## Report for the Centre of Sustainable Cropping: December 2020

## Detection of *Rhizoctonia solani* AG-2.1 across the CSC rotation (2011-2019)

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## Introduction

*Rhizoctonia solani* is a ubiquitous soil-borne saprophytic fungus often referred to as a ‘species complex’. At least 13 anastamosis groups (AGs) of *R. solani* are known to exist. *Rhizoctonia solani* has been shown to be pathogenic to a wide range of crops world-wide, often reducing yield and quality. The host range of different AGs varies, for example, *R. solani* AG3 has a very narrow host range, infecting and causing disease on potato. In contrast, *R. solani* AG2.1 is known to have a broad host range. For example, *R. solani* AG2.1 can be pathogenic to potato, but any resulting disease is not usually severe whereas it can be problematic during seedling establishment of brassica species where it is implicated in ‘damping off’, a condition where young root systems rot, resulting in poor crop establishment.

The aim of this work was to investigate the impact of agronomic management practices (conventional versus integrated) for different crops, including potato and soil seed rape (OSR), grown in a six-year rotation at the CSC on *R. solani* AG2.1 detectable in the soil.

## Detection of *Rhizoctonia solani* AG2.1 in soil sampled from the CSC platform

The CSC platform is based on a six-field rotation (Balruddery Farm, Dundee, Scotland) with individual 5-6 Ha fields planted with potato, winter wheat, beans, spring barley, winter OSR and winter barley each year. One half of each field is managed according to current conventional crop husbandry practice and an integrated management package is applied to the other half. Further details of the design and management treatments can be found at [www.hutton.ac.uk/csc](http://www.hutton.ac.uk/csc)

Soil samples were taken in March and November each year from each half field, i.e. conventional and integrated management treatments (2011-2019). A soil sample consisted of a bulk of 100 x 10 g samples taken from across the field area in a W-shape.

Soil DNA extractions were carried out according to the method of Brierley *et al.* (2009). Target pathogen DNA was quantified using real-time PCR for the detection of *Rhizoctonia solani* AG2.1 (Budge 2009).

*R. solani* AG2.1 was detected in 18 of 108 field soil samples taken post-harvest in November (Table 1). There was no apparent effect of the management treatments on detection of *R. solani* AG2.1, with ten positive samples originating from integrated field treatments and eight from conventionally managed treatments. Of the 18 AG 2.1 positive samples, a greater proportion were from fields which had grown potato and OSR (6 and 5 respectively) compared with other crops (Table 1).

Table 1. Crops planted across the six diﬀerent experimental ﬁelds in 2011−2019. Year corresponds to the year in which the crop was harvested. Winter wheat, Winter barley and Winter OSR are planted in the preceding year. Blue shaded cells indicate that *R. solani* AG2.1 was detected in soil samples taken in November (post-harvest. Each field is split in two, with one half managed conventionally (C) and the other half with an integrated (I) approach.



Table 2 shows detection of *R. solani* AG2.1 through a set of four time points, focussing on fields planted with OSR; March - previous crop, November – early establishment of OSR, March – later establishment of OSR and November - post harvest. There was only one occasion when *R. solani* AG2.1 was detected in March before an OSR crop was planted. In four out of the nine years, *R. solani* AG2.1 was detected in at least one of the field treatments (C or I) in the soil sampled in March during OSR establishment. In these fields, inoculum was generally also detected the following November post- harvest. There was no effect of the two management practices on detection of *R. solani* AG2.1 at any time point.

The number of stems was recorded prior to harvest between 2012-2017. Although there were differences between years, there was no evidence that high levels of *R. solani* AG2.1 detected in the establishing OSR crop lead to fewer stems or decreased yield (Table 2).

Table 2. *Rhizoctonia solani* AG2.1 detected in field soil; before, during and after cropping with OSR: March previous crop, November early establishment, March later establishment, and November post-harvest.

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Year | Field | Manage-ment treatment | AG2.1 a March -previous crop | AG2.1 a November- early establishment | AG2.1 a March Later establishment | AG2.1 a November - post harvest | Number of stemsb (m2) | Mean yield (t ha) |
|  |  |  |  |  |  |  |  |  |
| 2010/11 | Kennels | I | \* | \* | 0 | 0 |  | 2.40 |
|  |  | C | \* | \* | 0 | 0 |  | 3.77 |
|  |  |  |  |  |  |  |  |  |
| 2011/12 | Pylon | I | 0 | \* | 0 | 0 | 49.0 | 2.10 |
|  |  | C | 0 | \* | 0 | 0 | 43.5 | 2.06 |
|  |  |  |  |  |  |  |  |  |
| 2012/13 | Road Field | I | 0 | 0 | 0 | 0 | 60.2 | 1.62 |
|  |  | C | 0 | 0 | 0 | 0 | 46.7 | 3.94 |
|  |  |  |  |  |  |  |  |  |
| 2013/14 | Pylon | I | 0 | 0 | 6,114 | 105 | 88.0 | 3.04 |
|  |  | C | 0 | 0 | 0 | 0 | 65.7 | 2.87 |
|  |  |  |  |  |  |  |  |  |
| 2014/15 | Road Field | I | 0 | 0 | 0 | 43,068 | 56.9 | 4.05 |
|  |  | C | 0 | 0 | 161 | 770 | 53.9 | 3.68 |
|  |  |  |  |  |  |  |  |  |
| 2015/16 | Mid-East | I | 0 | 0 | 0 | 0 | 64.0 | 3.96 |
|  |  | C | 0 | 0 | 0 | 0 | 66.6 | 4.13 |
|  |  |  |  |  |  |  |  |  |
| 2016/17 | Estate | I | 0 | 0 | 0 | 0 | 33.5 | 2.58 |
|  |  | C | 0 | 0 | 0 | 0 | 30.6 | 4.55 |
|  |  |  |  |  |  |  |  |  |
| 2017/18 | Kennels | I | 0 | 0 | 603 | 5,159 |  | 2.42 |
|  |  | C | 0 | 0 | 100 | 363 |  | 2.51 |
|  |  |  |  |  |  |  |  |  |
| 2018/19 | Pylon | I | 5,557 | 0 | 1,249 | 0 |  | 2.64 |
|  |  | C | 0 | 0 | 233 | 0 |  | 4.19 |
|  |  |  |  |  |  |  |  |  |

a Soil inoculum is measured as *R. solani* AG2.1 pg DNA/g soil; b Stem numbers; average across all varieties and corrected for differences in sowing density between I and C treatments.

A. healthy OSR root from a seedling grown in a control pot and B. pruned OSR root of a seeding grown in compost inoculated with *R. solani* AG2.1

 

A.

B.

## Comment and Conclusion

In this study we demonstrated that *R. solani* AG2.1 can be detected in field soil, and that within the rotation studied (CSC), it was more prevalent in potato and OSR crops than barley, wheat and beans. In the CSC rotation, OSR did not follow potato, nor potato follow OSR, either of which may have potentially increased the risk of *R. solani* AG2.1 increasing in the soil. There was evidence that the pathogen could persist in the soil. When inoculum was detected in the establishing OSR crop, it was generally also detected in November, following harvest. However, there was no indication of longer-term persistence, as illustrated by the near absence of detection of *R. solani* AG2.1 in the field sampled before OSR was planted.

Although not demonstrated here, additional work shows that *R. solani* AG2.1 is pathogenic to crops such as OSR, carrot, sugar beet and broccoli. This therefore highlights the importance of the sequence of crops within a rotation to reduce disease pressure resulting from soil-borne pathogens such as *R. solani* AG2.1.

## References

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Budge GE, Shaw MW, Colyer A, Pietravalle S, Boonham N. 2009. Molecular tools to investigate *Rhizoctonia solani* distribution in soil. *Plant Pathology* 58, 1071–1080

The work presented here was funded by the Scottish Government’s Rural and Environment Science and Analytical Services (RESAS) Division.