



Work Package 5: Understanding the mechanisms for tolerance to PCN

This work package is being led by John Jones and his colleagues at the James Hutton Institute.

- Potato Cyst Nematodes or PCN are an important pest of potatoes and across Europe, PCN reduces potato yields and quality.
- In Scotland, the PCN infested land area is doubling every 7 years¹.
- Some potato varieties are tolerant to PCN which means they can maintain their yield in the presence of PCN.
- Nematicides are currently used to protect the yield of intolerant varieties.
- Chemical control options are being removed from the market, therefore there is a greater need for tolerant varieties and new methods for assessing the tolerance of current varieties.
- Currently tolerance is not understood genetically or easily measured.



Figure 1: PCN cysts on potato roots (Courtesy of John Jones, JHI)

We hope to achieve some of these aims by:

- Looking at differences in the root structure alongside the root response to PCN infection, in tolerant and intolerant varieties.
- Examining whether the same genetic mechanisms control tolerance and determinacy (a measure of the crop's capacity to maintain leaf production after flowering) as indeterminate varieties may be more tolerant of infection.

It is **important** to understand the **difference between tolerance and resistance** (which is being explored in other work packages).

Tolerance is the **ability of a potato variety to maintain yield in the presence of PCN**. However, a tolerant variety could allow large populations of PCN to develop as the nematodes are able to multiply on the roots of tolerant potato plants. After the crop is harvested, a much larger population of cysts can be returned to the soil to attack the next susceptible crop in the rotation.

Resistance is the **ability of a variety to limit PCN multiplication**. A resistant variety stimulates nematode eggs to hatch (just as a susceptible variety does), but the juvenile nematodes cannot form a feeding site on the roots as the resistant variety prevents the formation of a specialised feeding structure called the syncytium. With no syncytium to feed on, the nematodes never reach the adult stage, so their lifecycle is cut short, and the population decreases.

If you have any questions about this work package, you can contact John Jones at John.Jones@hutton.ac.uk 01382568828

¹ https://www.planthealthcentre.scot/sites/www.planthealthcentre.scot/files/2021-04/pcn_working_group_-_final_report.pdf

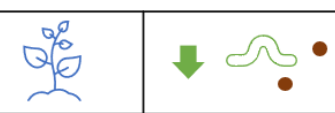
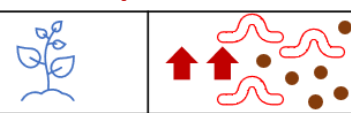

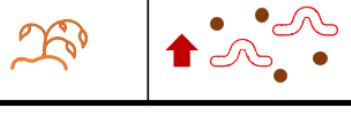
	Resistant	Susceptible
Tolerant	<p>A tolerant and resistant variety will cope with attack and limit PCN multiplication.</p> 	<p>A tolerant but susceptible variety may cope with attack but will not limit PCN multiplication.</p> 
Intolerant	<p>An intolerant and resistant variety is vulnerable to attack but will limit PCN multiplication.</p> 	<p>An intolerant and susceptible variety is vulnerable to attack and will not limit PCN multiplication.</p> 


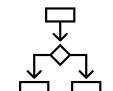






Figure 2: The four possible combinations of tolerance and resistance are shown above. A variety might sit somewhere between these 4 categories.

Work Package Success

1. Increased understanding and knowledge of tolerance within the industry.
2. Understand the effect and importance of plant determinacy and root architecture on PCN tolerance.
3. Identify robust genetic markers for tolerance.
4. Production of improved varieties with robust combinations of resistance and tolerance to PCN.



Figure 3: A healthy crop of potatoes.

 1. Economics	 2. Decision Support	 3. Resistance Markers	 4. Accelerated Breeding	 5. Tolerance to PCN	 6. Groundkeeper Control	 7. Integrated Pest Management	 8. Knowledge Exchange
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More information and factsheets about each work package can be found on pcnhub.ac.uk