Predicting virulence behaviour of *Globodera pallida* populations

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The two species of potato cyst nematodes, *Globodera rostochiensis* and *G. pallida,* are the most economically important nematode problems of the UK potato industry. They occur in 65% of UK potato land with *G. pallida* present at 92% of these sites[1]. They are difficult to manage because of the persistence of viable cysts in the soil for many years and the lack of resistance in cultivars that are commercially accepted. The increasing pressure to reduce the use of chemicals for their control heightens the need to deploy resistant cultivars effectively. Furthermore, cysts which are spread through movement of farm machinery or non-certified seed tubers establish new infestations which may go undetected for many years until population levels build up and there is evidence of damage to the crop. Effective strategies to control these nematodes and prevent spread are vital to the potato industry.

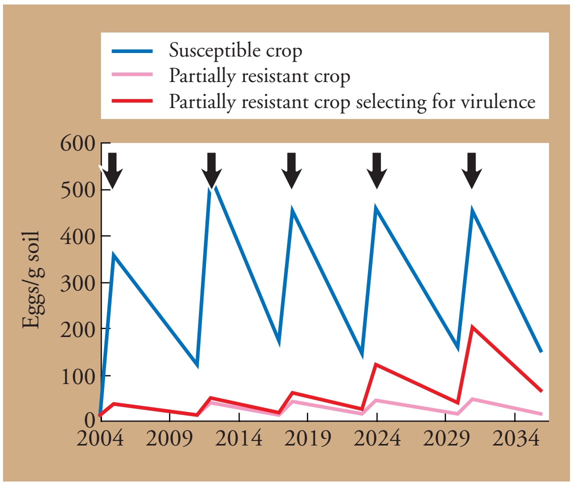

Figure 1 Population trends of potato cyst nematode reproduction if potatoes are grown every six years.

In order to inform advisors and growers, SCRI, with the support of the British Potato Council and a Defra Sustainable Arable LINK project, have produced a computer model which can be used as an educational tool to show how nematode population numbers vary with different control measures such as resistance, rotation length and nematicides. The program can be used to explore different control strategies and shows both the likely changes in nematode population levels and the amount of yield loss that a grower might experience. With the model, possible outcomes of growing cultivars with partial resistance to *G. pallida* can be demonstrated. Because a proportion of *G. pallida* individuals are virulent and able to reproduce on cultivars with partial resistance, the model indicates that growing partially resistant cultivars could limit *G. pallida* population levels but not eliminate them unless a nematicidal treatment or long rotation was also used. There is also the possibility that the nematode populations could be selected for an increasing number of virulent individuals that would render the partially resistant cultivars less and less effective as is shown in Fig. 1. To increase the scope of the model to take account of these potential changes, a population genetics approach is being taken. Molecular features identified that are indicative of the virulence status within a population will enable the monitoring and prediction of population behaviour. This information will increase the utility of the model.

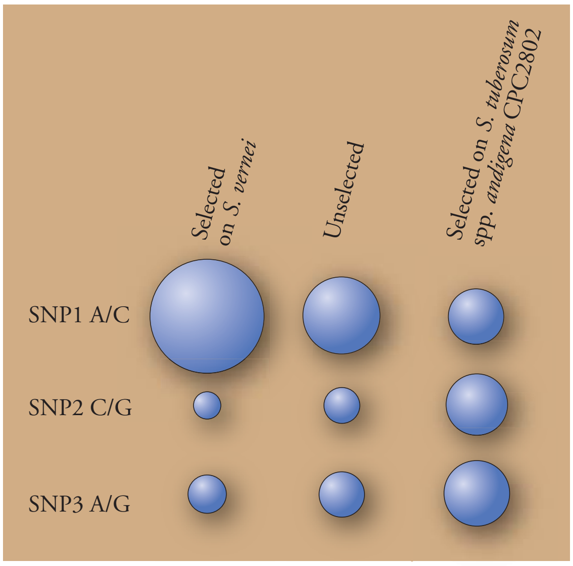

Figure 2 Proportions of A/C, C/G and A/G found in SNP1, 2, and 3 respectively with three PCN populations, unselected, selected on *S. vernei* or selected on *S. tuberosum* ssp. *andigena* CPC2802.

We have been investigating a number of genes that may be implicated in the nematode pathogenicity to see if there is evidence of selection in the sequences (single nucleotide polymorphisms - SNPs) after growth of the populations on resistant cultivars. Sequencing of the chorismate mutase gene revealed that there were a number of changes which affect the amino acid composition of the translation product that could in turn affect the plant response to the translation product. The proportions of variants of three SNPs in different populations have been quantified by pyrosequencing. Compared to the unselected population, the proportion of SNP1 (A) has increased in the population selected on a cultivar with resistance derived from *Solanum vernei* (Fig. 2). In the population selected on a potato with resistance derived from *S. tuberosum* ssp. *andigena* CPC2802, there is a reduction of SNP1 (A) but an increase in SNP2 (C) and SNP3 (A). By looking at a wide range of populations with different proportions of virulent individuals we hope to be able to discover if there are consistent associations between the molecular variation and virulence differences. Such an association would support the idea that the gene was implicated in the nematode/plant interaction as well as being a relatively fast way of monitoring virulence levels within *G. pallida* populations.

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References

[1] Minnis, S.T., Haydock, P.P.J., Ibrahim, S.K., Grove, I.G., Evans, K. & Russell, M.D. (2002). *Annals of Applied Biology* **140**, 187-196.