Investigating factors affecting infection of potato by *Spongospora subterranea*

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The relationship between *S. subterranea* soil inoculum concentration and disease on progeny tubers has been difficult to establish (van de Graaf *et al.,* 2005, Nakayama *et al.,* 2007). Under conducive environmental conditions, low levels of inoculum can cause significant amounts of disease and this is thought to occur due to multiplication of the pathogen in the roots.

Powdery scab symptoms and root galls are known to be favoured by soil temperatures between 12-15°C and 17°C respectively (van de Graaf *et al*., 2005;2007). However, in order to improve risk assessment and decision support for powdery scab control, a more detailed evaluation of the interaction between the pathogen, soil and environment and the resulting levels of infection and disease development is required.

Preliminary results from the first year of trials conducted at SCRI as part of an international initiative are discussed.

Materials and Methods

Trials were planted according to an EU standard protocol (http://www.spongospora.ethz.ch/workshops.html.) to allow comparison of results across countries: Plots of one powdery scab susceptible (Agria) and one moderately susceptible cultivar (Nicola) (x 4 replicates) were planted into land infested with *S. subterranea*.

Soil inoculum was quantified using the methods of Brierley et al (2009) and van de Graaf et al (2003) and irrigation was applied up to 4 weeks after tuber initiation

Commencing at tuber set (3 weeks after 50% emergence) 4 plants/rep/cultivar were sampled weekly for 7 weeks. Root galling and tuber disease symptoms were scored on each plant according to standard protocols (http://www.spongospora.ethz.ch/LaFretaz/scoringtable.htm) Infection of symptomless roots and tubers by *S. subterranea* was quantified using real-time PCR..

Environmental conditions were monitored using in-field monitoring equipment and met-station data.

Results

Root galling

Root galling was first observed on 22/7/08 and the severity of root galling increased over subsequent weeks. At each date, cultivar Agria showed a significantly greater root gall severity than cultivar Nicola (Figure 1a).

Galling on potato roots caused by *S. subterranea*

DNA of *S. subterranea* was detected in both cultivars from the earliest sampling date (1/7/08). Significantly more DNA of *S. subterranea* was detected in roots of cultivar Nicola compared with cultivar Agria at all sampling dates except the first (Figure 1b).

Fig 1a

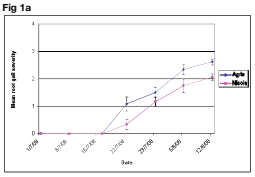

Fig 1b

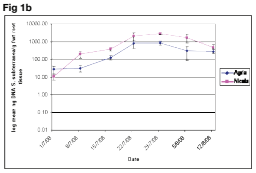

Fig. 1 a). Mean root gall disease severity on a 0-4 scale of increasing severity and b) amount of *S. subterranea* DNA (log ng DNA/g fresh weight of root tissue) measured at 7 weekly intervals on cultivars Agria and Nicola Standard errors of means are shown.

Powdery scab

Powdery scab symptoms were first observed at SCRI on 29/7/08 and were significantly more severe on cultivar Agria than Nicola, as would be expected. (Fig 2a)

DNA of *S.subterranea* was detectable in symptomless tubers from the time of tuber formation (8/7/08) (Figure 2b). Significantly more DNA was detected in symptomless tubers of cultivar Agria compared with Nicola.

Fig 2a

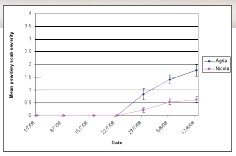

Fig 2b

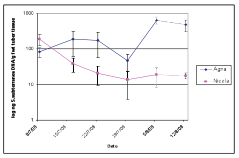

Fig. 2 a). Mean powdery scab disease severity on a 0-6 scale of increasing severity and b) amount of *S. subterranea* DNA (log ng DNA/g fresh weight of tuber tissue) measured at 7 weekly intervals on cultivars Agria and Nicola Standard errors of means are shown.

Weather data

Mean soil temperatures (°C) and soil moisture deficits (mm) are shown in Figure 3. The mean daily temperature was approx. 15°C and the site was irrigated to ensure disease development. Weather conditions were conducive for the early infection of tissues by *S. subterranea* and the development of root galls and powdery scab.

Fig 3

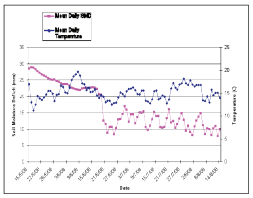

Fig. 3. Mean daily soil moisture deficit (mm) and temperature (°C) values over the duration of the trial.

Conclusions and future work

Preliminary results show that:

- DNA of *S. subterranea* was detected in roots of all cultivars at both sites from the earliest sampling dates. Root galls were not visualized until at least 5 weeks after root infection had occurred.
- DNA of *S. subterranea* was detectable in symptomless tubers from the time of tuber formation. Powdery scab symptoms were first observed 3 weeks after infection was detected.
- Results from trials at several sites will be compiled to allow the timing of infection under different environmental conditions to be determined.
- This work will be extended to monitor PMTV infection concurrently.

References

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