Final Project Summary

Project title	Investigating components of the oilseed rape light leaf spot epidemic responsible for increased yield loss to the UK Arable Industry		
Project number	21120022	**Final Project Report**	PR587
Start date	01/08/2013	**End date**	31/12/2016
AHDB Cereals & Oilseeds funding	£78,205	**Total cost**	£93,205

What was the challenge/demand for the work?

Extensive research over the past 30-40 years has investigated different aspects of the epidemiology of the winter oilseed rape disease light leaf spot (LLS) caused by the fungus *Pyrenopeziza brassicae*. Growers follow a variety of best management practices on their farms. Despite these efforts, the incidence and severity of LLS and subsequent yield loss had increased substantially in the UK in recent years. The increase was partly explained by failure to use varieties with improved levels of host resistance and the poor timing of fungicide applications targeted at controlling LLS. This responsive-mode project aimed to re-assess the importance of different components of the epidemic. The main aim of the project was to develop a novel decision support tool to predict LLS epidemic onset by modelling the inter-crop development and maturation of the fungus using pre-defined parameters readily available from existing literature. This would provide growers and advisors with a "heads up" warning that the start of the epidemic was imminent, much like the phoma leaf spot forecast produced for a number of years.

How did the project address this?

The project involved a series of field experiments, data analysis and modelling to investigate aspects of the epidemiology of the LLS pathogen and the role of different environmental conditions for pathogen development. Field experiments involved 3 seasons of field monitoring of disease development at various sites across the UK, in plots sown with three different varieties (high, medium and low resistance ratings). Plot monitoring was done in conjunction with in-field spore sampling and in-field meteorological data recording was also done at a number of the sites. Data were analysed using standard statistical techniques and outcomes were communicated to industry via the farming press, workshops and demonstration events such as the annual Cereals event.

What outputs has the project delivered?

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There were two major outputs from the project:

a. Differential infection of varieties at different geographical locations.
b. Knowledge that ascospores were produced and released much earlier than previously thought indicating earlier onset of infection.

a. Differential response of varieties with respect to resistance rating at different geographical locations.

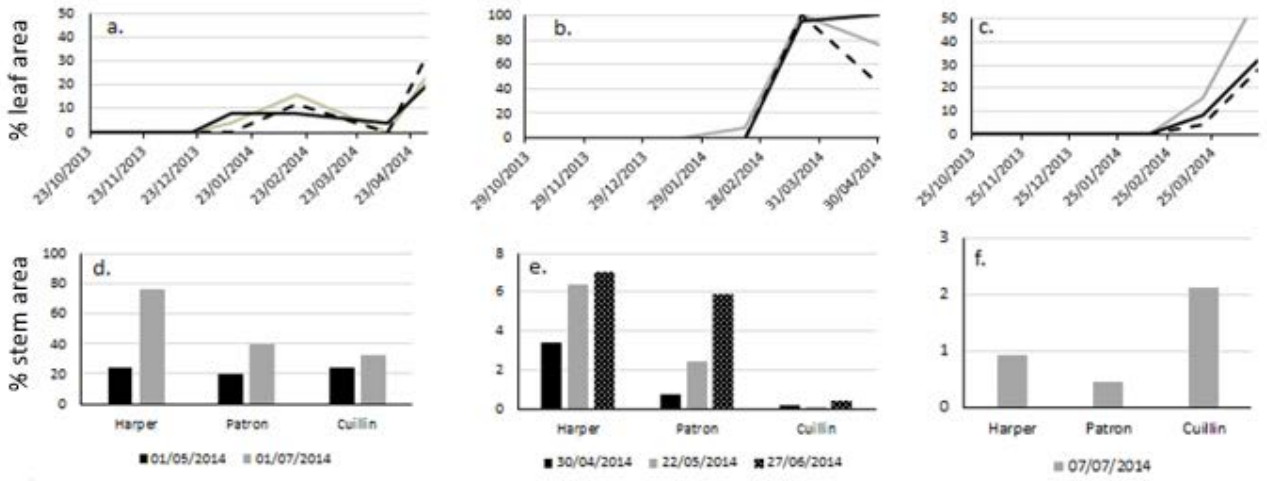

Figure 1. Incidence of leaves affected (a, b & c; Cuillin ----- resistance rating 8, Harper —— resistance rating 6, Patron —— resistance rating 4) and percentage stem area affected (d, e, and f) with light leaf spot at High Mowthorpe North Yorkshire (a & d), ADAS Rosemaund (b & e) and ADAS Boxworth (c & f) during the 2013/14 season. (Note difference in scale at each site indicating very different levels of disease at each site).

Results from field evaluation of varieties with different resistance ratings (Cuillin/Cracker, 8; Harper, 6; Patron/Charger, 4) during 2013/14 (Figure 1), 2014/15 and 2015/16 seasons indicated that not only was resistance of the “resistant” varieties eroded, but that there was differential response of varieties across different geographical locations. This, in conjunction with results from recent work from a PhD study at the University of Hertfordshire (Klöpple, pers com) indicates the LLS population interacts with the OSR host through a gene-for-gene race structure and highlights the need for a better understanding of the importance of utilising host resistance as a control strategy.

b. Ascospore monitoring and implications for disease forecasting.

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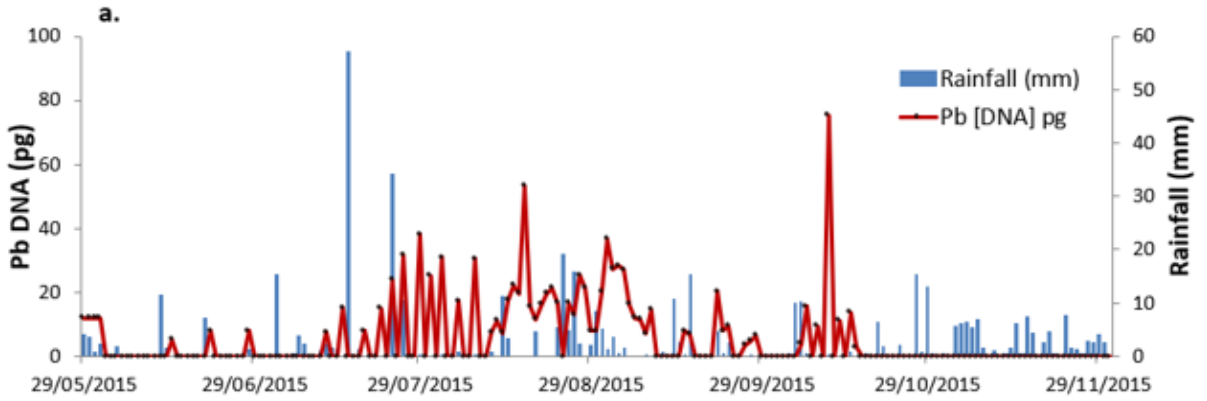

Figure 2. Amount of *Pyrenopeziza brassicae* DNA captured by a 7 day volumetric Burkard spore trap sited on the roof of the North Building, Rothamsted Research during 2015 plotted against rain events.

Analysis of spore trap data during the project indicated that apothecial development and subsequent ascospore release occurred much earlier in the season than had been previously considered. Spore release was observed throughout the summer months during a number of seasons and for example, was found to occur from mid-May onwards (Figure 2a) during the 2015 season. Data also indicated that the main flush of ascospores had finished by mid-September/early October most seasons. The results indicate that spore release happens throughout the summer period and unlike the mono-cyclic disease phoma leaf spot and stem canker, spore release and subsequent infection of new OSR leaf material seems to be ongoing. The polycyclic nature of the LLS infection process results in a chaotic scenario at the field level (Figure 3) and since there is no effective “start” date, the development of a date-driven epidemic onset model for LLS could not be defined.

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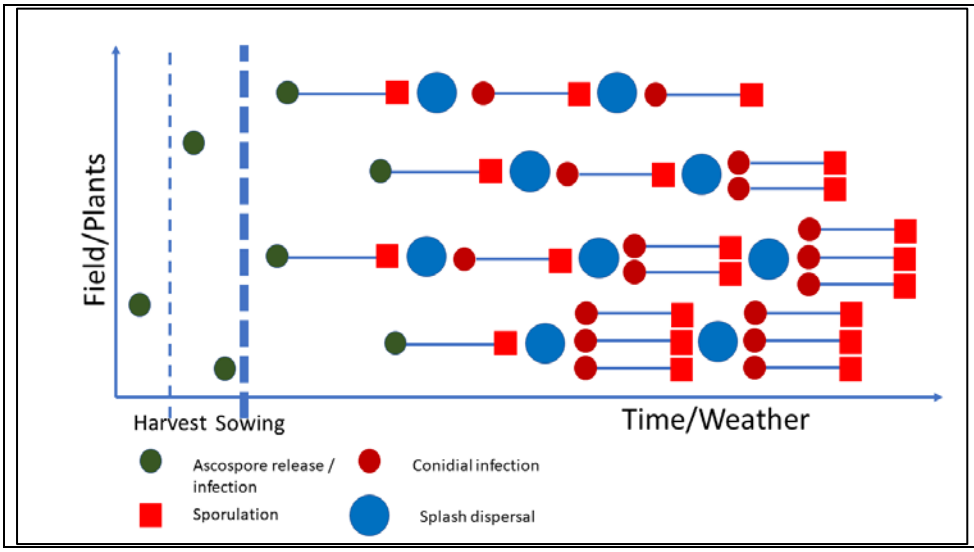

Figure 3. Schematic showing a proposed "chaotic" development of a light leaf spot epidemic on winter oilseed rape in the UK in late autumn, early winter.

Who will benefit from this project and why?
Major beneficiaries from this project are arable growers and their advisors since the results provide further detailed information on the epidemic process regarding LLS infection and provide new insights into possible control strategies to reduce the considerable losses caused by this disease to the UK agroindustry.

If the challenge has not been specifically met, state why and how this could be overcome
It was not possible to produce a date-driven model for LLS epidemic onset. Results from the project indicated that fungal development and spore production was an ongoing process that was part of the polycyclic nature of this specific disease and that because of this, there was no effective start date to the epidemic. However, the outcomes from this project provide novel information on the LLS epidemic process and raise interesting questions pertinent to future control strategies for LLS.

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Government sponsor	None