Final Project Summary

Project title	Soil borne pathogens of oilseed rape: assessing their distribution and potential contribution to yield decline.		
Project number	RD-2012-3790	**Final Project Report**	SR44 (PhD)
Start date	October 2013	**End date**	December 2016
AHDB Cereals & Oilseeds funding	£18, 750	**Total cost**	£109,500

What was the challenge/demand for the work?

Yield decline is witnessed in many crop species worldwide, contributing to a decrease in agricultural productivity. This decline has been linked previously to many different factors, both biotic and abiotic in nature. However, it would appear that soil is integral to many of these and soil-borne pathogens have been implicated in the cause of disease and yield loss in oilseed rape (OSR). In the UK, few surveys examining soil borne diseases of OSR have been conducted, and this project aimed to elucidate which pathogenic fungal species are present within UK crops of OSR, and to examine their effect on plant health and yield decline.

How did the project address this?

Previously collected field samples from a HAU project were used as a starting point to survey for potential candidate pathogens. These samples encompassed a wide range of both agronomic and geographic variables, although primarily focusing on OSR rotation length. Root samples were analysed using a novel molecular technique known as high throughput sequencing (HTS) or more commonly next generation sequencing (NGS). This enabled us to examine the fungal species, both pathogenic and non-pathogenic, present within the root samples and to explore whether there was a relationship to the agronomic or geographic factors, with a particular focus on known plant pathogens. From this it was found that fungal communities differed very little, being dominated by soil generalists and saprophytes. However, a number of pathogenic species were also present, with *Rhizoctonia solani* being the most abundant. Consequently, further work focussed on infection of OSR by *R. solani*.

Rhizoctonia solani has been report as a pathogen of OSR in other countries globally, such as Canada and Australia, along with some reports on vegetable brassicas within the UK and Europe. Many of these reports describe this pathogen as primarily a damping-off disease, and a few also attempt to further classify the sub types or anastomosis groups (AG) responsible. Based on these observations, we used quantitative real-time polymerase chain reaction (qPCR) to examine the root samples for the presence and quantity of several commonly cited AG; 2-1, 2-2, 4 HGII, 5 and 8. We established that AG 2-1 was the most common AG, being present at 60% of sites tested, followed by AG 5 and 8 in much smaller

quantities. In addition, *in vitro* experiments showed that isolates of AG 2-1 caused visual disease symptoms on young OSR seedlings, whilst other AGs tested caused little to no appreciable symptoms. This assay also highlighted the variation in pathogenicity between multiple AG 2-1 isolates. Based on these observations, glasshouse experiments were used to elucidate the inoculum threshold for disease, and to observe if this altered disease symptoms or caused any sub-clinical effects. Initial experiments utilised OSR seedlings which were grown for 30 days, before being assessed for disease symptoms and biomass as a proxy for yield. The results indicated that relatively little inoculum was needed to cause symptoms and in particular pre- and post-emergence damping off.

Further experiments concentrated on the use of a model brassica plant (DHSL150) which was more suited to glasshouse growth and had a shorter lifespan (c. 160 days) than OSR. Using this model plant in combination with the methods developed before we were able to observe that damping off appeared to be the main mechanism by which plant yield was reduced, with no other symptoms occurring. Although, the inability to generate uniform inoculum for experiments somewhat hindered this, resulting in either excessive or no disease symptoms between experiments; which have also been found by other researchers studying this pathogen.

What outputs has the project delivered?

This project has identified that *Rhizoctonia solani* AG 2-1 is prominent within UK crops of OSR, with small amounts of inoculum resulting in appreciable disease. Furthermore, this appears to affect yield through a reduction in seed germination and plant establishment resulting in uneven crop establishment. Through the use of molecular methods it appears that agronomic factors such as rotation length, cultivation or a variety of other cultural methods have limited impact on this pathogen, likely as a consequence of its adaptive lifestyle and long lived survival structures.

Who will benefit from this project and why?

This project is primarily aimed at OSR growers, with a view to increasing their productivity and profitability. In particular by raising awareness of soil-borne pathogens in general, and in particular *Rhizoctonia solani* AG2-1. However, it is also useful to the wider scientific community, as it highlights the lack of agronomic or chemical management of soil-borne diseases within OSR production, potentially highlighting areas for further applied research to aid growers.

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If the challenge has not been specifically met, state why and how this could be overcome

How have you benefited from this studentship?
This studentship has allowed me to develop and grow as a researcher, providing me with the opportunity to learn new techniques and to appreciate wider scientific research. I have also gained a greater understanding of UK agriculture, with the AHDB providing me the opportunity to interact with growers and end users of my research, which has given me a valuable insight.

Lead partner	Harper Adams University
Scientific partners	N/a
Industry partners	The Morley Agricultural Foundation, and The Felix Thornley Cobbold Trust.
Government sponsor	N/a