelines should be implemented when applying products containing chlorpyrifos:

- USE LERAP – low drift – three star rated nozzles
- Adopt a 20 metre buffer zone (1 m for dry water bodies).

This is in addition to current label requirements.

Dimethoate sprays (Danadim Progress) are applied at peak invasion of first instar larvae when damage symptoms ('deadhearts') start to appear on cereal shoots. However, this is only permissible for product with the old MAPP number (12208) until the end of March 2014. The new product (MAPP number 158970) does not have a WBF recommendation on the label. The future of dimethoate is also under review. Plant samples can be checked to determine the numbers of wheat bulb fly larvae present. The thresholds vary according to crop growth stage and range from 10% of tillers attacked at single shoot (pre-GS20) stages to 15% of tillers attacked at GS21 and 20% of tillers attacked at GS22.

If plants are well-tillered by the time that wheat bulb fly larvae hatch between January and March, it is possible that they will be able to tolerate some pest attack and an insecticide spray may not be required.

2.5. References

HGCA (2003). Pest management in cereals and oilseed rape – a guide, 23 pp.

HGCA Topic Sheet No. 118 (Autumn 2013). Predicting and controlling wheat bulb fly, 2 pp.

Oakley J N, Young J E B. 2000. Economics of pest control in cereals in the UK. *The BCPC Conference – Pests and Diseases 2000,* 663-670.

Oakley J N. 2003. Wheat bulb fly. In – *'Pest management in cereals and oilseed rape – a guide'*. HGCA, 24pp.

Young J E B. 1992. Control of wheat bulb fly in winter wheat. I. Chemical methods. II. Varietal susceptibility. *HGCA Project Report No. 67*.

Young J E B 2000. Dealing with wheat bulb fly*. HGCA Topic sheet No. 38*, 2 pp.

Young J E B, Cochrane J. 1993. Changes in wheat bulb fly (*Delia coarctata*) populations in East Anglia in relation to crop rotations, climatic data and damage forecasting. *Annals of Applied Biology* **123**: 485-498.

Young J E B, Ellis S A. 1996. *Impact of changes in arable agriculture on the biology and control of wheat bulb fly.* Research Review No. 33, HGCA, London.

APPENDIX A

Egg populations ranked in descending order for 15 fields sampled in eastern England in autumn 2013 (shaded sites are potentially at risk if late sown).

County	Previous crop	Number of eggs (number/m²)	Risk category
North Lincolnshire	Sugar beet	212	Moderate
Norfolk	Sugar beet	158	Moderate
North Lincolnshire	Vining peas	144	Moderate
Suffolk	Potatoes	123	Moderate
Suffolk	Potatoes	110	Moderate
Cambridgeshire	Sugar beet	103	Moderate
Cambridgeshire	Potatoes	75	Low
Norfolk	Sugar beet	55	Low
Cambridgeshire	Potatoes	48	Low
Cambridgeshire	Sugar beet	41	Low
Cambridgeshire	Oilseed rape	27	Low
Cambridgeshire	Sugar beet	27	Low
Cambridgeshire	Onions	14	Low
Cambridgeshire	Onions	7	Low
Cambridgeshire	Oilseed rape	0	Low
Mean		76	

APPENDIX B

Egg populations ranked in descending order for 15 fields sampled in northern England in autumn 2013 (shaded sites are potentially at risk if late sown).

County	Previous crop	Number of eggs (number/m²)	Risk category
East Yorkshire	Vining peas	561	Very high
East Yorkshire	Seed potatoes	283	High
North Yorkshire	Potatoes	210	Moderate
East Yorkshire	Fallow	210	Moderate
East Yorkshire	Vining peas	191	Moderate
North Yorkshire	Potatoes	142	Moderate
NorthYorkshire	Potatoes	93	Low
East Yorkshire	Vining peas	80	Low
North Yorkshire	Potatoes	62	Low
East Yorkshire	Vining peas	56	Low
North Yorkshire	Fallow	19	Low
North Lincolnshire	Fallow	12	Low
North Lincolnshire	Fallow	6	Low
East Yorkshire	Vining peas	6	Low
North Yorkshire	Fallow	0	Low
Mean		129	