Understanding the genetic mechanisms of resistance to Potato leafroll virus in potato

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Introduction

- Potato leafroll virus (PLRV) is the major pathogen of potato in Scotland. PLRV is transmitted between potato plants by aphids and vertically via tubers.
- The incidence of PLRV in Scottish seed and ware potato crops has increased significantly in recent years. This follows the ban on the use of neonicotinoids used to control PLRV vector aphids. Also, milder winters might contribute to an increased aphid survival rate and further drive virus spread.
- Introduction of virus resistant potato varieties offers a sustainable solution to this increasing problem.
- On-going research at the James Hutton Institute aims to identify gene(s) which confer resistance to PLRV and help characterise the underlying mechanism of antiviral defense.
- This information will be used to develop varieties by conventional breeding or by utilising Gene Editing.

Acknowledgements

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Approaches

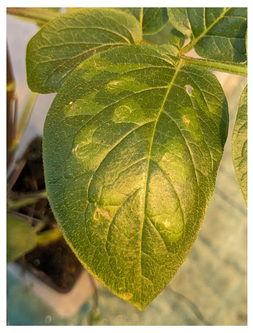
Resistance to viruses, including PLRV, may operate by several mechanisms:

1. Preventing replication via activation of resistance pathways
2. Block virus spread within plants
3. Reduce aphid transmission
4. Block transmission via tubers

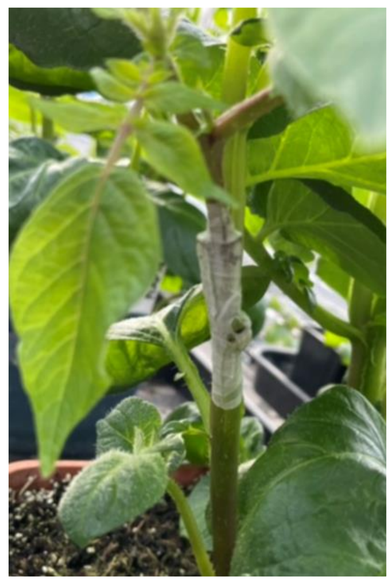
We use a range of genomics tools, genomic-assisted breeding, and a number of approaches to characterize virus resistance phenotypes.

Genetic Tools

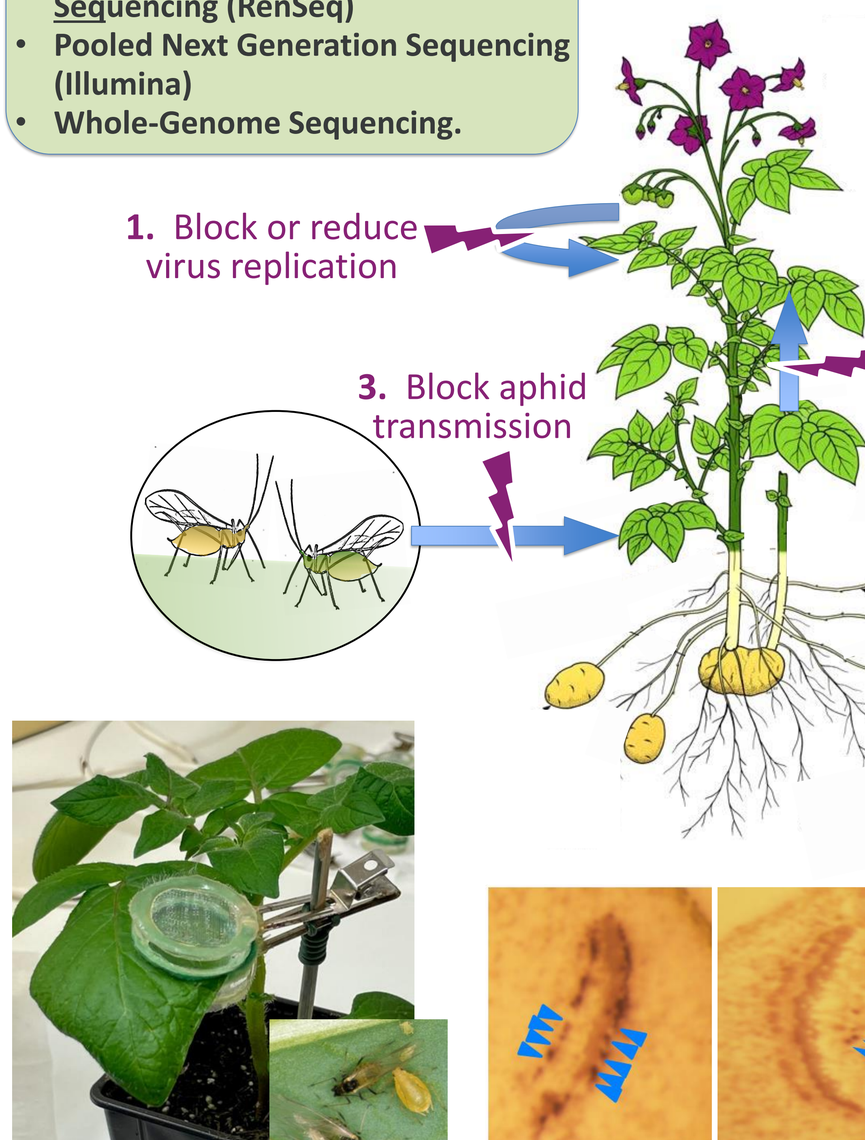
- **Resistance Gene Enrichment Sequencing (RenSeq)**
- **Pooled Next Generation Sequencing (Illumina)**
- **Whole-Genome Sequencing.**



Agroinfiltration with PLRV clone
Determination of susceptibility or resistance to PLRV infection by means of agrobacterium delivered PLRV infectious clone.



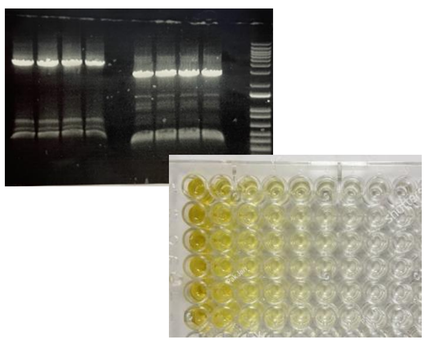
Inoculation with PLRV by grafting
Analysis of PLRV movement and replication in phloem.



Aphid transmission tests
Susceptibility to aphid-transmitted PLRV.

Immunoprints
Distribution and number of PLRV infected phloem elements of stems, petioles and stolons

Virus detection and quantification
Detection of the virus by RT-PCR and ELISA



Conclusions

Research is on-going to investigate the genetic mechanism of resistance to PLRV with an aim to:

- Characterize virus-resistant cultivars and types of resistance
- Identify genotyping markers associated with different types of antivirus resistance to assist conventional breeding
- Identify potential targets for Gene Editing (susceptibility factors) – to introduce virus resistance into contemporary commercial potato varieties