

## Final Project Summary

<b>Project title</b>	The identification, prevalence and impacts of viral diseases of UK winter wheat		
<b>Project number</b>	RD-2009-3625	<b>Final Project Report</b>	SR32
<b>Start date</b>	8 February 2010	<b>End date</b>	27 February 2014
<b>AHDB Cereals &amp; Oilseeds funding</b>	£37,500	<b>Total cost</b>	£66,117

### What was the demand for the work?

Since around 2000, wheat yields in the UK appear to have plateaued below the theoretical potential yield. Due to records from the UK and abroad stating that some viruses of wheat could cause significant yield loss, it was proposed that they or as yet unidentified viruses could be contributory factors to the plateau.

### How did the project address this?

The project began with a literature review of viruses found in wheat and other Gramineae in the UK, Europe and globally. The aim was to determine potential viruses in the UK, and to predict future threats. In the past, the UK climate was not conducive to the survival of insect vectors of viruses, or optimum for the impact of viruses in wheat. However, climate change may mean that it will be in the future. Therefore viruses currently absent from the UK may become a threat. Based on the literature review real-time polymerase chain reaction assays (qPCR) were developed for ten viruses which were considered the most likely viruses to be present in the UK at the time. There were 1356 samples of wheat tested for each of these viruses. There was a low prevalence of known viruses.

A second part of the project used next generation pyrosequencing technology to search for known, and most importantly currently unknown viruses of wheat or viruses which could affect wheat. For this, in-depth sampling of a single field was done, involving 120 samples. The samples consisted of wheat; weeds from within the crop and margins; surrounding mown grass; and the contents of insect traps. This was to allow testing of potential reservoirs and vectors of viruses which could transfer to wheat. The results showed that known viruses were present, but also suggested that at least eight novel viruses (four in wheat) were detected.

The project also investigated Cynovirus mottle virus (CnMoV), in the literature search this was identified as a potential cause of yield loss in wheat for which little survey work had been done historically. The complete genome of the virus was characterised, which allowed the design of a real-time polymerase chain reaction assay. This was also used in the above study but the virus was not found in the survey. However, work into the impact of the virus on wheat showed that it can cause significant reductions in yield in terms of the total number of grains produced (up to 83%) and the thousand grain weight (up to 30%) when compared to healthy control plants.

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Therefore, CnMoV is a virus to be aware of as climate change occurs which could increase the threat of the virus through impact on the insect vectors. The potential for seed transmission was also investigated in a small scale trial. It was determined that it would be unlikely to occur however further more extensive testing is required. This was an important area of study because such information is vital to inform control strategies for viruses of wheat.

### What outputs has the project delivered?

It was determined that the prevalence of known viruses in UK wheat was low. However, numerous potentially novel viruses were detected in and around just one field of wheat. One of these 'viruses' was detected in 25% of the wheat samples tested. If this were to translate to the UK as a whole it could partially explain the plateau in the yield of wheat.

It was also confirmed through literature searching and investigations into CnMoV that viruses can have significant impacts on the yield of wheat. Therefore these pathogens should be further investigated as much as other diseases of wheat which are currently given a higher level of importance.

### Who will benefit from this project and why?

AHDB Cereals & Oilseeds and the farming community, which look to it for advice and information, will hopefully gain from this project by taking some comfort in that known viruses are not thought to be a major cause of yield loss in wheat. It may be important at the current time to focus on other diseases of wheat and investigate other factors which affect wheat health, such as nutrients. However, viruses should not be forgotten because it is important to remember that potentially novel, currently under-studied viruses could be contributing. Benefit may come from studies into such viruses which could be the key to unlocking further yield potential. The project has highlighted the impacts that viruses can have on wheat, including yield loss. Hopefully the message that the farming community can take from this is that it is important to be aware of viruses and keep an eye out for the symptoms they cause and send any suspect samples for testing at establishments such as The Food and Environment Research Agency (Fera).

The genome of CnMoV is intended to be published on GenBank. By doing so it will be available for others to search against when analysing the results of next generation sequencing or other sequencing results. The other information about CnMoV is also intended to be published, which will aid the scientific and farming community.

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

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<b>How have you benefited from this studentship?</b>	
<p>I have benefitted greatly and would like to take this opportunity to thank AHDB Cereals &amp; Oilseeds and Defra Seedcorn for funding the project. I think I have had an excellent opportunity to develop my interest in plant pathology and skills as a scientist, which began in an undergraduate degree in biology at The University of Nottingham. I have thoroughly enjoyed learning more about the background of virology, plant pathology in general and farming. Attending various meetings, events and conferences spread all over the globe has been absolutely brilliant and has allowed me to develop my confidence and meet some interesting people who will hopefully be collaborators in the future. The challenges along the way have made me a more resilient, motivated, determined person and enabled me to develop planning and troubleshooting skills. Following the end of three years of laboratory work at the Food and Environment Research Agency I began a job as a molecular plant virologist. I am sure the studentship was a contributory factor to this. I hope to continue with a career in plant pathology.</p>	
<b>Lead partner</b>	The University of Nottingham
<b>Scientific partners</b>	The Food and Environment Research Agency
<b>Industry partners</b>	
<b>Government sponsor</b>	Defra Seedcorn

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