

Identification sources of resistance to *potato mop-top virus* and its vector *Spongospora subterranea*



Adnan A. Lahuf^{1,2}, Louise Sullivan¹, Alison Lees¹, Lesley Torrance¹ and Alison Roberts¹

¹The James Hutton Institute, Errol Road, Invergowrie, Dundee, DD2 5DA, Scotland, UK

²Department of life Sciences, Aberdeen University, Aberdeen, AB24 3UU, Scotland, UK

Email: Adnan.Lahuf@hutton.ac.uk

Introduction

- *Potato mop-top virus* can cause economic losses particularly in potato systems in cooler countries such as Scotland and Scandinavia because it induces spraing symptoms (brown arcs in the flesh) (Fig.1) which decrease the quality of tubers of sensitive cultivars.
- PMTV is soil-borne being naturally transmitted by *Spongospora subterranea* which is also the causal agent of powdery scab on potato (Fig.2).
- Development of resistant cultivars is the most effective strategy in resistance against plant viruses. However, no sources of resistance to PMTV have been identified in potato.
- *Solanum phureja* is a diploid species (Fig. 3) which is cultivated in South America (the Andean region). Clones of this species have been found to possess resistance against a number of plant pathogens
- The aim of this study was to test clones of the *Solanum tuberosum* Group Phureja, held at The James Hutton Institute, for field resistance to PMTV and powdery scab disease.



(Fig.1)



(Fig.2)



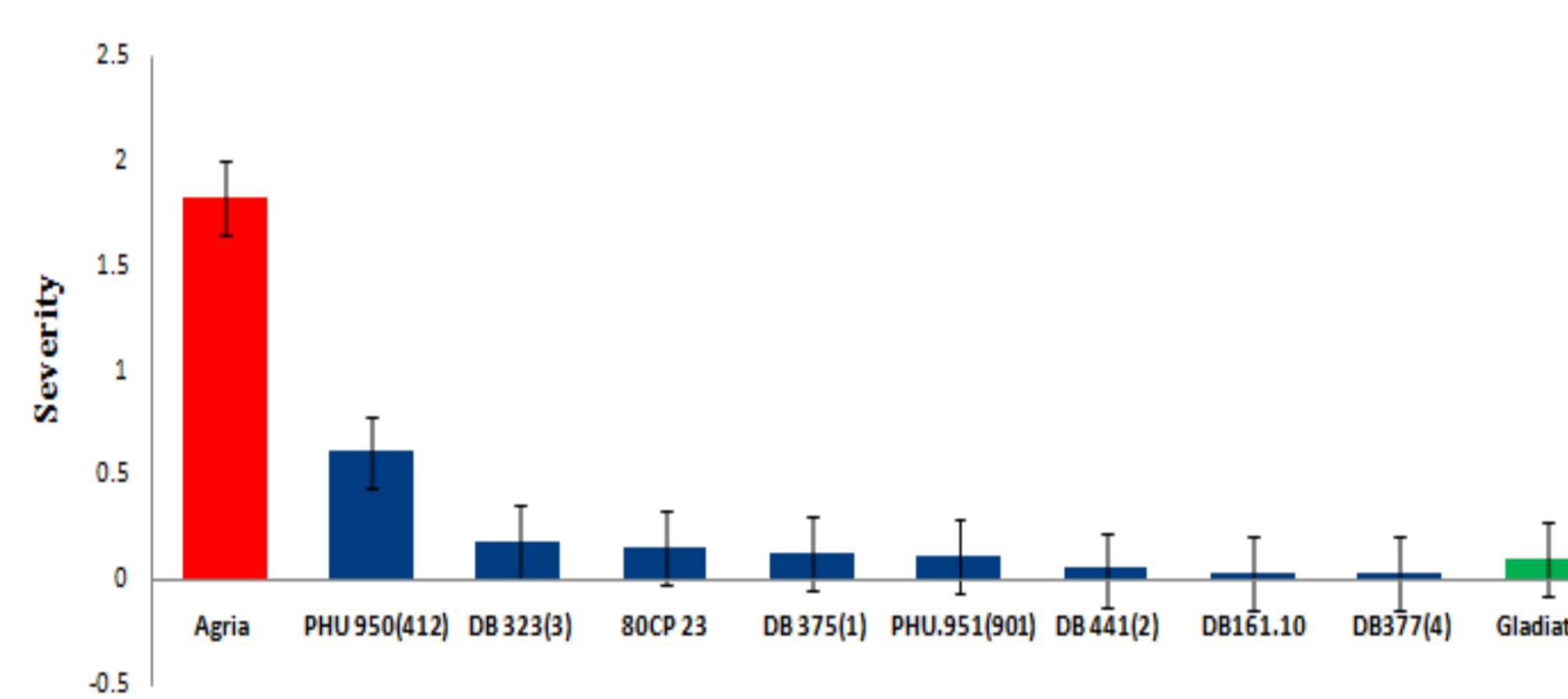
(Fig.3)

Methods

- Thirty-five clones of *Solanum tuberosum* Group Phureja plus *S. tuberosum* cultivars cv. Agria (sensitive to powdery scab), cv. Nicola (sensitive to PMTV) and cv. Gladiator (the resistant cultivar) were planted in 2011.
- In the second season (2012), the most resistant eight clones from the first season were planted with cvs. Agria and Gladiator as controls.
- Over the two seasons, the resistance evaluation of *S. tuberosum* Group Phureja clones was accomplished by collecting root samples for visual assessment of *Spongospora* galls and to process to detect *S. subterranea* and PMTV during the early stage of plant growth by quantitative - polymerase chain reaction (QPCR) and quantitative reverse transcriptase polymerase chain reaction (QRT-PCR).
- After three months of growth, PMTV infection was assessed using ELISA to test leaf samples.
- All tubers were scored visually after harvest for *S. subterranea* and PMTV infection according to Merz (2000) and Anon (1976) scoring systems, then stored for 2 weeks at 18 °C and 10 weeks at 4 °C to allow disease to develop during storage.
- Following storage, tuber samples were analysed by visual scoring and QPCR to detect *S. subterranea*. And using visual scoring, ELISA and QRT-PCR to detect PMTV in tubers.



Results



Figs 4-7. present results from two seasons combined for the best performing 8 clones. **Fig 4. visual scoring mean of *S. subterranea* on tubers.** All of the clones tested had fewer symptoms of *S. subterranea* than cv. Agria (the sensitive cultivar) and three clones displayed fewer symptoms than Gladiator (the resistant cultivar).

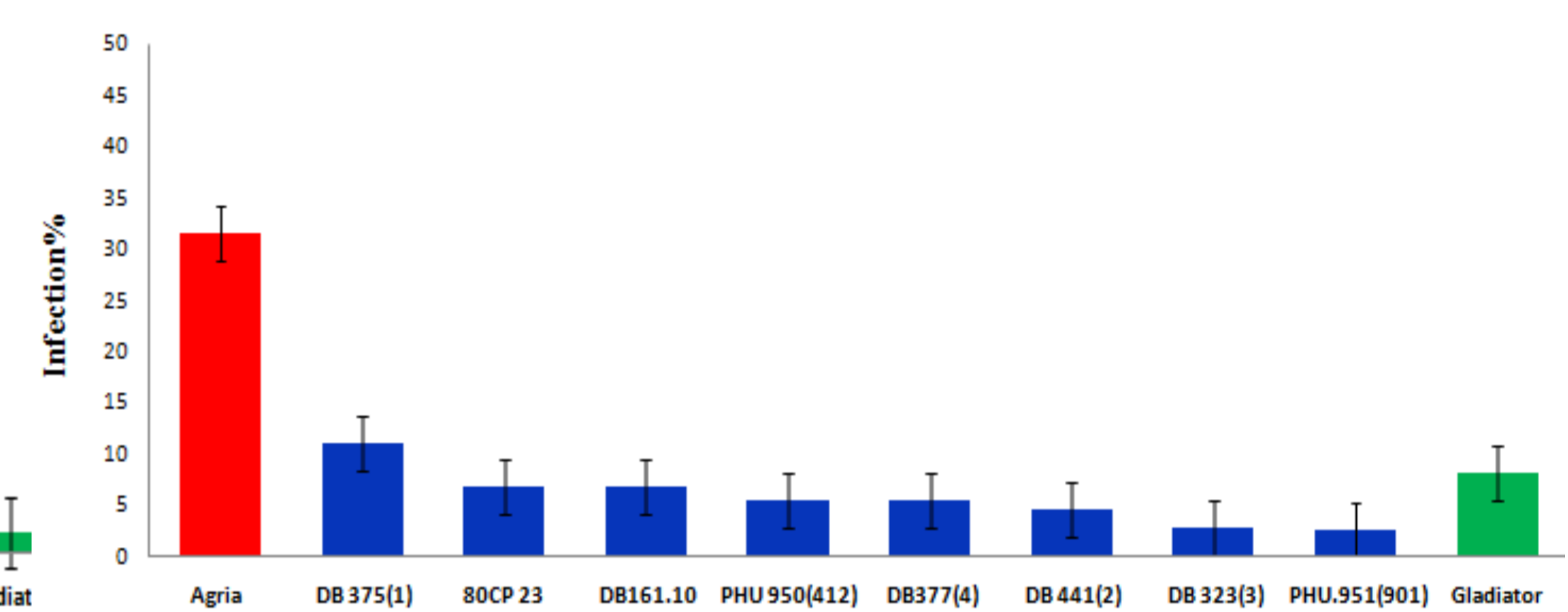


Fig 5. percentage (%) of tubers scoring positive by ELISA .PMTV was detected in 31.6% of tubers the sensitive cv. Agria but only in 2.7-11.1% of the eight clones tubers under test; meaning that all clones tested showed improved PMTV resistance

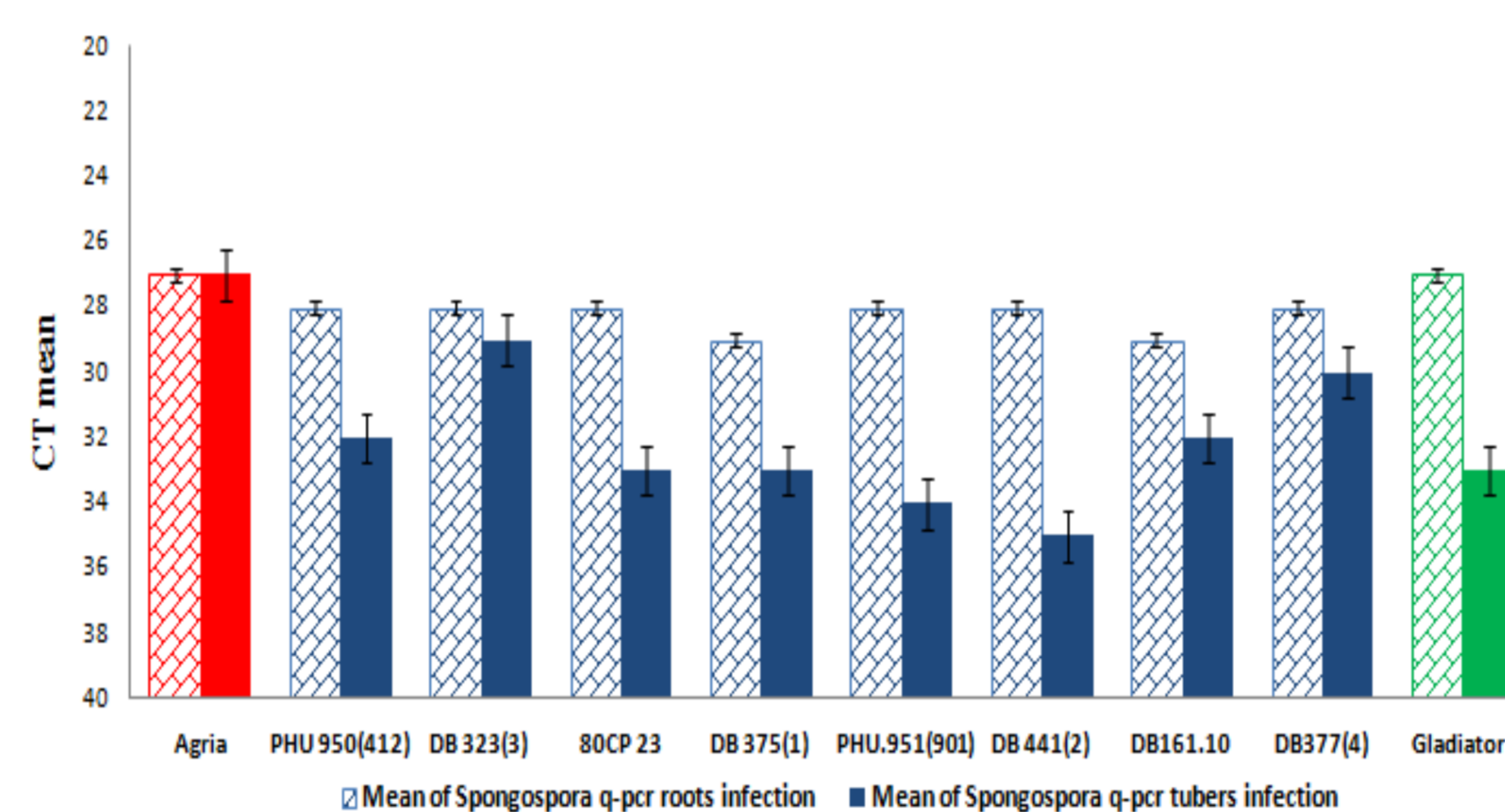


Fig 6. Mean of *S. subterranea* infection in roots and tubers assessed by QPCR. More *S. subterranea* was detected in roots than tubers, and the amounts in roots were similar in all clones. All clones tested showed less infection in tubers than cv. Agria (susceptible control) and two clones had less infection than cv. Gladiator(resistant control).

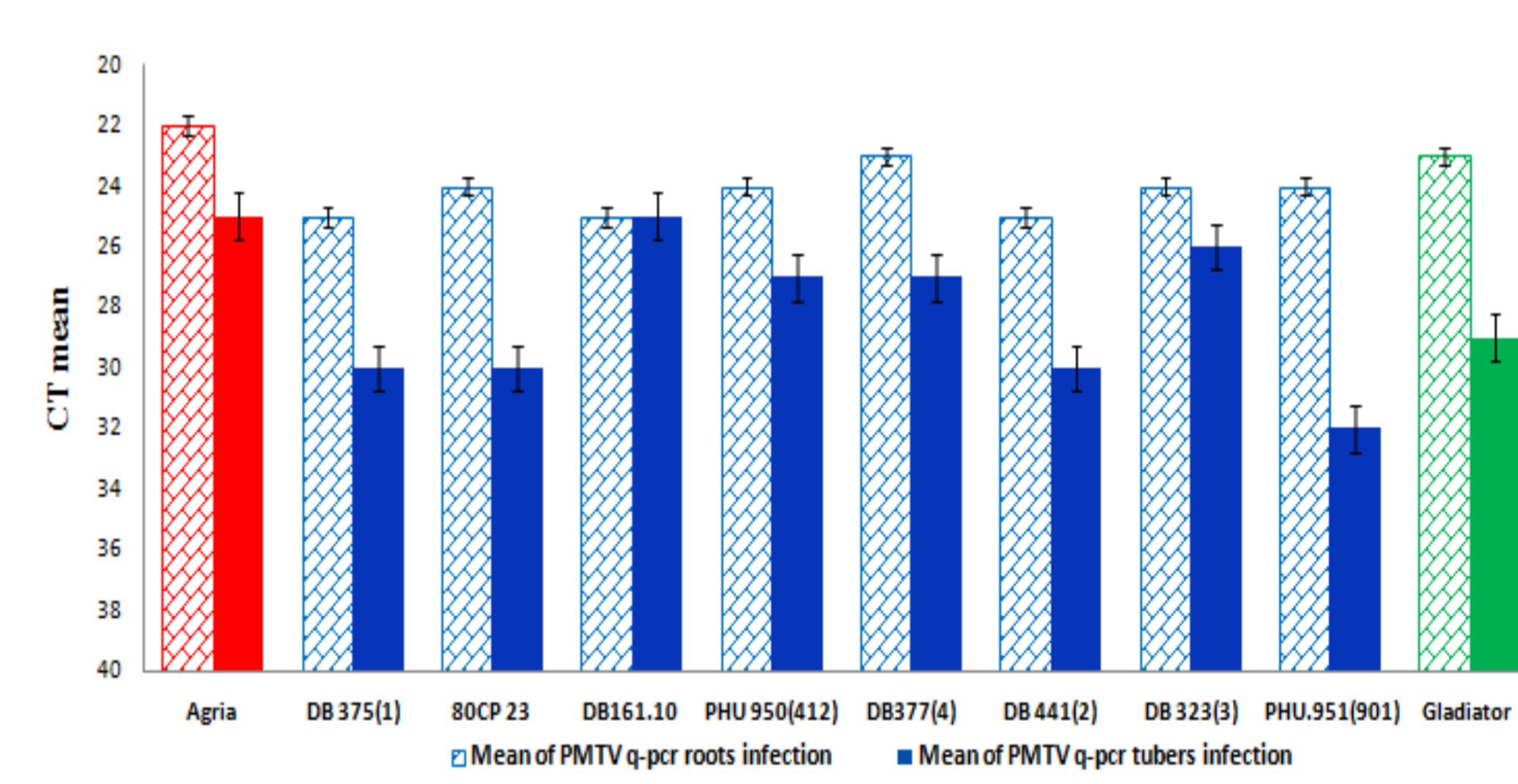


Fig 7. Mean of PMTV infection in roots and tubers assessed by QRT-PCR. More PMTV was detected in roots than tubers, and the amount detected in roots were relatively similar in all clones. Four clones had substantially less PMTV infection in tubers than cv. Agria (susceptible control) which showed less infection than cv. Gladiator.

Summary: Thirty-five clones of *S. tuberosum* Group Phureja were evaluated over two seasons to identify sources of resistance to powdery scab and PMTV. The assessment of diseases severity was accomplished by visual scoring, ELISA, QPCR and QRT-PCR. In the first season, eight clones showed better resistance to PMTV than a commercial potato cultivar. These clones were planted again to confirm the result in a second trial. Two clones displayed the best field resistance to PMTV and displayed good resistance to powdery scab.

Conclusions

- ❖ Clones showed different levels of accumulation of PMTV and *S. subterranea* in root and tubers.
- ❖ Some clones showed field resistance to *S. subterranea* and PMTV in the tubers that was better than the commercial cultivar.
- ❖ Two clones have been selected that have excellent level of field resistance to both pathogens and these clones can be used in potato breeding programmes as parents to introduce resistance into commercial cultivars.

Acknowledgment

Adnan A. Lahuf is in receipt of a post graduate scholarship from the Iraqi Ministry of Higher Education and Scientific Research .

References

- Anon (1976).** Manual of Plant Growth Stages and Disease Assessment Keys. MAFF Publications, Pinner, Middlesex.
- Merz, U. (2000).** Powdery scab research in Switzerland. In: Merz, U. and A.K. Lees [eds.] Proceedings of the first European Powdery Scab Workshop, 2000. Aberdeen, Scotland, July 20-22