



HIP WP 1.2: Getting to the Roots of Stress Resilience of Potato Plants

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The goal of this project is to gain insight in the role of the root system in tolerance to stress conditions (salinity and low Nitrogen availability).

Roots are notoriously difficult to investigate, as these are underground structures. Yet, roots are the first to sense many environmental stresses like drought, salinity and low nutrient availability, and root structure and specific water, ion and nutrient uptake properties are at the basis of tolerance mechanisms that may enable crops to maintain an appreciable yield under stress conditions.

In this project we are assessing variation in and genetic control of the response of roots to soil salinity and low N availability, and the consequences for growth of the crop.

Highlights:

In the first year, we started with development of a method and protocol to assess root structure variation. Several potato lines were grown on vertical agar plates in which the roots are visible and can be imaged. We have optimized conditions (light, media) for evaluation of the salinity response using a limited set of diploid potato lines. A larger set of lines is now available to assess variation in root structure and root structure adaptation in 2021. We have established variation for salinity tolerance in a limited set of potato cultivars in a hydroponics system, displaying variation in growth as well as root formation under saline conditions. We have used potato field trials of another HIP project in which potato cultivars were grown amongst others under nitrogen limitation, and established variation in root structure under these conditions as well.

A candidate gene approach targeting genes known to be important for root architecture under stress has been initiated. We will generate expression profiles using RNAseq, and generate lines with altered expression of the candidate genes to characterize their role in root architecture plasticity under saline and N-limiting conditions.

Bottlenecks:

Personal issues with essential participants in the project have caused some delay. In addition, the Corona pandemic has further delayed some experiments and analyses, as well as the provision of materials for screening.

Planning:

The project is delayed for reasons mentioned above. We will evaluate and phenotype of root and above-ground characteristics of potato cultivars in spring, summer and fall of 2021 both in a hydroponics growth system and in pots. We will screen (visualize and analyze) a diversity set of mostly diploid potato lines for root architecture and root plasticity on agar plates under saline and if time allows also N-limiting conditions. Lines with modified expression of candidate genes involved in root architecture and plasticity will be made and, if possible, analyzed

Products:

- Dataset of root and shoot trait response to salt and N-limitation of potato cultivars and genotypes.

- Ranking list of cultivars and genotypes with respect to salt tolerance, N-limitation tolerance and root plasticity.
- A videoclip was made, in which the project aims and setup is explained (Figure 1; https://youtu.be/Q_juH6CCJDs)



Figure 1: Hydroponics system to study stress responses in the roots (videostill from the project movieclip).