Grower Summary

FV 429

Towards the development of a laboratory based assay for the detection of Common Root Rot (Aphanomyces euteiches) in vining peas.

Final 2016

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Project title:	Towards the development of a laboratory based assay for the detection of Common Root Rot (*Aphanomyces euteiches*) in vining peas.
Project number:	FV 429
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Report:	Final report, February 2016
Previous report:	Annual report, January 2015
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Date project commenced:	03/02/2014
Date project completed	31/01/2016

GROWER SUMMARY

Headline

A quick and reliable plate test to determine levels of common root rot (*Aphanomyces euteiches*) in soil samples has been developed. This test is now available at PGRO as a service to growers and can be used to assess risk levels of disease development prior to pea planting.

Background

Vining peas for the frozen pea market are grown in eastern parts of the UK due to climatic conditions, and in close proximity to processing factories to comply with 150 minutes from field to frozen. These two factors put huge pressures on land and pea yields have been declining over the last 10 years not only in the UK but worldwide, in pea cropping areas. Foot rot diseases are a major reason for yield losses and are caused by a complex of soil-borne pathogens including *Fusarium solani* f.sp *pisi*, *Fusarium oxysporum* f.sp *pisi*, *Didymella pinodella* and *Aphanomyces euteiches*. Disease symptoms usually appear when the plant begins to flower or earlier when plants are stressed due to waterlogging or other environmental factors. Strong disease development can lead to complete crop losses and in less severe incidences uneven maturity of the crop and associated reduction in product quality. All of the pathogens produce long-lasting resting spores leading to increased pathogen levels in soils over pea cropping cycles. In France and the Great Lakes Regions of the USA, inoculum levels of *A. euteiches* in soil have become so high that pea production and the processing factories have been relocated to less infected areas. *Aphanomyces* levels in the UK seem to be on the rise and if we do not find ways to accurately determine pathogen levels in soil we could be at risk of not being able to grow peas in the future.

Chemical treatment against foot rot diseases is not available and once the disease has developed there is very little a grower can do to save the crop. Disease development is weather and soil structure dependent, and is favoured by high soil moisture and often seen in soils where there has been a history of soil compaction and water-logging. Another factor is drilling time and peas sown in cold wet soils appear to be more susceptible than those grown later in the season. Mitigation is limited to crop rotation strategies.

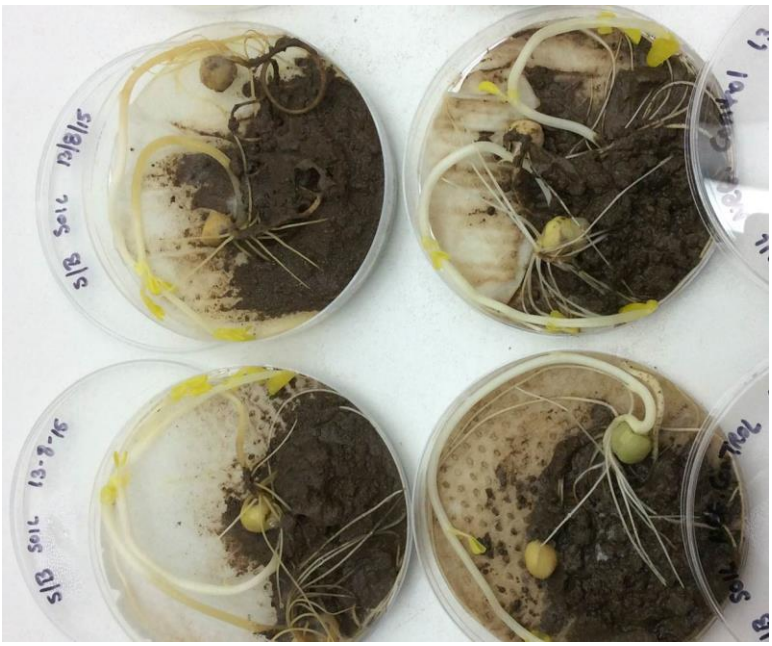
One strategy for pea growers to reduce risks of yield losses is to assess pathogen levels in fields before planting pea crops. Prediction of pathogen levels in soil will give an indication about likelihood of disease development when conditions are favourable for the disease. At PGRO, a soil test is offered to test for abundance of *F. solani* f.sp *pisi* and *D. pinodella*. However, no such test exists for *A. euteiches* and therefore this project aimed to develop a

quick and reliable laboratory test to measure abundance of *A. euteiches* in soils to be able to assess risk levels of disease development prior to pea planting.

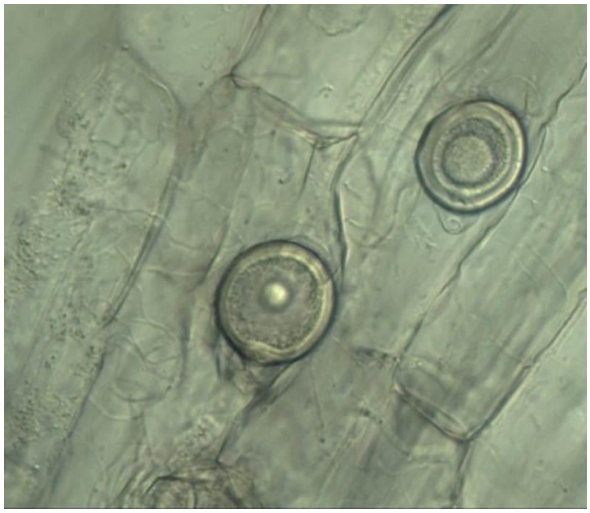
Summary

One mitigation strategy to avoid yield losses due to common root rot disease in peas is to assess *A. euteiches* levels in soils prior to pea cropping and to choose fields with low levels where disease development is unlikely to occur. A soil bait method is available to assess *A. euteiches* levels in soils but requires up to six weeks to deliver results which is too long for growers who need to use it for rotational planning.

To overcome this limitation, a quick laboratory test to assess levels of *A. euteiches* in soils has been developed. Pea seedlings are grown for eleven days in a dish whilst being exposed to the test soil (Picture 1). After the incubation period the roots of the seedlings are assessed for infection by *A. euteiches*. Roots of infected seedlings are honey coloured and softer than healthy roots (Picture 1). The infection is scored on a scale from 0-5 based on the percentage of the root tissue showing disease symptoms. To validate that the disease symptoms are caused by *A. euteiches* the roots are microscopically examined for the presence of thick walled oospores (Picture 2).



Picture 1: Plate test using soil. Plates on the left were inoculated with *A. euteiches* infected test soil and seedlings show disease symptoms (honey discolouration). Plates on the right were inoculated with sterilised soil as a negative control and seedlings are completely healthy.



Picture 2: Thick walled *Aphanomyces euteiches* oospores in roots of pea seedling that had been growing in infected test soil.

The plate method using soil was developed alongside a second method that uses organic matter extracted from test soils instead of the test soils themselves. *Aphanomyces euteiches* oospores are concentrated in the organic matter fraction of soils and it was proposed that using organic matter instead of soil might give better infection. However, all three methods, the traditionally used soil bait method (pot), the plate method using soil (soil) and the plate method using organic matter (OM) gave similar results on all test soils (Figures 1 and 2). It is known that *A. euteiches* occurs in Scotland and therefore, Scottish fields were selected for soil sampling. In 2014, eight soil samples and in 2015, nine soil samples were collected from fields near Perth, Scotland. Results obtained using the three different methods significantly correlated in both years, demonstrating that all three methods give the same consistency for assessing risk levels of *A. euteiches* in soils.

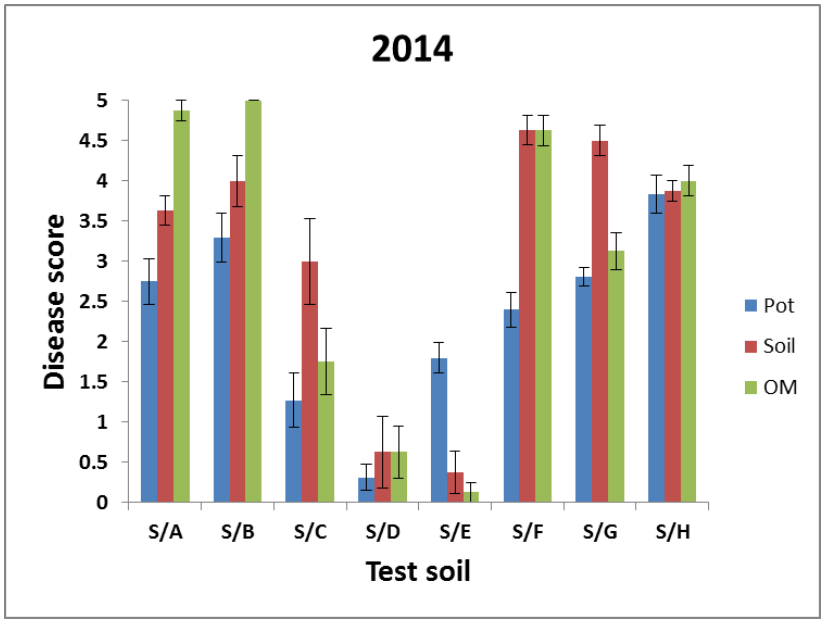


Figure 1: Disease scores (scale 0 to 5) for levels of *A. euteiches* infection of pea roots assessed using the soil bait method (pot), the plate method using soil (soil) and the plate method using organic matter (OM). Test soils had been collected from Scottish fields in 2014. Data show mean values and standard error (n>8).

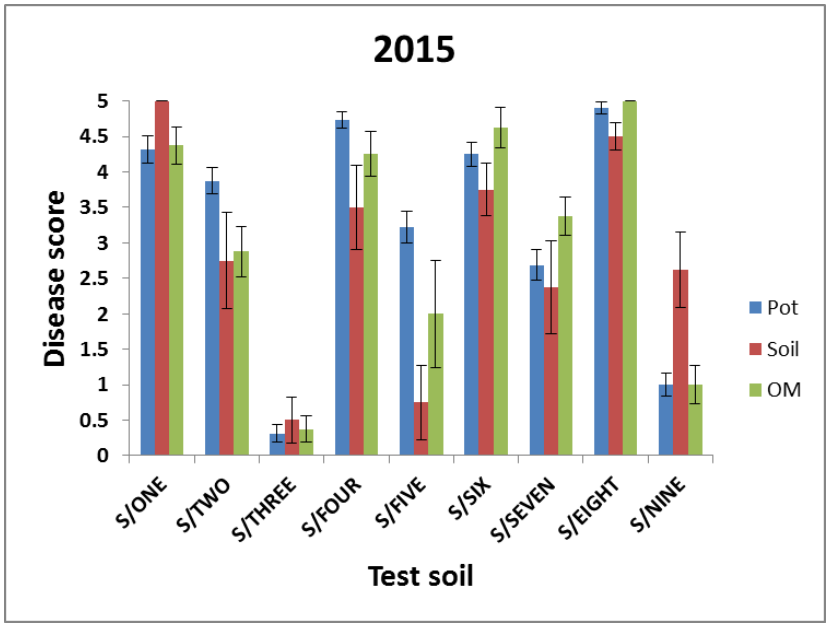


Figure 2: Disease scores (scale 0 to 5) for levels of *A. euteiches* infection of pea roots assessed using the soil bait method (pot), the plate method using soil (soil) and the plate method using organic matter (OM). Test soils had been collected from Scottish fields in 2015. Data show mean values and standard error (n>8).

The fields from which the tests soils had been collected were visually rated for disease development. When foot rot levels in the pea crop were high the soils scored a high *A. euteiches* rating (Table 1). This shows that *A. euteiches* levels in soils can be used to predict disease development in the field when conditions are favourable for disease development.

Table 1: Visually rated disease status of pea crops and average *A. euteiches* risk score determined using the soil bait method, the plate method using soil and the plate method using organic matter.

Sample	Year	Status of crop	*A. euteiches* risk score
S/A	2014	Slightly sick crop	3.75
S/B	2014	Healthy crop	4.10
S/C	2014	Sick crop	2.01
S/D	2014	Healthy crop	0.52
S/E	2014	Very healthy crop	0.77
S/F	2014	Sick crop	3.88
S/G	2014	Very sick crop	3.48
S/H	2014	Very sick crop	3.90
S/One	2015	Very sick crop	4.56
S/Two	2015	Very sick crop	3.17
S/Three	2015	Healthy crop	0.40
S/Four	2015	Very sick crop	4.16
S/Five	2015	Healthy crop	1.99
S/Six	2015	Healthy crop	4.21
S/Seven	2015	Very sick crop	2.81
S/Eight	2015	Slightly sick crop	4.80
S/Nine	2015	Slightly sick crop	1.54

The test using soil instead of organic matter is quicker because it does not require the extra time for extraction of organic matter from soil. The soil test is therefore cheaper to run and has been chosen to be offered as a service to pea growers by PGRO.

Financial Benefits

Presently, it is not possible to link levels of *A. euteiches* in soils prior to pea planting with potential yield losses. However, work undertaken in Wisconsin, USA in the 1980s suggested that yield losses range from 42% to 86% in susceptible pea varieties. In extreme cases total crop loss can occur. Furthermore, PGRO is already working on linking *A. euteiches* levels in soils with potential yield losses. In addition to yield losses, foot rot diseases also lead to reduction in product quality and in most cases when clear foot rot symptoms are visible in the field the crop is not commercially viable. Since the disease cannot be controlled chemically, assessing pathogen levels in soils holds great potential to minimise impacts of the disease. If *A. euteiches* levels in soils are high (scores >3) it seems very likely that disease will develop especially in wet years or in fields with soil compaction or waterlogging issues. Furthermore,

levels of *A. euteiches* in some areas of France and of the USA have become so high that pea cropping had to be abandoned in these areas. Testing soil samples for the presence of *A. euteiches* will also help to monitor pathogen distribution across the UK. PGRO recommends testing soils for levels of *A. euteiches* prior to pea planting to help control disease development and spread especially in the northern regions of the UK where high levels of *A. euteiches* are already present in soils.

Action Points

To measure *A. euteiches* levels in soils, a soil sample of around 2 kg needs to be collected by growers using a W shape across the field. The soil samples need to be sent to PGRO where the developed plate test will be used to assess risk levels in soils at a price of £149 per sample. Within two weeks, growers will be informed of risk levels in their fields which can be used to inform decisions on whether to plant a pea crop or not. To avoid potentially high yield losses due to common root rot fields with *A. euteiches* levels of greater than 3 should not be used for pea cropping.