Delivering a sustainable potato industry for Scotland through management of Potato cyst nematode (PCN)

Project Report - Year One

https://www.pcnhub.ac.uk/

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Content

1 Introduction

The potato and flower bulb industries in Scotland are worth £250 million and £4 million, respectively. Scottish seed potatoes supply 70% of a GB potato industry worth £928 million

and many billions to the wider potato-based food and drink industries. Scottish seed potato exports are worth £50 million. As potato seed cannot be grown on land infested with PCN, and flower bulbs from infested fields cannot be exported, PCN has a major impact on the potato and flower bulb industries in Scotland. It has been estimated by SASA that PCN currently costs the Scottish potato and flower bulb industries ca £25 million a year, expected to rise (based on modelling predictions) to £125 million by 2024 and, in the absence of mitigation, a possible cessation of the seed potato industry by 2050. While one species of PCN (*Globodera rostochiensis*) is currently controlled, mainly using resistant potato varieties, another species, *G. pallida,* is spreading at a rate of 5% per year (doubling every 6-7 years) and has already infested 13% of seed and bulb-growing land. For more information see the Plant Health Centre's report entitled 'The future threat of PCN in Scotland' (https://www.planthealthcentre.scot/publications/future-threat-pcn-scotland).

In 2020, a Ministerial round table meeting took place on PCN, culminating in a request to Scotland's Plant Health Centre (PHC) to hold a working group to identify actions to reduce the spread of *G. pallida*. As a consequence of the working group, a report was submitted to Scottish Government (https://www.planthealthcentre.scot/publications/pcn-working-group-final-report) with key recommendations including to preserve the land base for future generations, control the epidemic and increase the sector's capability and motivation to implement these changes. However, it was also recognised that investment was needed to address the actions in support of the recommendations. This project was funded following the working group report. It aims to address the actions in the report through a 5-year programme together with regular, coordinated and comprehensive engagement with industry. The work involves both academia and industry, with expertise including potato genetics and breeding, nematology, integrated pest management, precision agriculture, field trialling and agronomy, spatio-temporal modelling, economics and stakeholder engagement. The project continues in parallel with Scottish Government work (undertaken by SASA) aimed at potential policy rule changes for ways to help landowners maintain PCN-free land, increased statutory sampling provision, groundkeeper (GK) surveillance and (together with the project) increased provisions for diagnostics. In a recent survey of the industry by NFUS (July 2021), soil health and PCN were considered the top priorities for potato research and development in the future.

2 Objectives and expected outcomes of the project

2.1 Objectives

i) To prioritise and quantify the main interventions impacting PCN spread and construct solutions with stakeholders that maximise industry self-management of the problem and inform a national strategy on potential Government actions.
ii) To develop IPM tools for PCN and integrate them into a fully delivered and validated decision support tool for Scottish growers.
iii) To develop resistance markers, tolerance tests and pre-breeding methods to provide tools for potato breeders to accelerate the development of suitable varieties.

2.2 Expected key outputs

i) A full economic assessment of PCN in Scotland at the start and end of the programme.
ii) A comprehensive decision support system (DSS) for growers.
iii) Novel markers for use in breeding and development of pre-breeding material.
iv) Modernisation of breeding methods to ensure rapid progress is achieved in delivering new resistant varieties.
v) New simple and universally acceptable methods of determining varietal tolerance to PCN.

vi) Improved control of groundkeepers (rogue potatoes that grow in other crops following a potato crop and allow PCN and other pests and diseases to persist through field generations).
vii) New IPM methods for PCN control.
viii) A national strategy, time-lined and with key performance indicators to ensure completion of all aspects of the project and provide the basis of a wider programme of knowledge exchange targeted at specific stakeholder groups.

3 Summary of progress

All work packages are progressing well after the first year of work on the PCN working group project.

3.1 WP1 Economic Assessment

This is progressing well but there has been a delay in competing the review due to the difficulty in obtaining suitable upstream and downstream economic data on potato production in addition to farm gate values. Assistance from AHDB and the use of their 'Farmbench' business comparison tool, together with information from local industry, will now allow the baseline report to be completed.

3.2 WP2 Decision support

A desk study on the merits or the AHDB PCN Calculator has been completed and key evidence gaps identified (available on the Plant Health Centre website). A contract has now been signed with AHDB for use of the PCN Calculator in the project. A workshop, including industry representatives, took place to identify the key components of a decisions support system (DSS) for PCN. Specifications for the DSS are now being collated to allow next steps to take place.

3.3 WP3 Resistance marker development and mobilising new resistance

Specific (KASP) markers for PCN *G. rostochiensis H1* have been developed and we have shown that these markers can faithfully detect the presence and absence of the resistance genes. These are highly informative and very easy to use in breeding applications for which they have now been made available. Other *G. rostochiensis* and *G. pallida* resistances are now being screened from several potato species and moved into pre-breeding programmes.

3.4 WP4 Dihaploid induction for accelerated crop improvement

A panel of cultivars for dihaploid production has been selected with the potato breeders at James Hutton Limited. Clones were pollinated and berries harvested from successful crosses and seeds extracted. A further round of 'winter crosses' were also performed. The resultant seed will now be grown and checked for the dihaploids genotype.

3.5 WP 5 Mechanistic understanding of tolerance to PCN to aid breeding

A desk study on the potential link between tolerance and determinacy has been produced (available on the Plant Health Centre website). This desk study found a potential link between tolerance and both determinacy and nitrogen groups. The outcomes from this study will now allow several glasshouse and field experiments to take place to test the findings and these are now ongoing.

3.6 WP6 Groundkeeper control

A desk study is underway to determine the effects of loss of glyphosate on groundkeeper (GK) control. Approximately 35 fields were flown using a drone in 2021 to collect visual data on groundkeepers for the subsequent development of GK- recognition software. GPS has been used to pinpoint PCN infestations in the field to allow soil samples to be taken for PCN before and after counts.

3.7 WP7 Novel IPM tools

Field trials have been undertaken to examine varieties for *G. pallida* resistant and tolerant. Further trials are also underway to determine the effects of a chitin-based soil amendment on PCN numbers.

3.8 WP8: National knowledge exchange and communications programme

Although a national strategy for PCN has not yet been completed due to difficulties in obtaining data for both the economics analysis and a separate Plant Health Centre-funded PCN modelling project, other aspects of KE and comms is going well. This includes a new website, logo and campaign name (PCN Action Scotland), best practice demonstration and industry questionnaire on a decisions support tool. A timeline has been developed for future engagement across a wide range of relevant stakeholders.

4 Conclusions

Considerable effort and teamwork have gone into all work packages in this project, with regular meetings (both within and across WPs) taking place throughout the year. A meeting (virtual) with the original Working Group members also took place on 15th February 2022. While most milestones have been met, some issues with data availability have delayed some areas, including the economics analysis, with inevitable knock-on effects to other areas, such as the development of the national strategy. However, these delayed areas are expected to be complete early in year 2 of the project.

Good progress has been made in all WPs. (WP1) Much of the data needed for the economics review has now been gathered, including that provided by AHDB. (WP2) Plans for the decisions support system (DSS) have progressed following a workshop with industry, and discussions with the owners of Nemadecide and the AHDB Calculator are proving positive in terms of their use as the basis for the DSS. (WP3) Improved markers for breeding have been produced and potential sources of resistance identified. (WP4) Seed has been collected for use in dihaploids breeding and is currently being tested. (WP5) Tolerance has been linked to determinacy and new field and glasshouse trials are underway to examine this is more detail. (WP6) The field data for groundkeeper (GK) recognition software continues to be gathered and GPS is being used to gain more knowledge about the role of GKs in the spread of PCN. (WP7) IPM strategies are underway, with good field data from varieties trials examining resistance and tolerance to *G. pallida*, and samples taken using GSP to examine the effects of chitin soil amendment on PCN populations. (WP8) PCN KE and comms is moving at pace with a new web site, strapline (PCN Action Scotland), logo, field demonstrations, stakeholder meetings, questionnaires and factsheets (see pcnhub.ac.uk).

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