Final Project Summary

Project title	**Integrating Control strategies Against soil- borne Rhizoctonia solani in OilSeed rape (ICAROS)**		
Project number	21140008	**Final Project Report**	PR616
Start date	July 2016	**End date**	October 2019
AHDB Cereals & Oilseeds funding	£80, 000	**Total cost**	£619,000 (Innovate UK project)

What was the challenge/demand for the work?

Rhizoctonia solani anastomosis group (AG) 2-1 is an aggressive soil-borne fungal pathogen of oilseed rape (OSR; *Brassica napus*) and canola worldwide and the main causal agent of pre- and post-emergence damping off, hypocotyl and root rot seedling diseases. Partial or complete OSR and canola plant stand losses are associated with high seedling disease incidence of 80-100% caused by AG2-1 whilst yield losses of up to 30% have been estimated due to root rot caused in mature plants.

The aim of the ICAROS project was to investigate genetic resistance/varietal resistance (Challenge 1) and develop integrated strategies, inclusive of novel seed treatments (Challenge 2), for the control of soil-borne *Rhizoctonia solani* in OSR. An additional challenge was to investigate yield loss to *R. solani* and to develop new guidelines for disease management in collaboration with the AHDB (Challenge 3).

How did the project address this?

Challenge 1: *Rhizoctonia solani* is an unrecognised but key pathogen for OSR growers: can varietal resistance to *R.solani* be identified in any available OSR varieties or does it exist in diverse germplasm? A key achievement was that through the ICAROS project we developed a novel high-throughput disease screening methodology, which allowed us to identify candidate genes for resistance in diverse germplasm. Furthermore we phenotyped commercial varieties and provided the first information on the susceptibility of commercially available genotypes adapted to different environments (UK and Europe). As resistance is not a trait that has been introduced yet, the newly identified candidate genes can be further explored in the future with breeding companies to improve commercial varieties.

Challenge 2: Developing seed treatments for use against *Rhizoctonia solani* in OSR.
The project aimed to identify effective seed treatments that could be registered in the UK and Europe and made available to growers to protect against *R. solani*. At the time of project initiation, the seed treatment options were based on old generic chemistry (thiram) which had only moderate efficacy: moreover, in the final quarters (2019) of the project, thiram was withdrawn for use in the EU28. Until 2019, more than 95% of growers in the UK had treated OSR seed with thiram-based seed treatment for the control of damping off (Agrii, Syngenta). Thus this project was particularly timely, since there is a very real need for new, Rhizoctonia-targeted solutions in the market. A key achievement was to identify

and validate the effectiveness of novel chemistry based on succinate dehydrogenase inhibitors (SDHIs), in field, for the benefit of the UK OSR production industry.

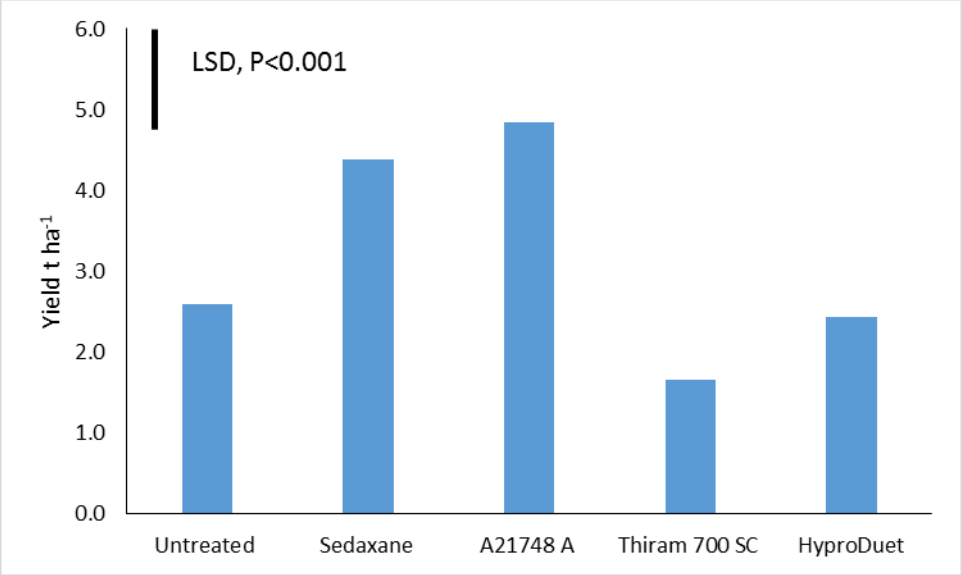

Fig. 1. Effect of seed treatments on yield in OSR field experiments inoculated with *Rhizoctonia solani* AG2-1 in two seasons. LSD: least significant difference; Sedaxane (5 ml per 1 million seeds), A21748 A sedaxane, metalaxyl-M and fludioxonil (25 ml per 1 million seeds), thiram 700 SC (28.5 ml per 1 million seeds) and HyproDuet (Thiram + Prochloraz) (45 ml per 1 million seeds). All fungicides were applied with the insecticide Thiamethoxam (6g PR kg^{-1}).

Challenge 3: The development of disease management guidelines against *R. solani* in OSR.
A key achievement was the first factsheet on the pathogen, *R. solani*, available online here: https://ahdb.org.uk/rhizoctonia in addition to online information on risk factors and management of the disease. Future guidelines for disease management will be incorporated into the OSR management guidelines produced by AHDB.

What outputs has the project delivered?

1) Enhanced understanding of the underpinning science and evidence base on disease by *R. solani*. The project has led to a wide range of discoveries including on the complex relationship between *R. solani* and the soil environment, and the effects of *R. solani* on OSR including, for example, delay in flowering and synchrony, with evidence that the new treatment will promote synchronous flowering which will provide a further benefit for producers that adopt it.

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2) Candidate genes for improved resistance varietal improvement of OSR for crop production to be pursued with breeding companies.

3) New seed treatment. This product is expected to lead to improved OSR yield and cost savings for growers over the longer-term.

Who will benefit from this project and why?

The developed resources online https://ahdb.org.uk/rhizoctonia and future development and dissemination of the disease management in the OSR production guidelines by AHDB is expected to lead to enhanced understanding of effects of an important soil-borne pathogen on OSR production and yield for growers, even where the specific product developed through the project is not taken-up. The project has also led to a range of other publicity outputs including articles in Crop Production Magazine (a specialist journal for UK arable farmers), the Farmers Guardian and Arable Farming, in order to raise awareness and generate interest/demand for the project outputs.

The principal outcome of the project will be a new seed treatment product expected to lead to improved OSR yield and cost savings for growers over the longer-term.

Development of new varieties of OSR seeds by breeding companies for crop production in long-term will require further research and investment, including specialist breeding facilities.

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

Remaining challenges:

1. Forward exploration and development of candidate genes through into breeding stages and commercially available seed.

2. Development and availability of in-field sampling and testing for *Rhizoctonia solani* for use by farmers on a practical level. This was beyond the scope of the project.

To overcome these, future engagement with breeding companies will be needed and further scientific investigations will be necessary into sampling strategy and prediction of disease.

Lead partner	Syngenta
Scientific partners	University of Nottingham
Industry partners	Syngenta, AHDB
Government sponsor	Innovate UK and BBSRC