

Work Package 4: Dihaploid induction for accelerated crop improvement

This work package is led by Glenn Bryan 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.
- Resistant varieties can control PCN. Currently, there are not many which are resistant to *G. pallida* (the most prevalent PCN species) and suitable for use in Scotland.
- Breeding varieties with specific characteristics such as PCN resistance takes a lot of time and resources.
- Emerging techniques such as breeding potatoes at diploid level, can speed up the development and availability of new and existing varieties with resistance qualities which will improve the management of PCN in a sustainable way.



Figure 1: Young potato plants emerging from the soil.

Aim

To develop new dihaploids that contain genes coding for resistance against the PCN species *G. pallida* and *G. rostochiensis*.



Figure 2: Female cyst emerging through a potato root (courtesy of the James Hutton Institute)

Potato plants are genetically complex because they are tetraploids which means they have 4 copies of genetic material. This makes identifying and introducing beneficial genetic characteristics, such as resistance to PCN, and producing robust gene markers, a challenging process.

Why is breeding potatoes at diploid level the way forward?

Breeding potatoes at the diploid level is more straightforward as genetic analysis can be done more efficiently. This is because there are **2 copies of genetic material** (rather than 4), so the **outcomes of breeding are more predictable**. **Crop improvement can be accelerated** due to the agility of diploid breeding. It is **easier to incorporate other important traits** e.g., heat tolerance, PVY and late blight resistance.

A selection of 12–15 standard tetraploid lines with key PCN and other resistances will be used for diploid induction within this work package.

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











Figure 3: Potato seedlings for a breeding programme in a glasshouse (courtesy of the James Hutton Institute)

- Diploid breeding involves crossing a tetraploid with a special pollinator (a dihaploid inducer) to create dihaploid offspring that contain two of the four copies of the genetic complement of the tetraploid parent.
- Dihaploids can reveal both positive and negative genetic variations that are hidden within their tetraploid parents and often show reduced fertility.
- Once beneficial genes have been identified, they can be bred into a standard tetraploid cultivar.
- This enables the faster 'stacking' of multiple useful potato characteristics such as PCN tolerance and resistance, skin quality, blight susceptibility etc.

Diploid potato breeding is gaining momentum throughout Europe, the US and Canada therefore this work package will help Scotland keep pace with the work occurring in other potato-growing countries.

Work Package Success

1. The development of dihaploid lines that contain different PCN resistances and combinations
2. Confirm the presence of PCN resistance and other plant health benefits with genetic markers at the diploid level.
3. Produce robust diploid breeding lines that can be used to breed traits at the diploid and tetraploid level, resulting in the stacking of desirable characteristics such as PCN resistance.
4. Maintain the UK and Scotland's leading role in potato breeding.

							
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

More information and factsheets about each work package can be found on pcnhub.ac.uk

