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National Survey of Cabbage Stem Flea Beetle Larvae in Winter Oilseed Rape Plants in Autumn 2016 and Spring 2017

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1. Abstract

The outputs of the spring 2017 and autumn 2016 national surveys of CSFB larvae in winter oilseed rape maintain the consistency of surveillance of cabbage stem flea beetle (*Psylliodes chrysocephala*; CSFB) larvae as part of a long-term data set. The data are broken down by region and county for both spring and autumn surveys. These data will be used to assess changes in CSFB prevalence and to monitor trends in agronomic practice for pest management. They will also be used to provide data for current and future research projects on the integrated pest management of CSFB. Eighty winter oilseed rape fields were selected at random from a list of farms in England. Winter oilseed rape crops were assessed for the presence of CSFB. Plants from all 79 fields were assessed in autumn and a subset of plants from 39 of the same fields was assessed the following spring.

The numbers of larvae found were lower in autumn 2016 compared with autumn 2015. This pattern was observed across all regions and it was most notable in the 'East' region. When the same fields were surveyed in spring, this reduction in numbers was still evident for the 'East', 'North' and 'South East' regions; however the reduction was not as substantial as might have been expected following the low autumn numbers. Although the numbers of larvae found during the autumn survey were lower in 2016 than in 2015, the numbers found in the spring survey were higher than in the previous spring for one region: 'South West'. The threshold of five larvae per plant was exceeded at one site (in Kent in the South-East region) during the autumn 2016 survey. There were 10 sites in the South-East in total and 6 of these were in Kent. Nationally, the threshold of five larvae per plant was exceeded at six sites during the spring 2017 survey. The six sites were in: Cambridgeshire (2 of 5 sites), Essex (1 of 2 sites), Lincolnshire (1 of 2 sites) and North Yorkshire (2 of 4 sites).

It is possible that smaller numbers of larvae were initially detected in some regions in autumn 2016 than in previous years due to a decrease in the adult beetle population: A lowered population of adult beetles was reflected in yellow water trap catches of this life stage in autumn 2016 (unpublished Fera Science Ltd. Data). The winter weather was warmer than usual, according to the Met Office Temperature Anomaly Map, and this allowed the adult beetles to remain active throughout winter. Oviposition may have continued during winter and the conditions for survival of the larvae were better than in most previous winters, in that the mean temperature was higher. This may explain the differences between the numbers of larvae found during the autumn 2016 and spring 2017 surveys in some regions.

The implication for the OSR industry is that it is possible that even with small recorded numbers of adults and larvae in autumn that a large population of CSFB larvae will be present in OSR plants in spring. Modelling work would be required to ascertain the effects of mean temperature on

population size and on changes in population size. Future research should work to produce predictions of spring CSFB populations based on varying temperature anomalies during the winter months.

2. Introduction

UK agriculture continues to face many challenges. Environmental considerations are now more important than ever. Severe epidemics and infestations occur in crops frequently, resistance to insecticides is more prevalent and increasingly unpredictable weather patterns under climate change are likely to lead to unreliability in current risk modelling approaches designed to improve crop management. Concerns over insecticide residues also continue to increase. Well conducted (objective, accurate, unbiased) national surveys are the best means of determining changes in the status of pests and the uptake of the most reliable advice on control strategies. This national survey project is uniquely positioned and has proven success in fulfilling these roles by delivering information and providing a forum to establish consensus across policy, research and industry perspectives.

The outputs of this project maintain the consistency of surveillance of CSFB larvae in winter oilseed rape. The data are broken down by region and county for both spring and autumn surveys. These data will be used to assess changes in CSFB prevalence and to monitor trends in agronomic practice for pest management. They will also be used to provide data for current and future research projects on the integrated pest management of CSFB.

3. Materials and methods

3.1. Selection of fields for the surveys

Field selection

Eighty winter oilseed rape fields were selected at random from a list of farms in England derived from annual returns to Defra Census Branch. Winter oilseed rape crops were assessed for the presence of cabbage stem flea beetle (*Psylliodes chrysocephala*). Plants from 79 fields were assessed in autumn and a subset of plants from 39 of the same fields was assessed in spring.

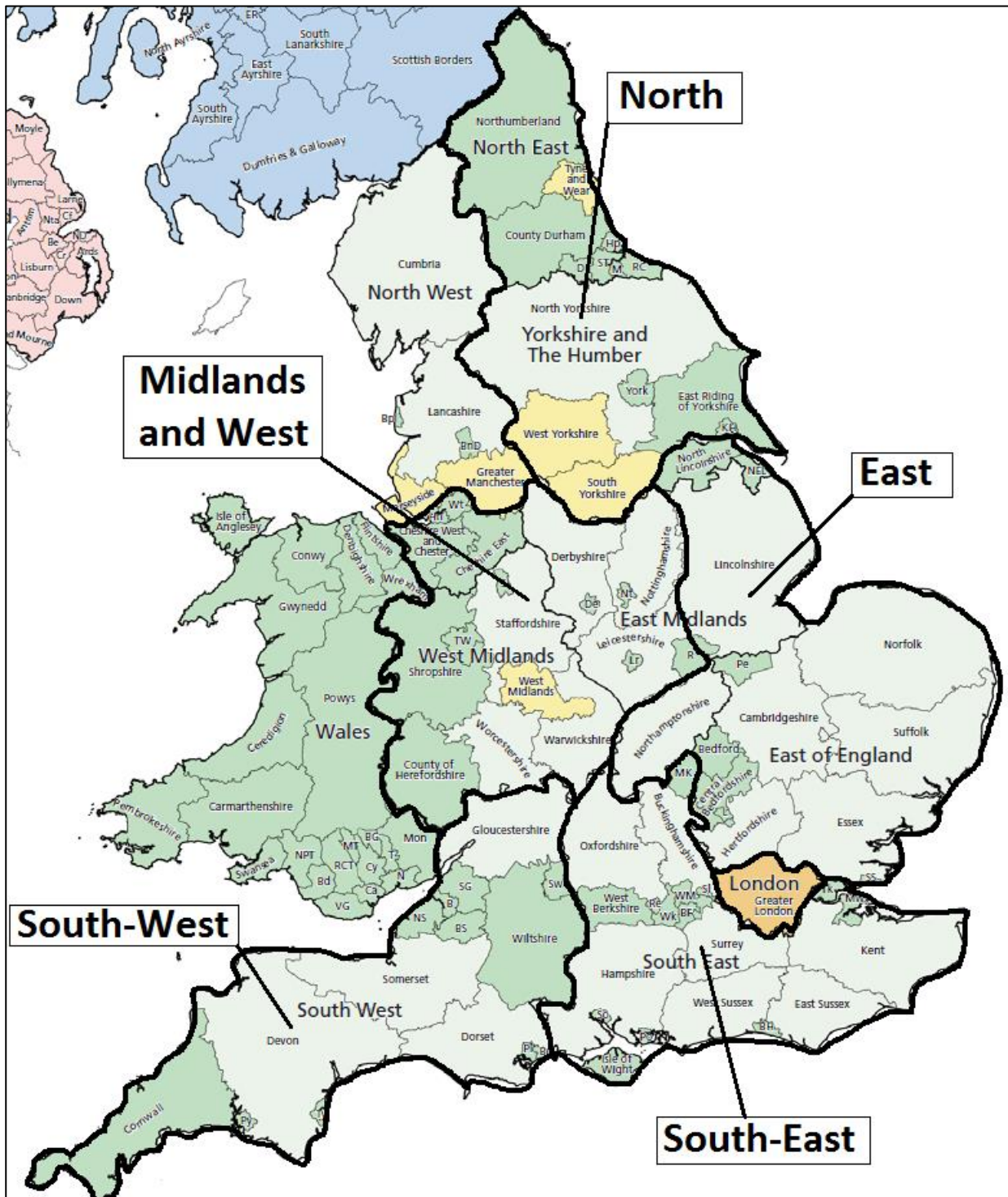
3.2. Count method for cabbage stem flea beetle larvae in oilseed rape plants

Plant dissection

Numbers of larvae were assessed by plant dissection using a standard protocol: Every leaf on each plant was removed close to the stem, dissected, and the total number of larvae recorded. Twenty-five plants were assessed per field.

4. Results

One sample from both the autumn and spring surveys was not returned; therefore 79 samples were assessed in autumn and 39 in spring. Map 1 shows the assignment of counties to regions.



Map 1. Assignment of geographical regions to counties for the 2017 survey. (Map courtesy of the Office for National Statistics.)

Figures 1 and 2 show the numbers of larvae per plant by geographical region over time. Overall, the numbers of larvae per plant were lower in autumn 2016 compared with the results of the autumn 2015 survey: in autumn 2016 we recorded 0.631 larvae per plant whereas there were, on average, 1.761 larvae per plant in autumn 2015. This pattern was observed across all regions and it was most notable in the 'East' and 'South West' regions (Table 1).

Table 1. Average number of larvae per plant by region in autumn 2015 and 2016

	East	Midlands and West	North	South East	South West
2015 (larvae per plant)	3.26	0.86	1.57	1.58	1.54
2016 (larvae per plant)	0.65	0.35	0.81	1.11	0.25
Difference (larvae per plant)	2.61	0.51	0.76	0.47	1.29
Difference (% reduction)	80	60	48	30	84

This reduction in numbers compared with spring 2016 was still evident in spring 2017 for the 'East', 'North' and 'South East' regions. However, in the East, the reduction was not as large as might have been expected following the much lower autumn numbers. There was a greater reduction in numbers in the South East in spring compared with the previous year than in autumn compared with the previous year. There was actually an increase of almost one larva per plant between spring 2016 and spring 2017 in the South West. This was not predicted by the autumn numbers of larvae per plant in the South West (Table 2).

Table 2. Average number of larvae per plant by region in spring 2016 and 2017

	East	Midlands and West	North	South East	South West
2016 (larvae per plant)	4.50	1.32	5.34	3.59	0.46
2017 (larvae per plant)	3.21	1.26	2.77	1.72	1.44
Difference (larvae per plant)	1.29	0.06	2.56	1.87	-0.98
Difference (% reduction)	29	5	48	52	-210

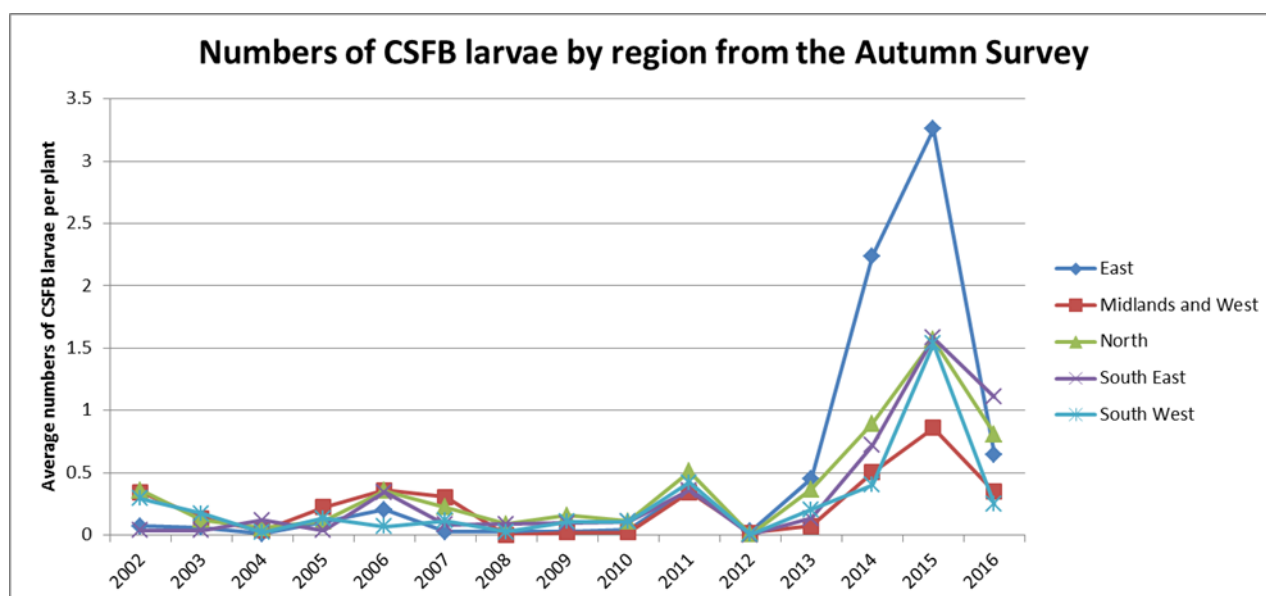


Figure 1. Mean number of CSFB larvae per plant by region – autumn survey

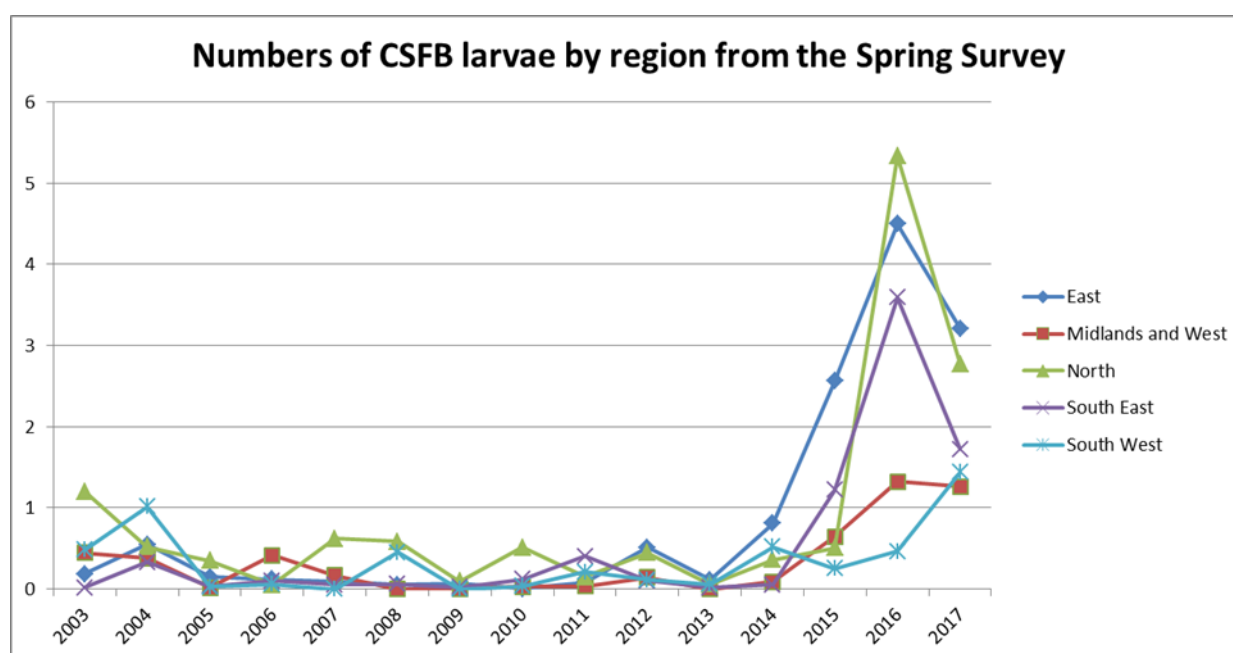


Figure 2. Mean number of CSFB larvae per plant by region – spring survey

County level data are shown in Figures 3–7. The five counties with the highest numbers of larvae per plant in the autumn 2016 survey were: Kent (1.7), North Yorkshire (1.5), Suffolk (1.3), Bedfordshire (1.3) and Hertfordshire (1.1) (Figure 3). The three counties with the highest numbers of larvae per plant in the spring 2017 survey were: North Yorkshire (6.0), Essex (5.6) and Cambridgeshire (4.0) (Figure 4). Due to a randomised selection process, three of the counties from which the highest numbers of larvae were recorded in autumn were not selected for resampling in spring: Suffolk, Bedfordshire and Hertfordshire.

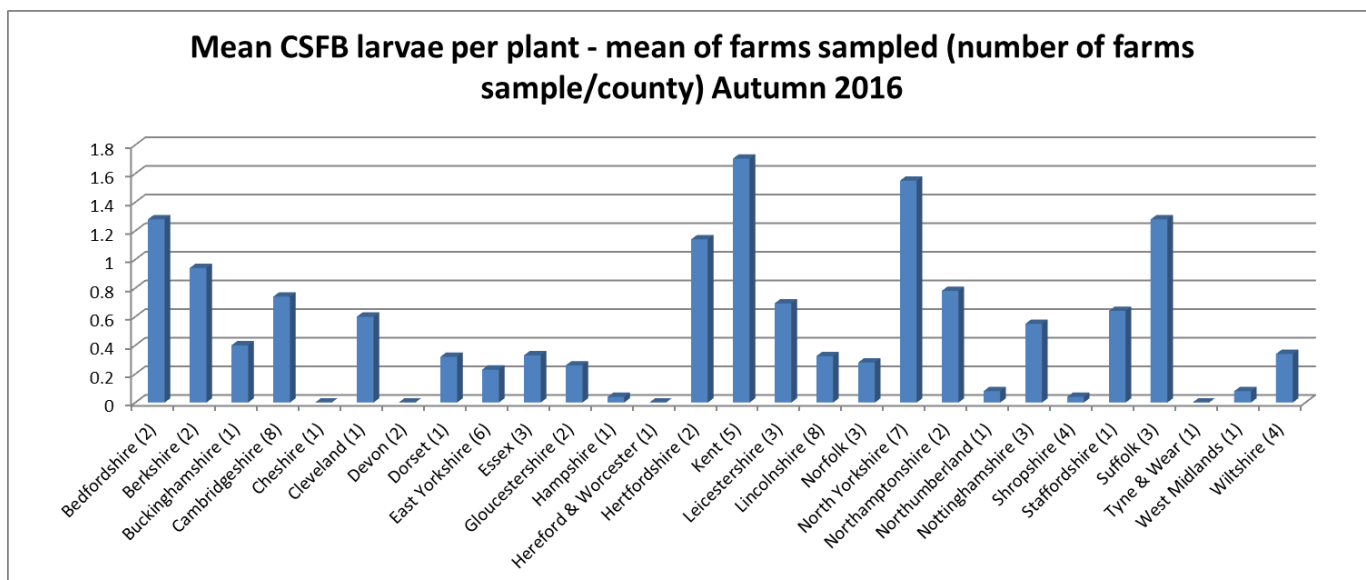


Figure 3. Mean number of CSFB larvae per plant by county – autumn 2016 survey

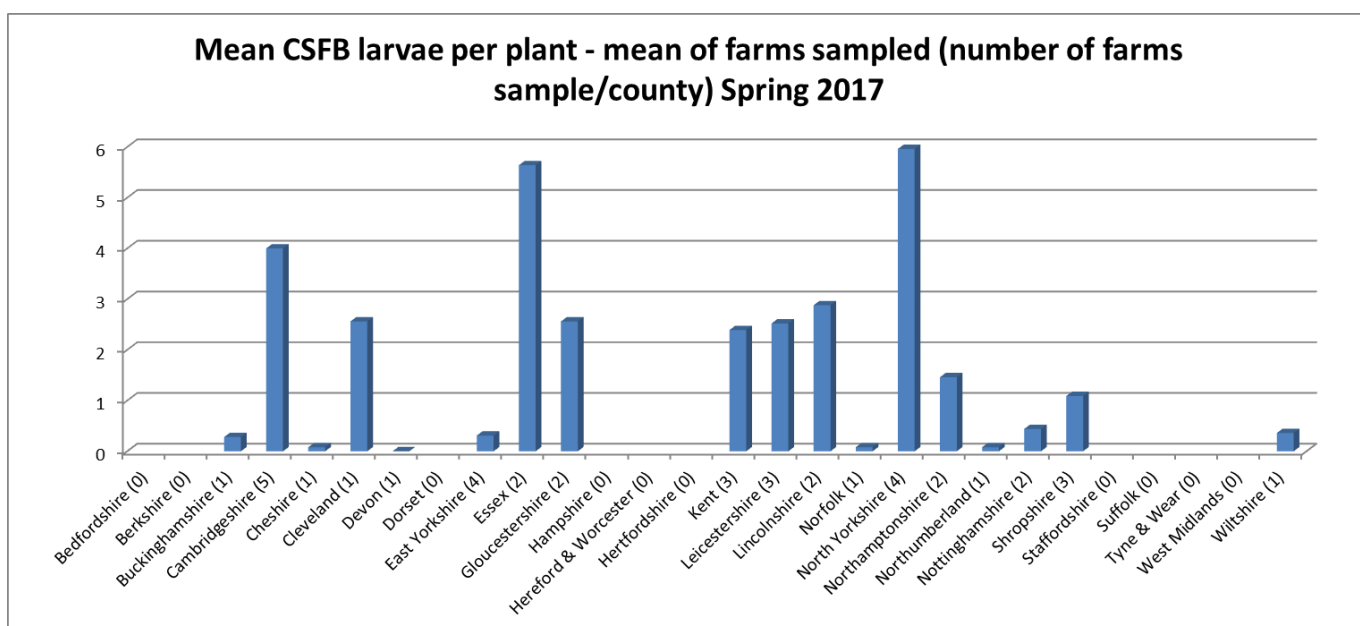


Figure 4. Mean number of CSFB larvae per plant by county – spring 2017 survey

The five counties with the largest increases in numbers of larvae per plant between the autumn and spring surveys were: Essex (5.31), North Yorkshire (4.41), Cambridgeshire (3.26), Lincolnshire (2.55) and Gloucestershire (2.30) (Figure 5, Table 3, Appendix A).

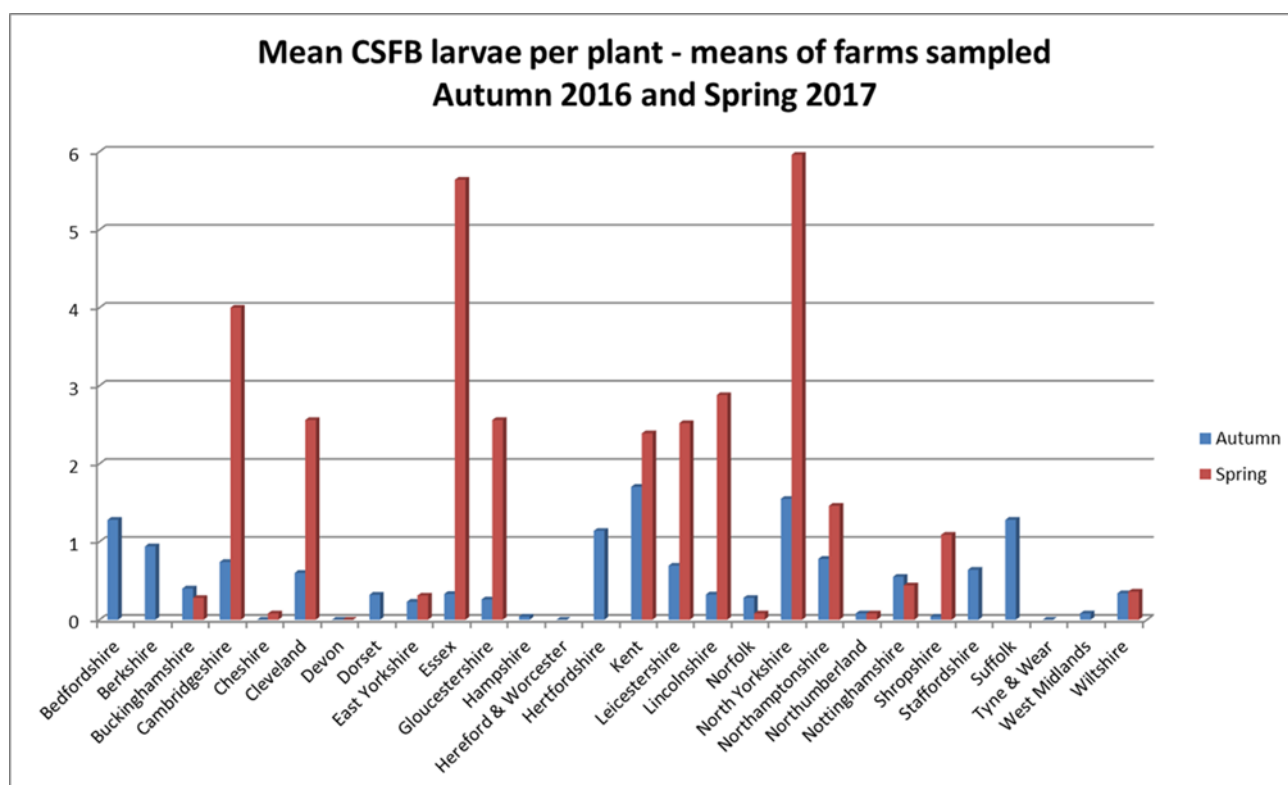


Figure 5. Mean number of CSFB larvae per plant by county – autumn 2016 and spring 2017 surveys for comparison by county. Where no spring results are reported no sites from this region were resampled during spring 2017.

Table 3. Differences in mean larvae per plant between autumn and spring surveys ranked by county

County	Differences in mean larvae per plant between autumn and spring surveys
Essex	5.31
North Yorkshire	4.41
Cambridgeshire	3.26
Lincolnshire	2.555
Gloucestershire	2.3
Cleveland	1.96
Leicestershire	1.827
Shropshire	1.05
Kent	0.686
Northamptonshire	0.68
Cheshire	0.08
East Yorkshire	0.08
Wiltshire	0.02
Devon	0
Northumberland	0

Nottinghamshire	-0.11
Buckinghamshire	-0.12
Norfolk	-0.2

The numbers of larvae were higher overall compared with the average numbers for previous survey years (Table 4). The threshold of five larvae per plant was exceeded at one site (in Kent in the South-East region) during the autumn 2016 survey. This constituted only 1.3% of the fields surveyed. There were 10 sites in the South-East in total and 6 of these were in Kent. The five larvae per plant threshold was exceeded at six sites during the spring 2017 survey. This constituted 15.4% of fields surveyed overall. The six sites were in: Cambridgeshire (2 of 5 sites), Essex (1 of 2 sites), Lincolnshire (1 of 2 sites) and North Yorkshire (2 of 4 sites).

Table 4. Mean larvae per plant – current year and previous years across all regions surveyed

Autumn surveys		Spring surveys	
Survey years	Mean larvae per plant	Survey years	Mean larvae per plant
2002 - 2012	0.14	2003 - 2013	0.21
2002 - 2015	0.32	2003 - 2016	0.49
2016	0.63	2017	2.08

County level data from the autumn 2014 and 2015 surveys are shown in Figures 6 and 7 for comparison.

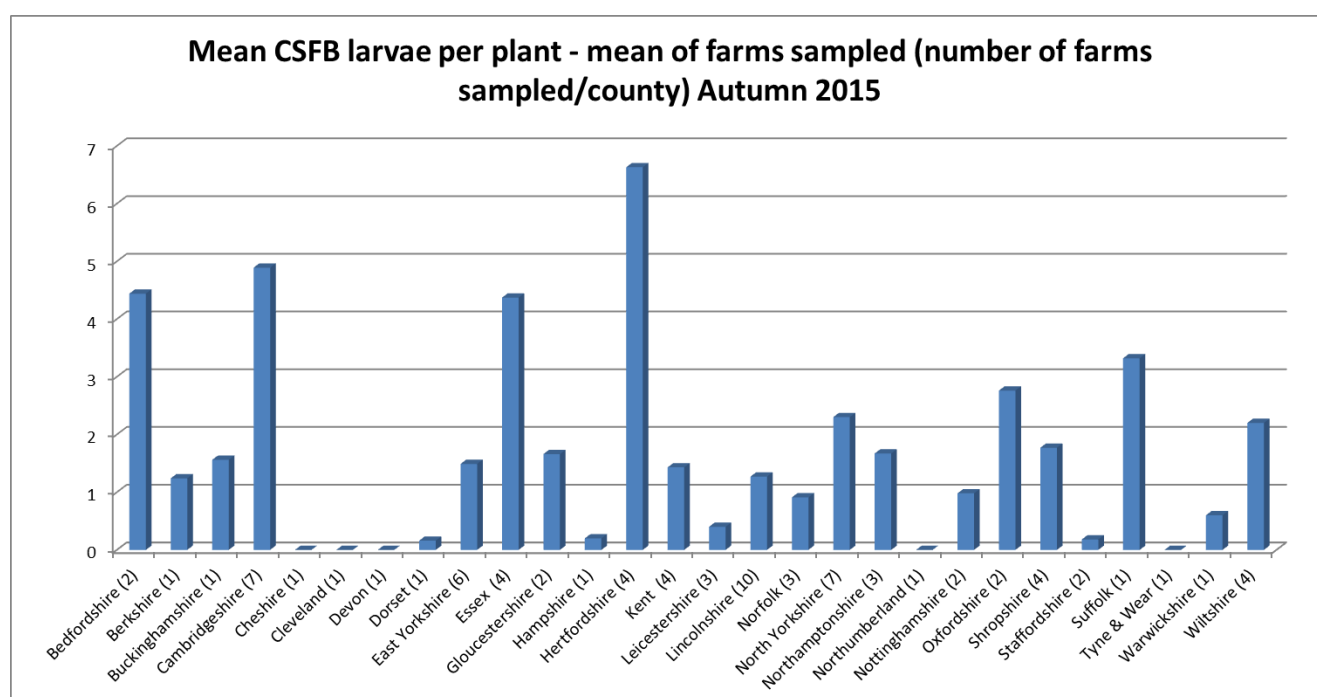


Figure 6. Mean number of CSFB larvae per plant by county – autumn 2015 survey

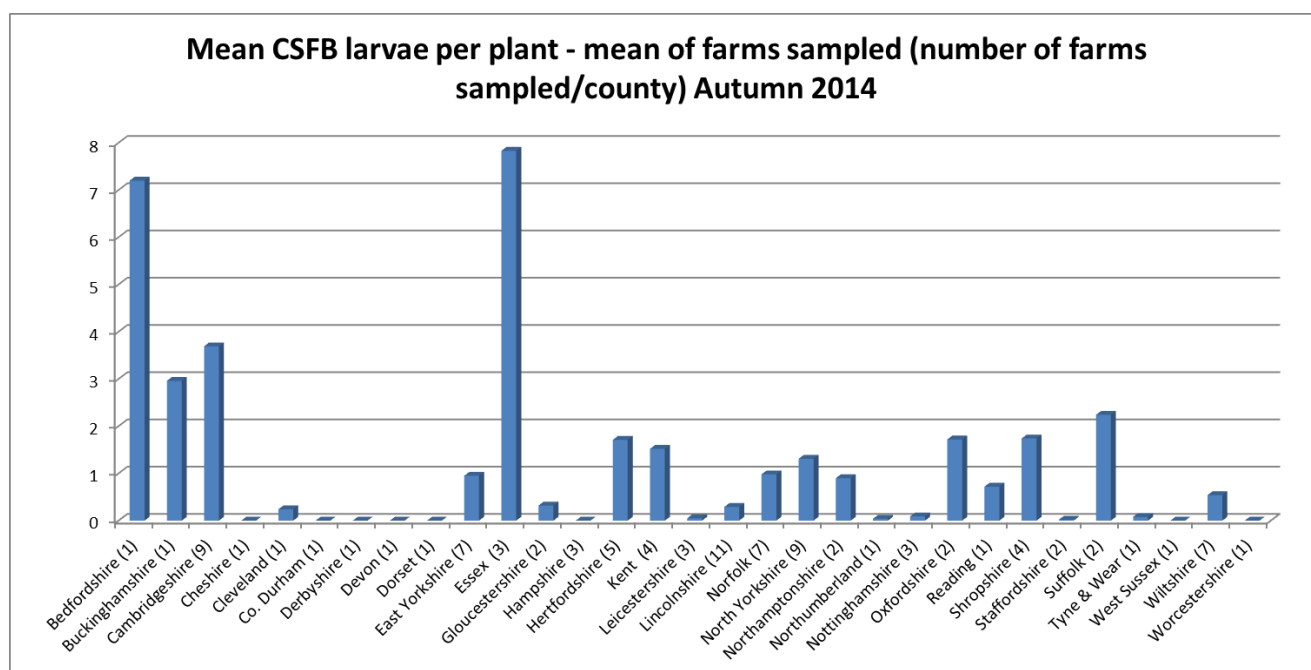


Figure 7. Mean number of CSFB larvae per plant by county – autumn 2014 survey

5. Discussion

It is possible that smaller numbers of larvae were initially detected in some regions in autumn 2016 than in previous years due to a decrease in the adult beetle population: A lowered population of adult beetles was reflected in yellow water trap catches of this life stage in autumn 2016 (unpublished Fera Science Ltd. Data). It is possible that the survival of eggs or small larvae may have been reduced due to dry weather. However, the winter weather was warmer than usual, according to the Met Office Temperature Anomaly Map (Figure 8), and this allowed the adult beetles to remain active throughout winter. Oviposition may have continued during winter and the conditions for survival of the larvae were better than in most previous winters, in that the mean temperature was higher (Figure 8). The increased temperature continued into March 2017. This may explain the differences between the numbers of larvae found during the autumn 2016 and spring 2017 surveys in some regions. There is evidence that temperature affects the time taken for egg development, the total number of eggs laid per female, the number of eggs laid per day and the mean hatching percentages (Alford, 1979; Mathiasen *et al.*, 2015). This increase in numbers of larvae per plant between autumn and spring has historically been 0.7 larvae per plant for the years 2002-20012. However, this increase was 1.5 larvae per plant between autumn 2016 and spring 2017. This increase was 1.28 larvae per plant between autumn 2015 and spring 2016, and 0.09 larvae per plant between autumn 2014 and spring 2015.

The implication for the OSR industry is that it is possible that even with small recorded numbers of adults and larvae in autumn that a large population of CSFB larvae will be present in OSR plants in

spring if the temperature during winter is higher than the average for years prior to 2014. Modelling work would be required to ascertain the effects of mean temperature on population size and on changes in population size. Future research should work to produce predictions of spring CSFB populations based on varying temperature anomalies during the winter months.

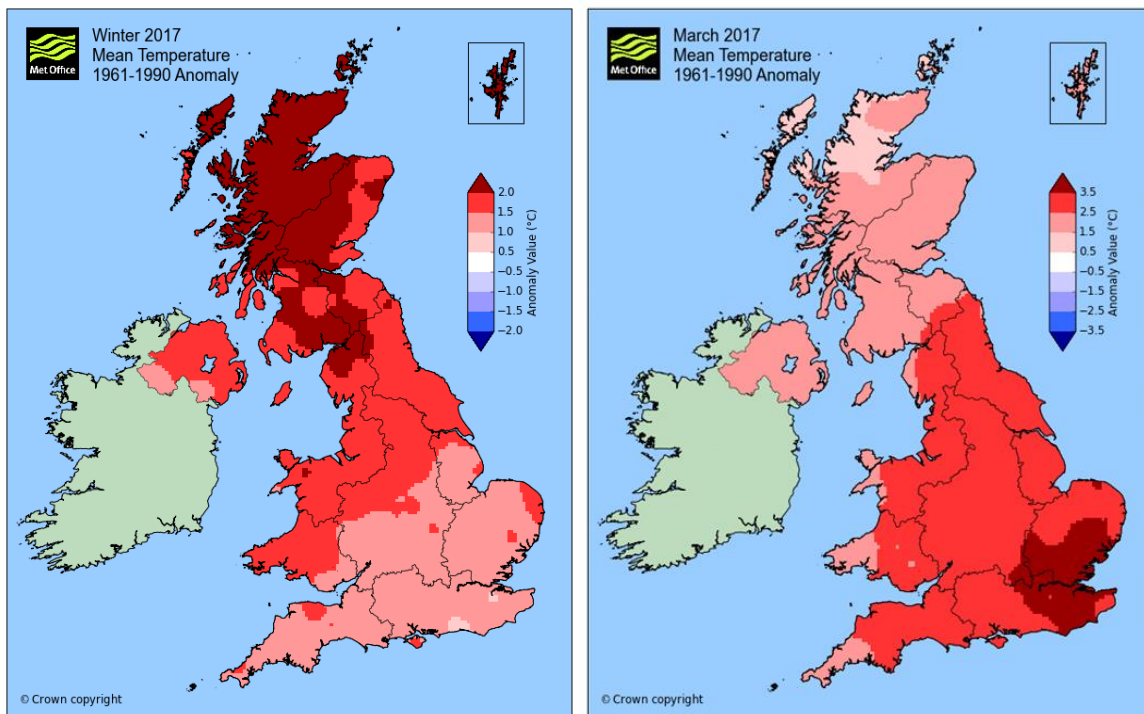


Figure 8. Met Office Maps of Mean Temperature 1961-1990 Anomaly for Winter 2017 and March 2017

6. Acknowledgements

Data from previous survey years is courtesy of Defra.

7. References

- Alford, D.V. 1979. Observations on the cabbage stem flea beetle, *Psylliodes chrysocephala*, on winter oil-seed rape in Cambridgeshire. *Annals of Applied Biology* 93, 117-123.
- Mathiasen, H., Sørensen, H., Bligaard, J., Esbjerg, P. 2015. Effect of temperature on reproduction and embryonic development of the cabbage stem flea beetle, *Psylliodes chrysocephala* L., (Coleoptera: Chrysomelidae). *Journal of Applied Entomology* 139, 600-608.

Appendix A. Mean larvae per plant from autumn 2016 and spring 2017 surveys with the difference in larvae per plant

	Autumn 2016		Spring 2017		Difference between autumn and spring	
County	Number of fields surveyed	Larvae per plant	Number of fields surveyed	Larvae per plant	Larvae per plant	% increase
Bedfordshire	2	1.28	Ns			
Berkshire	2	0.94	Ns			
Buckinghamshire	1	0.4	1	0.28	-0.12	-42.86
Cambridgeshire	8	0.74	5	4	3.26	81.50
Cheshire	1	0	1	0.08	0.08	*
Cleveland	1	0.6	1	2.56	1.96	76.56
Devon	2	0	1	0	0	*
Dorset	1	0.32	Ns			
East Yorkshire	6	0.23	4	0.31	0.08	-3.92
Essex	3	0.33	2	5.64	5.31	3.31
Gloucestershire	2	0.26	2	2.56	2.3	0.30
Hampshire	1	0.04	Ns			
Hereford & Worcester	1	0	Ns			
Hertfordshire	2	1.14	Ns			
Kent	5	1.704	3	2.39	0.69	-2.31
Leicestershire	3	0.693	3	2.52	1.83	-1.17
Lincolnshire	8	0.325	2	2.88	2.55	0.56
Norfolk	3	0.28	1	0.08	-0.2	-1.20
North Yorkshire	7	1.55	4	5.96	4.41	0.41
Northamptonshire	2	0.78	2	1.46	0.68	-1.32
Northumberland	1	0.08	1	0.08	0	-1.00
Nottinghamshire	3	0.55	2	0.44	-0.11	-2.11
Shropshire	4	0.04	3	1.09	1.05	-1.95
Staffordshire	1	0.64	Ns			
Suffolk	3	1.28	Ns			
Tyne & Wear	1	0	Ns			
West Midlands	1	0.08	Ns			
Wiltshire	4	0.34	1	0.36	0.02	-0.98

* = surveyed in spring and autumn but no larvae were found in either the autumn survey or in both surveys. Ns = not surveyed in spring 2017.