Project report for SSCR-Potatoes

***Project title*:**

Evaluating the effect of soil organic matter on the interaction between FLNs and *Rhizoctonia solani* AG3 and their impact on crop health

Applicant(s):

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Background to the project

Incorporation of organic matter into field soil may have positive benefits to soil structure, fertility and maintaining a healthy biota. However, complex interactions with intractable soil-borne pathogens can lead to negative impacts on plant health (Bonanomi et al., 2010). There is anecdotal evidence that managing FLN populations by increasing SOM (for example through the incorporation of cover crops) can have a negative impact on the control of *Rhizoctonia solani*, thus causing problems with emergence, stem canker and black scurf on potato. A field trial carried out here at the James Hutton Institute, showed that increasing SOM (through the incorporation of cattle manure mixed with barley straw) in soils infested with *R. solani* increased problems associated with *R. solani* infections (Brierley et al. 2015). Diagnostic assays to detect and quantify *R. solani* (Lees et al., 2008) and FLNs (Neilson) in soil have been developed and can be used to assess disease risk. An increased understanding of the interaction between soil organic matter and soil-borne pathogens, specifically, *R. solani* and FLN populations, and how these interactions impact upon potato health and disease, would provide vital information to inform disease risk in a rotation and how that informs management practice.

Aims and objectives

The aim is to establish how increasing SOM through the application of either manure or digestate effects the interaction between FLN and *R. solani* AG3. We would do this in two ways: a glasshouse pot experiment will manipulate SOM and FLN and *R. solani* AG3 infestation; and sampling soil from commercial potato field trials in which we would quantify abundance and infestation levels of FLN and *R. solani*, respectively, and use standard techniques to quantify SOM. Additionally, measurements taken from both field soils and potting mixes will be used to further validate the improvement of an existing mobile phone app (SOCIT) designed to provide an estimate of SOM content based on colour.

Research results

Glasshouse trial:

A glasshouse trial investigating the effect of increasing soil organic matter through the addition of both manure and municipal compost to field soil on disease symptoms resulting from *R. solani* infestation was completed. A suitable source of field soil infested with FLN was not identified, and as a result the glasshouse trial focussed on the interaction between SOM and *R. solani*.

Potting mixes comprised of varying ratios of field soil and either manure or municipal compost were inoculated with *R. solani* (AG3). Replicate pots of each potting mix were planted with a single Maris Piper mini-tuber (to eliminate effects from seed inoculum) and grown to maturity. Disease on progeny tubers was assessed visually.

No inoculum was detected in either field soil, manure or compost (to which no inoculum had been added). When *R. solani* inoculum was added to the range of potting mixes the mean amount of *R. solani* detected was 5500 pg DNA/ g soil. Based on previous glasshouse and field trials this equates to a relatively high inoculum pressure.

However, despite disease pressure being estimated to be relatively high, the incidence of black scurf across treatments was 24.5% and the mean severity was < 0.5%. Such low levels of disease across the experiment meant that no treatment effects were detectable. As the results had not shown significant differences between treatments, the SOM content of the potting mixes was not analysed.

Field data:

The field rotation at the Centre for Sustainable Cropping was used to determine amounts of *R. solani* in field soils under contrasting soil management. The sustainably managed half of each field includes the annual incorporation of municipal compost. Levels of soil organic matter are higher in the "sustainable" field areas than those managed "conventionally". A potato crop is included as part of the six-year rotation. Soil was sampled from the twelve field areas in November 2018. No *R. solani* was detected in either the low or high SOM areas of each field, including the one in which potato was harvested in 2018. No black scurf was recorded on the progeny tubers in this crop.

SOCIT app:

Additionally, measurements from the soil samples, which comprised a range of organic matter levels, were taken with the mobile phone app. SOCIT. These measurements added to the dataset being used for the continued development of the app. designed to provide an estimate of SOM content based on colour

Outcomes

1. Provide valuable information on the interaction between soil organic matter, FLN and *R. solani* AG3.
2. Provide preliminary evidence required on the interaction between FLNs, *R.solani* AG3 and soil organic matter needed for an anticipated application for funding to develop in-field diagnostics for SOM through the improvement and validation of an existing Hutton-developed mobile phone app.

1. *Rhizoctonia solani* could be described as a recalcitrant pathogen. It has been the focus of study for many years, yet consistent results are difficult to obtain, as exemplified by this study. Despite the data collected in this study not enhancing our understanding of the interaction between *R. solani* and SOM, it does add to our data set on pathogen detection and resulting disease. This data will be useful in the on-going development of a reliable soil-test for *R. solani* to assess disease risk.

2. Measurements from the soil samples, which comprised a range of organic matter levels, were taken with the mobile phone app. SOCIT. to develop in-field diagnostics for SOM through the improvement and validation of an existing Hutton-developed mobile phone app. These measurements added to the dataset being used for the continued development of the app. designed to provide an estimate of SOM content based on colour.

Next steps

Funding was secured in 2018 to investigate the impact of a biocontrol product on *Rhizoctonia solani*. This presented an opportunity to add to our dataset on levels of disease pressure associated with detectable levels of the pathogen in the soil. Similarly, data will continue to be collected from the CSC Balruddery enabling the interaction between *R. solani* and SOM to be continued; this is currently funded through RESAS WP2.1.5.
An application for an AHDB studentship "Evaluation of the utility of cover crops as part of an IPM strategy to manage free living plant-parasitic nematodes and *Rhizoctonia solani* under UK conditions" which would have enabled a more extensive investigation was not funded.

Further funding opportunities will continue to be sort.