An interim impact assessment of the neonicotinoid seed treatment ban on oilseed rape production in England

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Summary

The area of winter oilseed rape (WOSR) grown for harvest in 2015 in England is estimated to be 8% less than that grown for the 2014 harvest at 577,000 ha. A survey was conducted of 205 Farm Business Survey (FBS) farms selected in proportion to the number of growers by region, and where possible, by county. The survey investigated the reasons for increasing or decreasing the area grown and strategies and chemicals used to combat actual, or expected cabbage stem flea beetle (CSFB) attacks. The main reasons given for the area reduction were "rotation" and "price" with CSFB problems coming in third. An estimated 240,000 litres of insecticide, mainly pyrethroid based, was applied to winter oilseed rape crops to combat actual or predicted attacks by CSFB. At a national level in excess of 1.1 million ha was estimated to have been sprayed against CSFB with 33,957 kg of active substance (a.s.) used which represents a 2.5 fold increase in the use of autumn insecticides in England to combat the threat of CSFB. An estimated 17% of growers suffered crop losses due to CSFB with the area lost estimated at 16,000 ha or 3% of the area grown. Of this area an estimated 9,200 ha were replanted and 6,600 ha written off. The total cost of chemicals used to control CSFB is estimated at £7.8 million, the cost of their application £11.4 million, the cost of replanting was estimated at £0.7 million and the crop lost (and not replanted) at £2.3 million resulting in a total of £22 million.

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Introduction

Cabbage stem flea beetle (*Psylliodes chrysocephala*) is an important insect pest of autumn-sown oilseed rape and can significantly reduce crop establishment and yield. Adult beetles emerge from mid to late August onwards and migrate into oilseed rape crops, grazing on cotyledons of newly emerged crops. After about 14 days of grazing adults lay eggs into the soil until temperatures get as low as $0^{o}C$. Larvae emerge October/November to burrow into plants feeding on leaf stalks and stems during autumn and winter.

Seed dressings have provided an important tool in the control of cabbage stem flea beetle (CSFB). In 1992 over 340,000 ha of oilseed rape was treated with the organochlorine compound lindane (effective against cabbage stem flea beetle) as a seed treatment in addition to its use on wheat, barley, sugar beet and many vegetable crops (DEFRA 1996). However the use of gamma-HCH (lindane) seed treatment was revoked in 1999 (due to potential risk to operators). Neonicotinoids are a group of systemic insecticides first registered for use in 1994 that can be applied to a crop as a seed treatment or a foliar spray and are the most widely used insecticides for crop protection (Cresswell and Thomson 2012). They are used in oilseed rape (both autumn and spring sown) to protect the crop against cabbage stem flea beetle, other flea beetles and peach-potato aphids that transmit turnip yellow virus (TuYV). Imidacloprid, a new broad spectrum systemic neonicotinoid insecticide, was first approved for use on oilseed rape crops in 2000 and the area of crop treated then increased over time. Two other neonicotinoid compounds, thiamethoxam and clothianidin, were subsequently approved for use on oilseed rape crops in 2007 and 2008 respectively and have since overtaken imidacloprid in terms of use. In 2012 just under 600,000 hectares of oilseed rape had a seed treatment with 3 of the top 5 applications being neonicotinoids (Garthwaite *et al.* 2013) i.e. Cruiser (thiamethoxam), Modesto (clothianidin) and Chinook (imidacloprid) respectively accounting for 84% of the treated oilseed rape area. Both imidacloprid and clothianidin are co-formulated with the pyrethroid beta-cyfluthrin.

The European Commission have from 1st December 2013 suspended the use of neonicotinoid seed dressings (Regulation EU 540/2011) including imidacloprid (Chinook), clothianidin (Modesto) and thiamethoxam (Cruiser) on bee attractive crops (such as oilseed rape) for 2 years. This has resulted in the potential for increased damage to oilseed rape crops during early establishment and in a potential loss of confidence in this crop by some growers.

In the absence of neonicotinoid seed treatments, control is reliant on the use of foliar pyrethroid sprays. Foliar sprays tend to be reactive so display temporal variation based on pest pressure. The pyrethroid compounds used have varied over time. In the 1990s alpha-cypermethrin and cypermethrin were the principal compounds applied whilst since 2000 the majority of pyrethroid use was lambda cyhalothrin and tau-fluvalinate. Pyrethroids can be applied to control adult beetles and/or larvae. Treatments applied at early growth stages will kill adults while residues on leaves kill larvae hatching after application. In some situations, re-infestation of adults can happen quickly after treatment. An alternative approach is to target the larvae in late November/early December, although spray opportunities may be limited at this time of year. Cabbage stem flea beetles resistant to pyrethroids were detected in Germany in 2008 (Heimbach and Muller 2012) and resistance has now been confirmed in the UK in 2014. Resistance to pyrethroids is partial so growers will still get some control.

Two neonicotinoid sprays have been approved for use from October 2014 which came too late for many UK growers of autumn oilseed rape as CSFB damage was evident in the early autumn of 2014 in some crops (FWI 2014).

- InSyst – contains the neonicotinoid acetamipirid which was given emergency authorization for autumn application for a 120 day period to target CSFB which expired on 23.01.05 (although there is an approval for later season applications to control pollen beetles up to the end of flowering which expires 31.10.2019).

- Biscaya – contains the neonicotinoid thiacloprid with an extension of use to control the peach potato aphid (main vector of turnip yellows virus). It can be used twice in a crop of oilseed rape once in the autumn to control aphids (may give some control of CSFB) and once in spring to control pollen beetle

The effectiveness of these foliar neonicotinoid treatments in light of the seed dressing ban will only become apparent when they have been used commercially i.e. in the autumn of 2015.
The UK oilseed rape area has shown a consistent increase from the early 1970's to reach a peak of 756,000 ha in 2012 (Fig 1). However, since that time there has been a significant decline to a total estimated planted area of about 608,000 ha in 2014 (DEFRA 2015).

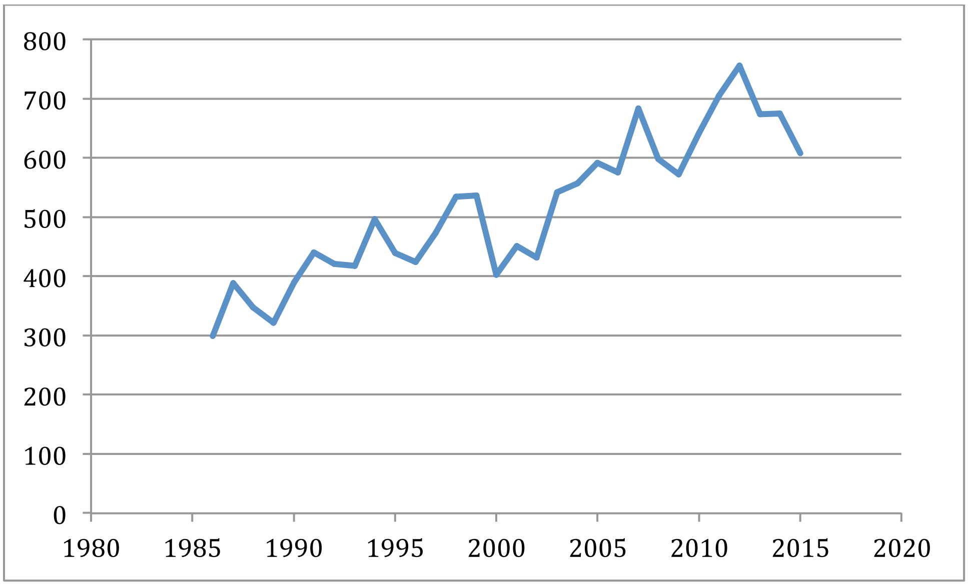

Fig 1. UK oilseed rape area (DEFRA 2015)

Methodology

Sample selection and method
A sample of 205 FBS farms was selected from the 419 that grew winter oilseed rape (both high erucic acid and double low varieties) for the 2013 harvest. Farms were selected in proportion to the number of growers by region, and where possible, by county. The growers were asked 12 questions (Annex 1) by telephone or face-to-face interview regarding: the areas grown for 2015 harvest (in relation to the 2014 harvest) the reasons for increasing or decreasing the area grown and strategies and chemicals used to combat actual, or expected, CSFB attacks.

Sample characteristics

The sample distribution is detailed in Table 1 by county. Counties are grouped to give a minimum sub-sample size of at least 10 farms. Table 2 describes the merged county groupings. Figure 2 presents these amalgamations geographically.

Table 3 and 4 describe the sample distribution by England and EU region respectively. The North West region, with only 4 farms (from Cheshire) is merged with the West Midlands region to ensure a sub-sample size of at least 10 farms.

Twenty farms selected, while growing WOSR in 2013 and 2014 grew no WOSR in 2015. The total area of WOSR grown on the sample farms was 9,744 hectares.

A comparison of the 2013 areas of WOSR grown by the sample farms and the 2013 Defra June survey data suggest that the sample represents 1.5% of growers and 1.8% of the WOSR area grown.

Weighting of sample data

The sample data were weighted up to population level using weights calculated from the 2013 June survey population data and the 2013 sample data of areas of WOSR grown. These weights, when applied to the sample data, estimate the WOSR area grown in 2013 to be within 3% of the 2013 Defra June survey area and within 0.2% of the 2014 June survey area.

Results

Change in area of WOSR grown 2014 to 2015

Of the growers sampled 32% are growing less WOSR (1,380 ha less) and 14% are growing more (501 ha more) with 54% are growing the same area of WOSR. The overall decrease of 880 ha represents an 8% reduction in area (Table 6). The largest reductions were observed in East Midlands, East of England and the South West (Table 7). At the national level this represents a total area grown of 576,744 ha i.e. a reduction of 53,248ha (Table 7) on the area grown in 2014.

Reasons for changing area

The most common reason given for reducing the area grown was “crop rotation”, second “price”, and third was “cabbage stem flea beetle”. Rotation and price were also the 2 most common reasons for growing more (Table 8). The 2 main reasons given by the 20 farms that are not growing any WOSR in 2015 were “price” and “cabbage stem flea beetle”.

The use of insecticides against actual or potential risk of attack by CSFB

82% of sampled growers reported using insecticides against CSFB attacks (actual or predicted). At regional level this varied from 96% in the East of England to 68% in the North West and West Midlands (Table 9). At a county level the use of insecticides varied between 60% and 100% (Table 10). In total 19% (36) of growers changed some agronomic practices in an attempt to reduce the impact of possible CSFB attacks (Table 11).

Insecticides used against CSFB

Cypermethrin was used by 50% of growers, followed by lambda-cyhalothrin (40% of growers) and pymetrozine (11% of growers). These figures take into account farmers using more than one product. A list of insecticides used by chemical name and by region is listed in Table 12.

Quantity of insecticides used against CSFB

The quantities used are calculated on the basis of: *"chemical used" * "declared rate of application" * "area sprayed" * "number of applications"*

On this basis the sample farms used a total of 4165 litres of insecticide against CSFB. (Two chemicals used are solids and use is measured in kg, but overall these account for only a small proportion and are simply counted in as litres for this presentation). The quantities used by chemical name and group (neonicotinoids, pyrethroids and pyridine azomethine) for the FBS sample farms for each region are presented in Tables 13 and 14 respectively.

The sample data is weighted up to an estimated total use of 239,972 litres of insecticide at a national level to combat CSFB (Tables 15 and 16) with the area sprayed in each region presented in Tables 17 and 18. (Please note that this assumes all insecticides are measured in litres, even though 2 are actually measured in kg).

Quantity of active substance used against CSFB

Using manufacturer's information the estimated quantities of insecticide used against CSFB can be converted into kilograms of active substance – Table 16. This allows a direct comparison of this study's estimates with other sources of information on pesticide use on oilseed rape i.e. Pesticide Usage Survey (PUS) (Garthwaite *et al*. 2013). The estimated total active substance used against CSFB was 33,957kg.

Area sprayed against CSFB

An average crop on the sample farms was sprayed twice (202% of area grown) against CSFB. On the sample farms this represents an area of nearly 20,000 ha. Table 17 presents the areas sprayed (against CSFB) by region. Table 18 weights up the sample data to present an estimate of the picture at national level where in excess of 1.1 million ha was estimated to have been sprayed against CSFB.

Area lost to CSFB

Of the sampled growers, 17% estimate to have lost crop to CSFB and a further 1% might lose some crop to the pest (Table 19). In terms of area this equates to some 259 ha or 3% of the area grown in the sample but this varies considerably from zero losses in some areas to an estimated 11% on the sample farms in Essex (Table 20). Weighted sample data estimates that nearly 16,000 ha were lost at the national level (Table 21).

Where crop loss was extensive and conditions allowed, some growers were able to redrill the crop. Of the sample area lost (259 ha – see above) some 152 ha were redrilled, as in 59% of the area initially lost (Table 22). On balance the area lost that was not redrilled (on the sample farms) was 107 ha. Weighting up of sample data indicates that some 9,200 ha had to be redrilled across England. Given an estimate of 15,800 ha originally lost to CSFB, of which 9,200 ha were redrilled leaves some 6,600 ha of WOSR crop area completely lost (Table 23).

Estimated total costs to growers of WOSR

Prices for the insecticides used were canvassed from local suppliers so may be subject to some variation both across the country and with scale of use (Table 24). The cost of insecticide application is taken from Nix (2013) "farmer's average cost" as are the costs of redrilling (cost of seed and a “farmer’s average cost” of drilling). Crop losses, for the area lost and not redrilled, are calculated on the basis of the area lost and an estimated 2015 harvest Gross Margin per hectare. Costs of implementing other changes in agronomic practice (see above) have not been included in these estimates.

This study estimates that the cost of CSFB control in WOSR England is £22 million. The spend on agrochemicals is estimated at £7.8m, with an £11.4m cost of application. The 6,604 ha of crop area lost to CSFB and not redrilled is estimated to have lost growers £2.3m, and the 9,214 ha that was lost to CSFB and then redrilled is estimated to have cost a further £0.7m (Table 25).

Table 1. Sample distribution by county

County	No farms	Ha 2015
Barnsley, Doncaster and Rotherham	1	11
Bedfordshire	3	267
Buckinghamshire	5	377
Cambridgeshire	8	208
Cheshire	4	143
Cornwall and Isles of Scilly	3	169
Darlington	2	31
Derbyshire	1	7
Devon	5	137
Dorset	4	103
Dudley and Sandwell	1	36
Durham	2	89
East Riding of Yorkshire	8	228
East Sussex	3	110
Essex	11	646
Gloucestershire	2	178
Hampshire	4	215
Herefordshire	3	39
Hertfordshire	8	414
Kent	5	355
Kingston upon Hull, City of	1	0
Leicester	1	15
Leicestershire	5	237
Lincolnshire*	24	1040
Norfolk	14	763
North Nottinghamshire	1	0
North Yorkshire	12	229
Northamptonshire	4	79
Northumberland	8	302
Nottinghamshire	5	130
Oxfordshire	6	617
Peterborough	1	38
Shropshire	4	119
Somerset	2	105
South and West Derbyshire	2	140
Staffordshire	1	24
Suffolk	11	946
Warwickshire	7	291
West Berkshire	1	35
West Sussex	1	50
Wiltshire	7	664
Windsor and Maidenhead	1	130
Worcestershire	2	0
York	1	27
Grand Total	205	9744

Table 2. Sample distribution by merged county

Merged Counties	No farms	Ha 2015	% area grown	% growers
Beds, Herts & Cambs	20	927	10%	10%
Chesh, Staffs & Shrops	10	323	3%	5%
Derby, Leics, Notts & Northants	19	607	6%	9%
Dorset, Devon & Cornwall	12	409	4%	6%
East Riding of Yorkshire	11	266	3%	5%
Essex	11	646	7%	5%
Gloucs, Wilts & Somerset	11	947	10%	5%
Heref, Worcs & Warwick	12	330	3%	6%
Kent, Sussex & Hants	13	730	7%	6%
Lincolnshire	24	1040	11%	12%
Norfolk	14	763	8%	7%
North Yorkshire	12	229	2%	6%
North'land & Durham	12	422	4%	6%
Oxs, Bucks & Berks	13	1159	12%	6%
Suffolk	11	946	10%	5%
Grand Total	205	9744	100%	100%

Table 3. Sample distribution by region

Merged Region	No farms	Ha 2015	% area grown	% growers
South East	26	1889	19%	13%
South West	23	1355	14%	11%
North West & West Midlands	22	653	7%	11%
Yorkshire & Humber	23	495	5%	11%
North East	12	422	4%	6%
East of England	56	3282	34%	27%
East Midlands	43	1648	17%	21%
Grand Total	205	9744	100%	100%

Table 4. Sample distribution by EU region

EU Region	No farms	Ha 2015	% area grown	% growers
England North	39	1060	11%	19%
England East	125	6818	70%	61%
England West	41	1865	19%	20%
Total	205	9744	100%	100%

Table 5. Sample distribution in comparison to population distribution

(2013 June Agricultural Survey)					Comparison of sample (2013 areas) with population	
by Region	No growers	Area grown (ha)	% area grown	% growers	% area sampled	% growers sampled
East Midlands	2718	144011	25%	20%	1.2%	1.6%
East of England	3211	152115	26%	24%	2.6%	1.7%
North East	658	21021	4%	5%	1.6%	1.8%
North West & West Midlands	1596	52704	9%	12%	1.1%	1.4%
South East	1510	81146	14%	11%	2.2%	1.7%
South West	1311	53701	9%	10%	2.3%	1.8%
Yorkshire & Humber	2313	79318	14%	17%	0.7%	1.0%
All	13317	584016			1.8%	1.5%

Fig 2. Amalgamation of counties

Table 6. Change in area of WOSR grown; 2014 to 2015 crops – FBS sample

[What is your change in area?]

Area WOSR change by region (ha)	Less	More
East Midlands	232	42
East of England	536	135
North East	52	65
South East	194	140
South West	157	0
Yorkshire & Humber	100	55
North West & West Midlands	110	64
All	1380	501

15_area	14_area	net change	% change
1648	1838	-190	-10%
3282	3683	-401	-11%
422	409	13	3%
653	707	-54	-8%
1889	2045	-157	-8%
1355	1400	-45	-3%
495	541	-46	-8%
9744	10623	-880	-8%

Table 7. Change in area of WOSR grown; 2014 to 2015 crops

WOSR change by region (ha)

	Less	More
East Midlands	15270	2678
East of England	31302	8064
North East	2940	4354
North West & West Midlands	7095	3924
South East	11190	7951
South West	9393	
Yorkshire & Humber	6457	3427
All	83646	30399

15_area	14_area	net change	% change
99338	111930	-12592	-11%
188053	211291	-23238	-11%
28492	27078	1414	5%
41077	44248	-3171	-7%
107601	110839	-3238	-3%
80787	90180	-9393	-10%
31395	34425	-3030	-9%
576744	629992	-53248	-8%

Table 8. Primary reasons for change in WOSR area grown - by region

		Primary reasons for growing less						Primary reasons for growing more		
	Less	**3 crop**	**csfb**	**other**	**price**	**rotation**	**More**	**other †**	**price ***	**rotation**
East Midlands	13	1	2	1	2	7	3		1	2
East of England	22	3	5	3	5	6	9		5	4
North East	1					1	5			5
South East	8	2	1		2	3	4			4
South West	6		1		3	2				
Yorkshire & Humber	9	1			4	4	3		1	2
North West & West Midlands	7		1	1		5	4	1		3
All	66	7	10	5	16	28	28	1	7	20

* price as a reason for expansion is due to fall in Sugar Beet price
† other includes pigeon and blackgrass problems

Table 9. Use of insecticides vs CSFB by region

	No	Yes	% of growers using
East Midlands	11	27	71%
East of England	2	50	96%
North East	3	9	75%
South East	5	20	80%
South West	3	18	86%
Yorkshire & Humber	3	15	83%
North West & West Midlands	6	13	68%
All	33	152	82%

Table 10. Use of insecticides vs CSFB by county

	No	Yes	% of growers using
Beds, Herts & Cambs	1	17	94%
Chesh, Staffs & Shrops	4	6	60%
Derby, Leics, Notts & Northants	6	11	65%
Dorset, Devon & Cornwall	3	8	73%
East Riding of Yorkshire	3	6	67%
Essex		11	100%
Gloucs, Wilts & Somerset		10	100%
Heref, Worcs & Warwick	2	7	78%
Kent, Sussex & Hants	3	9	75%
Lincolnshire	5	16	76%
Norfolk		12	100%
North Yorkshire		9	100%
North'land & Durham	3	9	75%
Oxs, Bucks & Berks	2	11	85%
Suffolk	1	10	91%
All	33	152	82%

Table 11. Change in agronomic practice by region

	drilled earlier	drilled later	increased monitoring of crop	increased seed rate	increased spray applications	other	used autumn fertiliser	variety change
East Midlands			1	1		2	1	
East of England	4			1		1		2
North East							1	
South East	3	1				1	1	
South West	1		1		3			1
Yorkshire & Humber			1		5			
North West & West Midlands			1		3			
All	8	1	4	2	11	4	3	3

Table 12. Choice of insecticide vs CSFB by region

	East Midlands	East of England	North East	North West & West Midlands	South East	South West	Yorkshire & Humber	All	% of growers using
Acetamiprid	0	1	0	0	0	0	0	1	1%
Alpha-cypermethrin	0	5	0	0	3	0	2	10	5%
Beta cyfluthrin	0	0	0	0	0	0	1	1	1%
Cypermethrin	22	28	4	7	11	12	9	93	50%
Deltamethrin	0	1	0	0	0	0	0	1	1%
Lambda cyhalothrin	8	32	6	8	8	7	5	74	40%
Pymetrozine	0	20	0	0	0	1	0	21	11%
Pyrethroid	1	1	0	0	1	0	0	3	2%
Tau-fluvalinate	0	1	0	0	1	0	0	2	1%
Thiacloprid	0	1	0	0	3	1	0	5	3%

Table 13. Quantity of insecticide used against CSFB by region – FBS sample

	East Midlands	East of England	North East	North West & West Midlands	South East	South West	Yorkshire & Humber	All	% by quantity
Acetamiprid (kg)	0	6	0	0	0	0	0	6	0%
Alpha-cypermethrin	0	55	0	0	25	0	14	94	2%
Beta cyfluthrin	0	0	0	0	0	0	10	10	0%
Cypermethrin	342	1242	51	84	350	261	87	2417	58%
Deltamethrin	0	14	0	0	0	0	0	14	0%
Lambda cyhalothrin	32	252	18	84	443	93	7	929	22%
Pymetrozine (kg)	0	393	0	0	0	4	0	397	10%
Pyrethroid	40	26	0	0	71	0	0	137	3%
Tau-fluvalinate	0	25	0	0	3	0	0	28	1%
Thiacloprid	0	37	0	0	79	16	0	132	3%
All	414	2051	69	168	971	373	118	4165	100%

Quantities in litres unless specified
Quantity is calculated as: rate/ha (in litres/ha or grams/ha) * ha * number of applications
Acetamiprid and thiacloprid are both neonicotinoid spray products approved for use in October 2014 which was too late for many growers

Table 14. Quantity of insecticide (by chemical group) used against CSFB by region – FBS sample

Chemical group	East Midlands	East of England	North East	North West & West Midlands	South East	South West	Yorkshire & Humber	All	% by quantity
Neonicotinoid	0	43	0	0	79	16	0	137	3%
Pyrethroid	414	1615	69	168	892	353	118	3630	87%
Pyridine azomethine	0	393	0	0	0	4	0	397	10%
All	414	2051	69	168	971	373	118	4165	100%

Quantity is calculated as: rate/ha (in litres/ha or grams/ha) * ha * number of applications

Table 15. Estimate of quantity of insecticide (by chemical group) used against CSFB by region

	East Midlands	East of England	North East	North West & West Midlands	South East	South West	Yorkshire & Humber	All	% by quantity
Neonicotinoid	0	2450	0	0	4378	955	0	7784	3%
Pyrethroid	24665	91877	4323	10205	50372	20709	7730	209881	87%
Pyridine azomethine	0	22011	0	0	0	296	0	22307	9%
All	24665	116338	4323	10205	54751	21961	7730	239972	100%

Quantity is calculated as: rate/ha (in litres/ha or grams/ha) * ha * number of applications

Table 16. Estimate of quantity of insecticide active substance used against CSFB by region

	East Midlands	East of England	North East	North West & West Midlands	South East	South West	Yorkshire & Humber	All
Acetamiprid	0	70	0	0	0	0	0	70
Alpha-cypermethrin	0	12	0	0	199	64	76	352
Beta cyfluthrin	0	0	0	0	0	0	19	19
Cypermethrin	2,015	6,382	315	487	2,305	1,425	441	13,370
Deltamethrin	0	22	0	0	0	0	0	22
Lamda-cyhalothrin	452	1,605	117	519	2,438	521	48	5,700
Pymetrozine	0	11,005	0	0	0	148	0	11,154
Thiacloprid	0	840	0	0	1,092	229	0	2,161
Zeta-cypermethrin	0	939	0	15	0	24	132	1,109
All	2,466	20,876	432	1,020	6,034	2,411	716	33,957

Quantity is calculated as: rate/ha (in litres/ha or grams/ha) * ha * number of applications*proportion of active substance in product

Table 17. Area sprayed by insecticide group by region – FBS sample

	East Midlands	East of England	North East	North West & West Midlands	South East	South West	Yorkshire & Humber	All
Neonicotinoid	0	153	0	0	263	47	0	463
Pyrethroid	1972	8883	445	684	2846	1591	736	17157
Pyridine azomethine	0	2092	0	0	0	17	0	2109
All	1972	11127	445	684	3109	1655	736	19729
Area grown (ha)	1648	3282	422	653	1889	1355	495	9744
% area sprayed	120%	339%	106%	105%	165%	122%	149%	202%

Table 18. Estimate of area sprayed by insecticide group by region

	East Midlands	East of England	North East	North West & West Midlands	South East	South West	Yorkshire & Humber	All
Neonicotinoid	0	8752	0	0	14594	2895	0	26241
Pyrethroid	119140	508348	28516	42148	161232	93715	47400	1000500
Pyridine azomethine	0	116799	0	0	0	1185	0	117984
All	119140	633900	28516	42148	175826	97795	47400	1144725
Area grown (ha)	99338	188053	28492	41077	107601	80787	31395	576744
% area sprayed	120%	337%	100%	103%	163%	121%	151%	198%

Table 19. Area lost (ha) to CSFB by region – sample

	Possibly	Yes	All	Area grown	% lost of area grown
East Midlands		42	42	1648	3%
East of England		141	141	3282	4%
North East		0	0	422	0%
North West & West Midlands		9	9	653	1%
South East		9	9	1889	<1%
South West		43	43	1355	3%
Yorkshire & Humber	2	13	15	495	3%
All	2	257	259	9744	3%

Table 20. Area lost (ha) to CSFB by county – sample

	Possibly	Yes	All	Area grown (ha)	% lost of area grown
Beds, Herts & Cambs		69.4	69.4	927	7%
Chesh, Staffs & Shrops		9.3	9.3	323	3%
Derby, Leics, Notts & Northant		0.4	0.4	607	<1%
Dorset, Devon & Cornwall		0.1	0.1	409	<1%
East Riding of Yorkshire		13.4	13.4	266	5%
Essex		69.8	69.8	646	11%
Gloucs, Wilts & Somerset		42.5	42.5	947	4%
Heref, Worcs & Warwick			0.0	330	-
Kent, Sussex & Hants		1.0	1.0	730	<1%
Lincolnshire		41.2	41.2	1040	4%
Norfolk		1.5	1.5	763	<1%
North Yorkshire	2		2.0	229	1%
North'land & Durham		0.2	0.2	422	<1%
Oxs, Bucks & Berks		8.1	8.1	1159	1%
Suffolk			0.0	946	-
All	2	256.9	258.9	9744	3%

Table 21. Estimated area lost (ha) to CSFB by region

	Possibly	Yes	All	Area grown	% lost of area grown
East Midlands		2439	2439	99338	2%
East of England		8656	8656	188053	5%
North East		15	15	28492	<1%
North West & West Midlands		725	725	41077	2%
South East		551	551	107601	1%
South West		2327	2327	80787	3%
Yorkshire & Humber	136	970	1106	31395	4%
All	136	15682	15818	576744	3%

Table 22. Area (ha) redrilled following CSFB losses by region – sample

	Yes	Area grown	% area grown redrilled
East Midlands	16.95	1648	1%
East of England	121.89	3282	4%
North East		422	-
North West & West Midlands		653	-
South East	8.09	1889	<1%
South West		1355	-
Yorkshire & Humber	5	495	1%
All	151.93	9744	2%

Table 23. Estimate of area (ha) redrilled following CSFB losses by region

	Yes	Area grown (ha)	% area redrilled	All area lost	Lost and not redrilled
East Midlands	963	99338	1%	2439	1476
East of England	7367	188053	4%	8656	1288
North East		28492	-	15	15
North West & West Midlands		41077	-	725	725
South East	494	107601	<1%	551	57
South West		80787	-	2327	2327
Yorkshire & Humber	389	31395	1%	1106	717
All	9214	576744	2%	15818	6604

Table 24. Prices of insecticides used against CSFB

Insecticide	Quantity	cost (£/litre or £/kg)	Total cost (£)
Acetamiprid (kg)	351	70	24564
Alpha-cypermethrin	5542	21	116389
Beta cyfluthrin	759	20	15188
Cypermethrin	136542	10	1365417
Deltamethrin	882	20	17640
Lambda cyhalothrin	53977	85	4588083
Pymetrozine (kg)	20179	56	1130035
Pyrethroid	7879	10	78790
Tau-fluvalinate	1572	35	55035
Thiacloprid	7433	50	371632
All	239972		7762772

Quantities in litres unless specified

Table 25. An estimate of the total costs of CSFB

	Area (ha)	Quantity	Cost £/ha	£
Chemicals used vs CSFB		239,972		7,762,772
Cost of applying chemicals vs CSFB	1,144,725		10	11,447,251
Crop lost and not redrilled	6,604		350	2,311,467
Cost of redrilling lost area	9,214		80	737,108
Total				22,258,598

Discussion

The reduction in autumn-sown oilseed rape planted in England of 8.8% (576,744 ha) identified in this survey is consistent with the reduction in planted area of 9.9% across the UK (DEFRA 2015). In the survey of 205 FBS farms carried out in the spring of 2015 for the effects of the neonicotinoid seed dressing ban, cabbage stem flea beetle risk was identified as the third most important reason for the reduction in area grown and behind ‘crop rotation’, and a ‘reduced commodity price’.

The survey data also identifies a loss of 259 ha or 3% of the area grown attributed to CSFB in the sample which equates to 15,800 ha of crop lost at a national level. The losses varied considerably by both region and county from zero losses in some areas to an estimated 11% on sample farms in Essex and the highest loss by region being the East of England at 5% of crop area. Where crop loss was extensive and conditions allowed, some growers were able to redrill the crop. Of the sample area lost (259 ha) some 152 ha were redrilled i.e. 59% of the area initially lost. Given a national loss of 15,800 ha then this equates to 9,200 ha of the crop area being re-drilled, with 6,600 ha of winter oilseed rape completely lost. The crop losses identified in this report with the requirement for re-drilling takes no account of subsequent crop damage caused by reported high numbers of larvae present in plants over-winter and the potential damage caused through their effects on growth and increased susceptibility to disease. The Spring Pest Survey (based on destructively sampling of twenty five plants from regional sites in England and assessment of CSFB larvae numbers) carried out by FERA in 2015 (DEFRA 2015) clearly shows a much higher level of CSFB larvae than in the previous 6 years. Levels were particularly high in the East (2.56 larvae per plant) and South-East regions (1.22 larvae per plant).

The crop loss data presented from this survey is in very close agreement to a study carried out by ADAS to provide a snapshot of potential damage caused by CSFB at the end of September 2014 (HGCA 2014). The ADAS study showed a crop loss estimate of 2.7% (18,000 ha) for Great Britain with half of this area being re-drilled and the other half left bare (HGCA 2014). This information was obtained from a network of 23 local agronomists covering 30 counties providing evidence of incidence and severity based on crops walked from 22-29th September 2014. Assessments were based on 32,000 ha of winter oilseed rape equivalent to 5% of the national area which was weighted and multiplied to give a county, region and GB picture. The worst affected regions were in the South East and Eastern region with the majority of crop losses occurring here and into parts of Yorkshire. Counties with the highest proportion of damage were Hampshire, Surrey, Bedfordshire and Hertfordshire.

In addition to the snapshot ADAS study carried out at the end of September the annual AHDB Market Intelligence Winter Planting Survey for 2014 (AHDB 2015) included a number of additional questions to gather further evidence on the impact of the neonicotinoid restrictions. Approximately 5.0% of the WOSR area originally planted was reported to have been lost to adult CSFB. At 32,000 hectares this represents a 2 fold increase in the area lost identified from the RBR survey. About 1.5% of this area was reported to have been successfully replanted which is the same as the level identified in the RBR survey. The remaining 3.5% was estimated to be equivalent to 22,000 ha lost in England. Over 1,300 WOSR growers, with crops equivalent to 8% of the national area in England and Wales, completed the survey based on planted areas as at 1 December 2014. Approximately 11% of respondents said they would have planted additional areas of WOSR, if neonicotinoid seed treatments had been available. This was estimated to be equivalent to 38,000 ha not planted in England.

The most readily available alternatives to neonicotinoid seed dressings for the control of CSFB are pyrethroid based spray treatments, where resistance was first identified in Germany in 2008 (Heimbach & Muller 2012) and has now been found in the UK (AHDB 2014). This, together with the inherently more difficult control achieved by foliar sprays because of the need for optimum pest monitoring, spray timing and ideal weather conditions, makes control more difficult with the use of pyrethroid sprays.

Of the sampled growers 82% reported using insecticides against CSFB attack (actual or predicted). At regional level this varied from 96% in the East of England to 68% in the North West and West Midlands. At a county level the use of insecticides varied between 60% and 100%. The highest levels of 100% were recorded in Essex, Gloucestershire, Wiltshire, Somerset, Norfolk and North Yorkshire. The lowest levels of insecticide spray use were generally in areas were reported losses were low thereby supporting the reactive use of sprays where and when pest attack is most likely as suggested by Hughes *et al* (2014). This is supported by the information that farmers in the East and South-East of England used an average of 3.3 and 1.65 spray applications per crop respectively to counteract the identified high risk in these areas.

An average crop on the sample farms was sprayed twice over (202% of area grown) against CSFB which represents an area in excess of 19,000 ha. At a national level in excess of 1.1 million ha are estimated to have been sprayed against CSFB. From this RBR survey 33,957 kg of a.s. was used in the autumn to combat the threat of CSFB which represents a 2.5 fold increase in the use of autumn insecticides to WOSR in England. This 2.5 fold increase is taken from the PUS data for 2012 which shows a total insecticide application (autumn + spring) of 34,422 kg of a.s. to WOSR in England (David Garthwaite *pers.comm.*) of which 45% was applied in the autumn.

The results presented here supports the ADAS snapshot study (HGCA 2014) which by the end of September showed that 58% of the winter oilseed rape crop (387,000 ha) had been treated with a pyrethroid spray with greatest use in the South East and Eastern region. It was also a view from this initial snapshot assessment that the earlier drilled crops were less susceptible to CSFB with crops drilled in mid-August having developed beyond the key at risk susceptible growth stage (more than 4 true leaves) by the time that migration started.

A clear outcome of this RBR survey is the very high cost nationally of pesticide sprays against cabbage stem flea beetle which was identified at £19 million of which £7.8 M was the cost of chemical and £11.4 M the cost of application. The projected insecticide usage cost does not take into account a cost saving of about £6 M taken from the ban on the use of neonicotinoid seed dressings based on an estimated average cost of £10/ha. The estimated cost of crop loss from cabbage stem flea beetle is estimated at £3 M based on an estimated £350 per hectare together with redrilling costs estimated at £80/ha.

Cultural management strategies provide an option for reducing the need for insecticide treatments in the control of CSFB. Sowing date is a clear management strategy that may be used to combat the threat of CSFB. Delayed sowing date provides a clear management option in reducing the number of adults attracted and hence eggs laid as beetles prefer developed crops to lay their eggs into. However this option provides an increased risk if eggs are laid as smaller plants are more vulnerable to attack. Once plants are beyond the seedling stage they are much less vulnerable to feeding damage (Gavloski and Lamb 2000) which indicates a potential role for early sowing and increased plant size to combat the threat. Increasing plant density, zero tillage, increased seed size and planting at wider row spacings have all been shown to reduce the damage from flea beetles (*Phyllotreta* spp.) in oilseed rape (Brodnaryk and Lamb 1991; Dodsall *et al* 1999; Doddsall and Stevenson 2005). These management practices need to be considered as part of an integrated management strategy to reduce insecticide use in the light of a prolonged neonicotinoid seed dressing ban and increasing evidence of resistance to pyrethroids in CSFB.

Conclusions

Insecticidal control of CSFB in the past has relied on a combination of seed treatment and foliar sprays. The absence of neonicotinoid seed treatments is making CSFB control more challenging for farmers with significant losses of crop identified in the autumn of 2014. The estimated 33,957 kg of a.s. used in the autumn to combat the threat of CSFB represents a 2.5 fold increase in the use of autumn insecticides to WOSR in England and is likely to be a direct result of the ban on neonicotinoid seed dressings. The increased use and reliance on pyrethroids for CSFB control has significant future implications since resistance has now been identified in the UK. The loss of neonicotinoid seed treatments poses a significant challenge to growers at a time when significant price reductions have occurred in the value of this crop, together with an increased threat from the fungal pathogen light leaf spot raising the question for many farmers as to the true value of oilseed rape in the crop rotation.

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Annex 1 – Survey questionnaire

Study of Winter Oilseed rape plantings autumn 2014

farm number [ ]

1	What area of WOSR did you plant in autumn 2014?					area (ha)
2	Is your planted area of WOSR more or less than normal?					more, same or less
3	If so, why?					
4	And by how much?					area (ha) or na
5.1	Did you use insecticides to combat actual or predicted CSFB attacks?					yes or no
5.2	(or change agronomic practices to avert possible CSFB damage)					
6	What chemical or chemicals?					chemical name
7	What rate was it, were they, applied at?					litre/ha or gm/ha
8.1	What area was treated?					area (ha)
8.2	(If multiple applications please record areas and incidence; e.g. 40ha*3 applications)					number of applications
8.3	If the same chemical is used at the same rate but for different areas or a different number of applications please use these cells					area (ha)
8.4						number of applications
8.5						area (ha)
8.6						number of applications
9	Despite or regardless of insecticide use did you lose any crop area due to CSFB?					yes or no
10	If so, what area?					area (ha) or na
11	Was any CSFB crop damage so severe that you have had to redrill?					yes, no or na
12	If so what area?					area (ha) or na
	Any further comments					