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Autumn survey of wheat bulb fly incidence 2015

Steve Ellis

ADAS, High Mowthorpe, Duggleby, Malton, North Yorkshire YO17 8BP

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1. Abstract

All cereals, except oats, can be attacked by wheat bulb fly. Eggs are laid in late summer in bare soil following fallows 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 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 crops sown in September and October, or 100 eggs/m² (1.0 million eggs/ha) for crops sown from November onwards.

The specific objectives of the project are:

1. To measure the incidence of wheat bulb fly each autumn in the infested areas
2. To forecast the need for seed treatment or alternative insecticidal treatments

A total of 30 fields were sampled in September 2015 in areas prone to wheat bulb fly, with 15 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 2015, one field of the 30 surveyed (3%) was considered at very high risk, containing egg numbers greater than 500/m² and four sites (13%) were considered at high risk, containing egg numbers between 250/m^2 and 500/m^2. In total, five sites (17%) were above the 250 eggs/m^2 threshold for crops sown in September and October. At 17%, the overall risk in 2015 is the highest recorded since 2011. It is possible that the wet weather that delayed harvest allowed saprophytic fungi to develop in cereal ears on which wheat bulb fly adult females could feed and mature more eggs than in drier seasons. Over all sites, the highest risk was after combining peas with a mean of 382 eggs/m^2, although only one combining pea site was sampled. The next highest risk was after seed potatoes with 186 eggs/m^2. Mean egg numbers in the north were higher than in the east. In the north, three of the sites sampled had egg numbers above the 2.5 million/ha threshold, whereas two sites were above this level in the east. The mean egg counts for the north was 168 eggs/m^2 and in the east it was 101 eggs/m^2.

Late-sown (November onwards) or slow developing crops are at greater risk from wheat bulb fly than those that are early sown (September/October) due to slower tiller development. As a result, a lower threshold of 100 eggs/m^2 or 1 million eggs/ha is applicable for these crops. In the north of England, 87% of monitored sites were above this level but in the east of England 27% of sites were above this level. In the north of England, the majority of crops sown from November onwards would benefit from a seed treatment.

2. Introduction

All cereals except oats can be attacked by wheat bulb fly. Eggs are laid in late summer in bare soil following fallows 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 (AHDB, 2014). The pest is most prevalent in eastern England 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 & 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 the 250 eggs/m² threshold ranged from 3% to 44% in the period 1984–1999 (Oakley & Young, 2000) and from 9% to 50% between 2000 and 2015 (Figure 1).

The wheat harvest 2015 was one of the latest harvests since 2008. The start of harvest was one to two weeks later than many recent years due to the delayed maturity of the crops. A period of settled weather coincided with the start of harvest and this enabled farmers to make rapid progress for a couple of weeks. There then followed a period of more unsettled weather through mid to late August, which caused disruptions to the end of harvest in the south and to the start of harvest further north, with the rate of progress slowing for a period of three weeks. Consequently, the end of harvest was behind recent years and, despite good progress in the better weather in week 10, farmers have been unable to catch up. The late harvest suggests that the risk from wheat bulb fly may be higher than in recent years and this survey will help determine if this is the case and provide valuable information on the potential risk from the pest for the 2015/16 season.

The overall objective of the project is to establish the annual incidence of wheat bulb fly in the autumn to allow farmers to decide on the need for seed treatment in late-sown crops. Specific objectives are:

1. To measure the incidence of wheat bulb fly each autumn in the infested areas.
2. To forecast the need for seed treatment.

Egg numbers can be estimated by soil sampling and related to threshold levels of 250 eggs/m² (2.5 million eggs/ha) for crops sown in September or October, or 100 eggs/m² (1.0 million eggs/ha) for crops sown from November onwards. At lower infestation levels, economic damage is less likely, although winter cereal crops sown from November onwards or those sown in spring before the end of March can be 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 of up to about 4 t/ha have been recorded following severe damage (Young & 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.

Seed treatment is the most effective option for later-sown crops, for example those at risk following 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.

3. Materials and methods

A total of 30 fields were sampled in September 2015 in areas prone to wheat bulb fly, with 15 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).

Table 1. Location of sampling sites, by region and county.

Region	County	Number of fields sampled
Eastern England	Cambridgeshire	8
	Norfolk	5
	Suffolk	2
	Total	15
Northern England	East Yorkshire	11
	North Yorkshire	4
	Total	15

Table 2. Preceding crop or rotation for sampled fields.

Rotation	Eastern England	Northern England
Oilseed rape	2	1
Onions	1	0
Peas (combining)	0	1
Peas (vining)	2	5
Potatoes	2	8
Sugar beet	8	0
Total	15	15

4. Results

In autumn 2015, one field from the total of 30 surveyed (3%) was considered at very high risk, containing egg numbers greater than 500/m^2 and four sites (13%) were considered at high risk, containing egg numbers between 250/m^2 and 500/m^2. In total, five sites (17%) were above the 250 eggs/m^2 threshold (Figure 1). At 17%, the overall risk in 2015 is the highest recorded since 2011. It is possible that the wet weather that delayed harvest allowed saprophytic fungi to develop in cereal ears, on which wheat bulb fly adult females could feed and mature more eggs than in drier seasons.

Average egg numbers in the north were higher than in the east. Three sites sampled in the north had egg numbers above the 2.5 million/ha threshold, whereas two sites were above this level in the east. Over all sites, the highest risk was after combining peas, although only one site after this crop was sampled (Figure 2), with a mean of 382 eggs/m^2. The next highest risk was after potatoes, with 186 eggs/m^2.

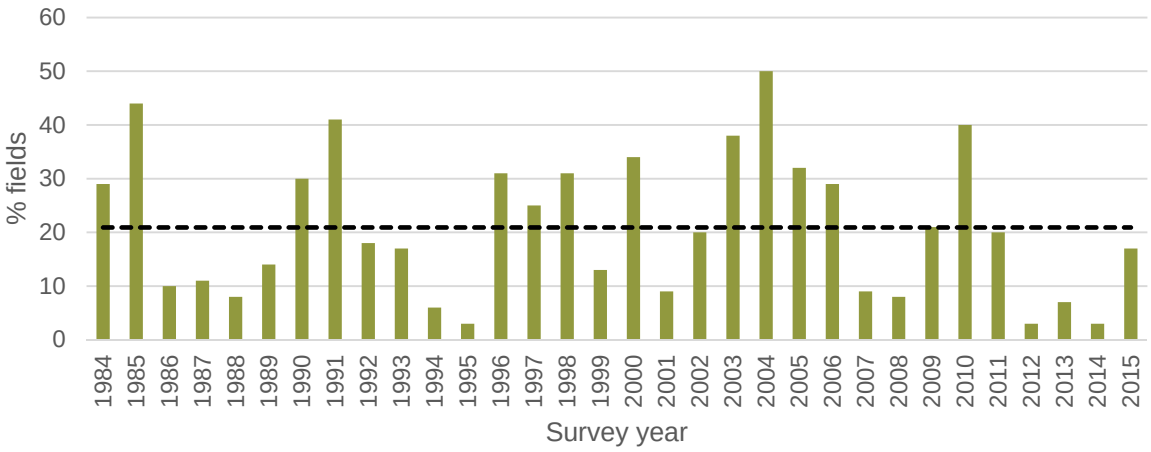

Figure 1. Wheat bulb fly annual risk levels 1984–2015 and overall mean (dashed line).

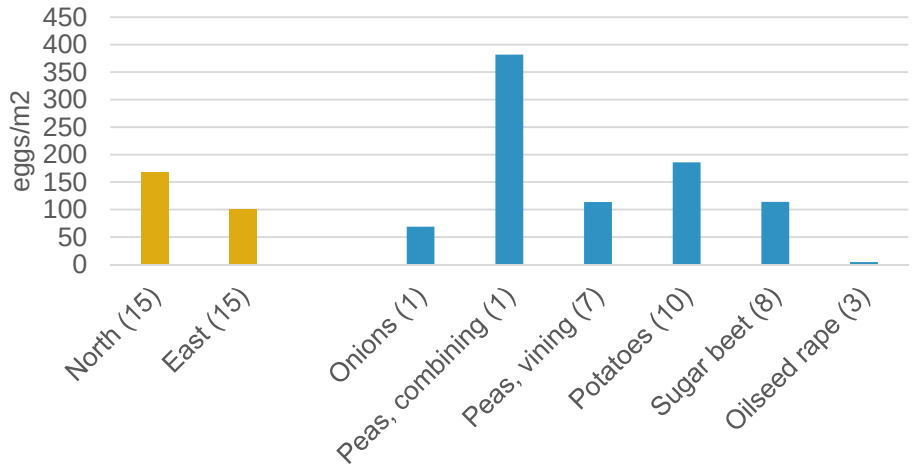

Figure 2. Average egg counts by region and preceding crop in autumn 2015 (number of sites in brackets).

4.1. Eastern England

The mean egg number was 101 eggs/m² for sites sampled in eastern England. This is higher than in 2014 (46 eggs/m²), 2013 (76 eggs/m²) and 2012 (96 eggs/m²) but much lower than the 179 eggs/m² and 309 eggs/m² recorded in 2011 and 2010, respectively. Therefore, the potential for wheat bulb fly damage in eastern England is relatively low. However, late-sown crops, which are likely to have few tillers at the time of egg hatch, could still be at risk. The highest egg population of 528 eggs/m² was after sugar beet in Cambridgeshire. This site and another with 377 eggs/m² after potatoes in Suffolk had a disproportionately large effect on the mean counts for eastern England, with all other sites having fewer than 116 eggs/m². Potatoes had the highest mean number of eggs of all crops sampled (199 eggs/m², Table 3).

Table 3. Mean eggs/m² and preceding crops in eastern England in autumn 2015 (range in brackets).

Rotation or previous crop	Number of fields sampled	Mean number of eggs per m²
Oilseed rape	2	7
Onions	1	69
Peas (vining)	2	15
Potatoes	2	199
Sugar beet	8	114
Mean egg count		101 (0–528)

In eastern England, one of the sampled fields was in the very high risk category and one in the high risk category (Table 4). Overall, 27% of the fields sampled in eastern England contained egg populations in the moderate, high or very high risk categories. This is higher than in 2014 (13%) but lower than in 2013 (40%), 2012 (47%), 2010 (80%) and 2009 (67%).

Table 4. Infestation categories and preceding crops in eastern England in autumn 2015.

Rotation or previous crop	Number of fields by rotation and risk category			
	Low (<100 eggs/m²)	Moderate (100–249 eggs/m²)	High (250–499 eggs/m²)	Very high (>500 eggs/m²)
Oilseed rape	2	0	0	0
Onions	1	0	0	0
Peas (vining)	1	1	0	0
Potatoes	1	0	1	0
Sugar beet	6	1	0	1
Total	11	2	1	1
% of fields by infestation category	73	13	7	7

4.2. Northern England

The mean egg number was 168 eggs/m² for sites sampled in northern England. This is higher than the mean count of 125 eggs/m² in 2014. The highest egg population of 382 eggs/m² was recorded in East Yorkshire after combining peas.

Table 5. Numbers of eggs/m² and preceding crops in northern England in autumn 2015 (range in brackets).

Rotation or previous crop	Number of fields sampled	Mean number of eggs per m²
Oilseed rape	1	0
Peas (combining)	1	382
Peas (vining)	5	134
Potatoes	8	183
Mean egg count		168 (0–382)

In northern England, three of the 15 fields (20% of the sites) were in the high risk category, ten fields (67% of sites) were in the moderate category and two fields (13%) were in the low category (Table 6). Overall, 13 fields (87% of sites) were in risk categories of moderate or above, which is higher than all years since 2010 (2014: 53%, 2013: 40%, 2012: 27%, 2011: 60%, 2010: 60% and 2009: 47%). This represents a significant risk to crops sown after November in areas and rotations at risk. The majority of crops sown after this cut-off date would benefit from a seed treatment.

Table 6. Infestation categories and preceding crops in northern England in autumn 2015.

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)
Oilseed rape	1	0	0	0
Peas (combining)	0	0	1	0
Peas (vining)	0	5	0	0
Potatoes	1	5	2	0
Total	2	10	3	0
% of fields by infestation category	13	67	20	

5. Discussion

Egg populations above 250 eggs/m² present a risk of economic damage to winter wheat crops drilled in September and October. Egg numbers above 100 eggs/m² justify the use of seed treatment on the late-drilled crops of winter wheat or barley sown from November onwards.

5.1. Early sown crops (September/October)

In 2015, 17% of sites (five sites out of 30) were over the 250 eggs/m^2 threshold (2.5 million eggs/ha) for crops sown in September or October. The overall risk in 2015 is the highest recorded since 2011, when 20% of sites were above threshold. It is possible that the wet weather that delayed harvest allowed saprophytic fungi to develop in cereal ears on which wheat bulb fly adult females could feed and mature more eggs than in drier seasons.

Mean egg numbers in the north were higher than in the east. In the north, three of the sites sampled had egg numbers above the 2.5 million/ha threshold, whereas two sites were above this level in the east. The mean egg count for the north was 168 eggs/m^2 and in the east it was 101 eggs/m^2.

5.2. Late-sown crops (November onwards)

Late-sown (November onwards) or slow developing crops are at greater risk than than those that are early sown (September/October) due to slower tiller development As a result, a lower threshold of 100 eggs/m^2 or 1 million eggs/ha is applicable for these crops. In the north of England, 87% of monitored sites (13 fields) were above this level and in the east of England, 27% of sites (four fields) were above this level. In the north, this represents a significant risk to crops sown after November and the majority of those sown after this cut-off date would benefit from a seed treatment.

A summary of control strategies for wheat bulb fly in relation to egg numbers and sowing date is given in Table 7.

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

Risk category	Sowing date		
	Sep–Oct	Nov–Dec	Jan–Mar
Low (<100 eggs/m^2)	Economic damage unlikely; no treatment	No treatment	A
Moderate (100–249 eggs/m^2)	No treatment	A	A
High (250–500 eggs/m^2)	Optional B	A Optional B	A B
Very high (>500 eggs/m^2)	B	A B	A B

A = seed treatment, such as Austral Plus or Signal 300 ES; B = egg-hatch spray, such as chlorpyrifos

5.3. Chemical control

Seed treatment (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 maximum depth of 4 cm in a firm, even seedbed. If egg counts indicate a high risk of wheat bulb fly damage (more than 250 eggs/m^2), a follow-up egg-hatch spray, in addition 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 or 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 eggs/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 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, 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 metre for dry water bodies)

This is in addition to current label requirements.

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.

6. References

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Appendix A

Egg populations ranked in descending order for 15 fields sampled in eastern England in autumn 2015

County	Previous crop	Number of eggs (number/m²)	Risk category
Cambridgeshire	Sugar beet	528	Very high
Suffolk	Potatoes	377	High
Cambridgeshire	Sugar beet	116	Moderate
Cambridgeshire	Vining peas	110	Moderate
Norfolk	Sugar beet	89	Low
Cambridgeshire	Onions	69	Low
Norfolk	Sugar beet	62	Low
Cambridgeshire	Sugar beet	62	Low
Norfolk	Sugar beet	27	Low
Cambridgeshire	Potatoes	21	Low
Cambridgeshire	Oilseed rape	14	Low
Norfolk	Sugar beet	14	Low
Suffolk	Sugar beet	14	Low
Norfolk	Vining peas	14	Low
Cambridgeshire	Oilseed rape	0	Low
Mean		101	

Appendix B

Egg populations ranked in descending order for 15 fields sampled in northern England in autumn 2015

County	Previous crop	Number of eggs (number/m²)	Risk category
East Yorkshire	Combining peas	382	High
East Yorkshire	Potatoes	308	High
East Yorkshire	Potatoes	302	High
East Yorkshire	Potatoes	191	Moderate
East Yorkshire	Vining peas	185	Moderate
East Yorkshire	Potatoes	167	Moderate
East Yorkshire	Potatoes	160	Moderate
North Yorkshire	Potatoes	154	Moderate
East Yorkshire	Vining peas	154	Moderate
North Yorkshire	Potatoes	117	Moderate
East Yorkshire	Vining peas	111	Moderate
East Yorkshire	Vining peas	111	Moderate
East Yorkshire	Vining peas	111	Moderate
North Yorkshire	Potatoes	62	Low
East Yorkshire	Oilseed rape	0	Low
Mean		168	