Final Project Summary

Project title	Maximising control of cabbage stem flea beetles (CSFB) without neonicotinoid seed treatments		
Project number	214-0009	**Final Project Report**	PR546
Start date	September 2013	**End date**	October 2014
AHDB Cereals & Oilseeds funding	£11,810	**Total cost**	£11,810

What was the challenge/demand for the work?

The 2013/14 cropping season was the last before the suspension of use of neonicotinoid seed treatments in oilseed rape took effect. The aim of this project was to conduct a one-year study to investigate establishing oilseed rape without neonicotinoids and to identify topics for further research.

In the absence of neonicotinoid insecticides, growers will have only foliar sprays of pyrethroid insecticides to combat cabbage stem flea beetle (CSFB). Overuse of these products could select for insecticide resistance. Therefore, work was also done to determine to what extent OSR seedlings can tolerate loss of leaf area due to 'shot-holing' damage from adult CSFB to help improve risk assessment for the pest.

The main objectives of this project were to:

1. Identify levels of CSFB control achievable without the use of neonicotinoids
2. Assess tolerance of oilseed rape seedlings to simulated 'shot hole' damage at a range of growth stages

How did the project address this?

The project involved a field experiment and a pot experiment.

Field experiment to investigate levels of CSFB control achievable without the use of neonicotinoids

The field experiment was established at Settrington, North Yorkshire, at a site with a previous history of CSFB damage. There were three experimental treatments (Table 1) replicated eight times to give 24 plots in total. The oilseed rape variety was PR46W21, sown on 9 September 2013 to achieve a plant population of 70 seeds/m^2.

The foliar spray of Hallmark was applied at the two-leaf stage on 15 October 2013. The spray was applied with an Oxford Precision Sprayer using flat fan nozzles (LD02F110) to achieve medium spray quality in the equivalent of 200 L water/ha. The plots received the same inputs as the field crop and these were applied by the host farmer. No other insecticides were applied to the crop. Numbers of adult CSFB were monitored with yellow water traps. Plant populations, number of shot holes per plant and crop yield were also assessed.

Table 1. List of treatments for field experiment

Treatment number	Treatment
1	Untreated seed
2	Cruiser OSR (fludioxinil, metalaxyl-M, thiamethoxam treated seed
3	Untreated seed + Hallmark (lamda-cyhalothrin) @ 50ml/ha in 200l water/ha

Glasshouse experiment to measure the tolerance of oilseed rape seedlings to loss of leaf area by simulating adult CSFB damage

The pot experiment was located in a glasshouse maintained at 15°C and 16 hours daylight to mimic conditions in late summer/early autumn. Pots were watered as necessary. There were 15~~6~~ defoliation treatments in total (Table 2) replicated six times to give 96 pots in total. Three oilseed rape seeds (cv PR46W21) were sown per plot and thinned after emergence to leave one seedling per pot. Green area and dry matter yield was assessed once seedlings had reached the six leaf stage.

Table 2. List of treatments for glasshouse experiment

Treatment	Both cotyledons	Leaf 1	Leaf 2
1	No defoliation	No defoliation	No defoliation
2	Slight (20% defoliation)	No defoliation	No defoliation
3	Severe (100% defoliation)	No defoliation	No defoliation
4	Moderate (50% defoliation)	No defoliation	No defoliation
5	Moderate (50% defoliation)	Slight (20% defoliation)	No defoliation
6	Moderate (50% defoliation)	Moderate (50% defoliation)	No defoliation
7	Moderate (50% defoliation)	Severe (100% defoliation)	No defoliation
8	Moderate (50% defoliation)	Slight (20% defoliation)	Slight (20% defoliation)
9	Moderate (50% defoliation)	Slight (20% defoliation)	Moderate (50% defoliation)
10	Moderate (50% defoliation)	Slight (20% defoliation)	Severe (100% defoliation)
11	Moderate (50% defoliation)	Moderate (50% defoliation)	Slight (20% defoliation)
12	Moderate (50% defoliation)	Moderate (50% defoliation)	Moderate (50% defoliation)
13	Moderate (50% defoliation)	Moderate (50% defoliation)	Severe (100% defoliation)
14	Moderate (50% defoliation)	Severe (100% defoliation)	Slight (20% defoliation)
15	Moderate (50% defoliation)	Severe (100% defoliation)	Moderate (50% defoliation)
16	Moderate (50% defoliation)	Severe (100% defoliation)	Severe (100% defoliation)

Final Project Summary

What outputs has the project delivered?

Field experiment to investigate levels of CSFB control achievable without the use of neonicotinoids

Numbers of CSFB in the field experiment were relatively low. Cruiser-treated seed improved plant populations compared with the untreated control (Table 3) but all treatments had sufficient plants to achieve potential yield. Cruiser and Hallmark both reduced the numbers of shot holes (Table 4) but levels of damage were less than the threshold of 25% leaf area lost at the 1–2 leaf stage that would justify insecticide treatment. There was no statistically significant effect of treatment on crop yield.

Table 3. Mean number of plants (number/m^2) in plots sown with untreated seed, Cruiser treated seed or untreated seed plus Hallmark spray at Settrington, North Yorkshire in October and November 2013

	Plant number/m^2						
Treatment	**10 Oct**	**17 Oct**	**25 Oct**	**31 Oct**	**6 Nov**	**15 Nov**	**21 Nov**
Untreated	68.8	68.8	67.1	65.4	65.4	60.0	59.2
Cruiser OSR	90.0	91.7	87.9	80.4	80.4	75.0	74.6
Untreated + Hallmark	80.4	80.8	78.3	69.2	69.2	66.2	67.5
F prob P	**<0.05**	**<0.05**	**<0.05**	**<0.05**	**<0.05**	**<0.05**	**<0.05**
SED (6df)	**7.07**	**7.16**	**6.49**	**4.93**	**4.93**	**4.83**	**9.53**

Table 4. Mean number of shot holes per plant in plots sown with untreated seed, Cruiser treated seed or untreated seed plus Hallmark spray at Settrington, North Yorkshire in October and November 2013

	Shot holes/plant						
Treatment	**10 Oct**	**17 Oct**	**25 Oct**	**31 Oct**	**6 Nov**	**15 Nov**	**21 Nov**
Untreated	1.6	2.2	2.8	2.8	2.9	3.4	3.7
Cruiser OSR	1.1	1.7	1.7	1.8	1.7	2.1	2.4
Untreated + Hallmark	1.1	2.1	2.0	2.6	2.5	2.9	3.2
F prob P	**0.094**	**0.469**	**<0.05**	**<0.05**	**<0.05**	**<0.01**	**<0.01**
SED (6df)	**0.26**	**0.37**	**0.35**	**0.23**	**0.33**	**0.31**	**0.31**

Glasshouse experiment to measure the tolerance of oilseed rape seedlings to loss of leaf area by simulating CSFB adult damage

Green leaf area

In the pot experiment there was surprisingly little impact of defoliation on subsequent green area at the six leaf stage (Figure 1) or dry matter yield. In 13 out of 15 defoliation treatments there was no significant difference in green leaf area between defoliated plants and the untreated control; in the remaining two defoliation treatments (treatment 3: removal of both cotyledons and treatment 12: 50% of the cotyledons, leaf 1 and leaf 2 removed), green leaf area was significantly increased.

Dry matter yield

Overall, only three of 15 defoliation treatments (16, 10 and 14) significantly reduced dry matter yield compared with the untreated control, eleven had no effect and, where both cotyledons were removed (treatment 3), dry matter yield was significantly increased. In summary, results showed that, once above ground, oilseed rape has significant inherent ability to compensate for loss of leaf area. It is clear that crop damage does not necessarily equate to loss of yield and results from the pot experiment suggest that defoliation thresholds may be too conservative.

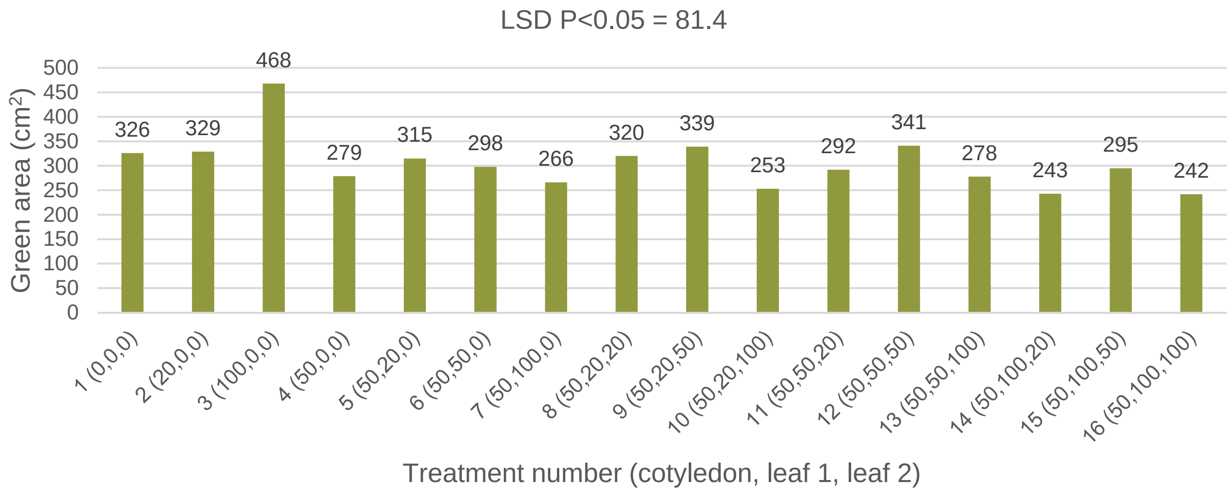

Figure 1. Green leaf area (cm^2) of oilseed rape seedlings at six leaf stage subjected to a range of defoliation treatments. Numbers in brackets indicate the % leaf or cotyledon removed.

Final Project Summary

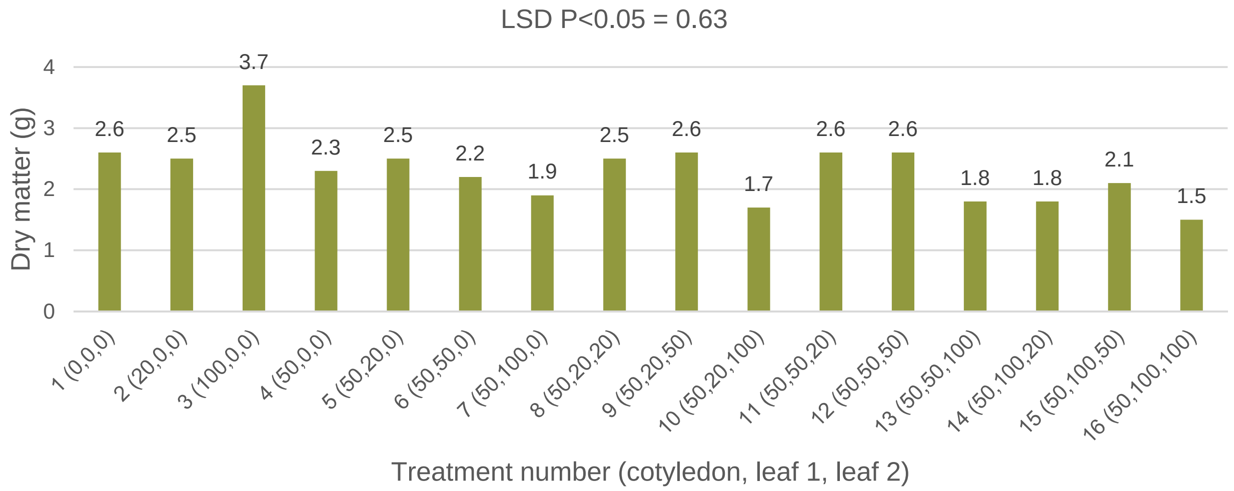

Figure 2. Dry matter yield (g) of oilseed rape seedlings at six leaf stage subjected to a range of defoliation treatments. Numbers in brackets indicate the % leaf or cotyledon removed.

Who will benefit from this project and why?
Farmers and agronomists will benefit from this project. Results showed that, once above ground, oilseed rape has significant inherent ability to compensate for loss of leaf area. Tolerance to loss of green area has the potential to limit unnecessary applications of insecticides, which improves the cost effectiveness of growing oilseed rape and also minimises impacts on non-target species. It is important to understand that crop damage does not necessarily adversely impact yield. Further research is required to validate the glasshouse study in the field but results have improved our understanding of the interaction between CSFB and oilseed rape and will contribute to the development of a rational approach to pest control minimising reliance on insecticide sprays.

If the challenge has not been specifically met, state why and how this could be overcome
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Lead partner	Steve Ellis, ADAS
Scientific partners	–
Industry partners	–
Government sponsor	–