Virulence and Molecular Characterization of *Globodera pallida* from Idaho

Vivian C. Blok and Mark S. Phillips
Plant Pathology Programme, SCRI, Invergowrie, Dundee DD2 5DA Scotland.

Cysts of the potato cyst nematode *Globodera pallida* were found for the first time in Idaho, U.S.A. in 2006. Samples of these cysts were used at the Scottish Crop Research Institute to conduct biological and molecular experiments to characterise the isolates.

**Hatching tests**

Juveniles hatching from three batches of cysts from Idaho and three UK *G. pallida* populations (Beadle, Halton and Lindley glasshouse cultures) and one *G. rostochiensis* populations were compared. Cysts were exposed to tomato root exudates and juveniles hatching were counted over a 5 week period. Idaho population 01 and 06 was of low viability (Fig 1) providing an explanation of the problems encountered by ourselves and others in reproducing the Idaho isolates.

**Molecular studies**

**Cytochrome B**

Part of the mitochondrial Cytochrome B gene was obtained for the Idaho population and compared with sequences from a broad range of South American and European *G. pallida* population sequences available on Genbank. There was very little within population variation, and Idaho CytoB had the greatest similarity to the European populations and the *G. pallida* population from southern Peru (Figure 3). It seems likely, that the Idaho and European populations originate from the same geographic region in southern Peru. Plantard et al. (2008), however there is no data to indicate whether the Idaho population was introduced to the USA directly or indirectly through Europe.

**Pectate lyase and Cathepsin**

Sequences of the nuclear genes, pectate lyase and cathepsin were obtained from the Idaho population. They did not distinguish groups of populations as clearly as the mitochondrial sequence but supported those findings. Pectate lyase gave the clearest differentiation among the populations and suggests that the Idaho population is most similar to other European *G. pallida* populations. Translation of the coding sequences indicated at least two different protein sequences but with no clear differentiation between populations from different origins. The cathepsin sequence showed very little intra-population variation either within coding regions or introns though the latter was slightly greater than the former. The protein sequence was the same from all clones examined and was identical to protein sequences from three European populations (Figure 4).

**Conclusions**

The Idaho population in terms of virulence and molecular characterisation appears to be of the Pa2/3 virulence group and most closely resembles *G. pallida* populations from southern Peru and Europe. It is interesting to note that there are a populations found in Canada and New Zealand which in molecular terms are of the same type. It has long been suggested (Evans and Stone, 1977) that potato cyst nematodes while originating in South America have been spread to non-indigenous regions via Europe. The data we have obtained are compatible with this notion though an introduction from Southern Peru to Idaho cannot be ruled out.

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