Root2Res
Root phenotyping and genetic improvement for rotational crops resilient to environmental change

Practice Abstract

Shovelomics: Measuring potato root traits in the ridge

Problem

The root system architecture and its interactions with soil microorganisms play a key role in crop performance, particularly in the capture of water and mineral elements. Studying roots is more complicated than studying the above-ground parts.

Solution

To facilitate the complex study of root systems, the shovelomics method was validated.

Principle

The Shovelomics method measures root traits on plants sampled with a spade. With this simple method, we can access the 3D architecture of the main roots growing into the ridge.

Benefits

Using shovelomics, root traits can be measured in 0 to 20 cm depth in the ridge. The parameters are measured by hand and software is required to measure the root length and root diameter automatically.

Applicability box

Theme: Potato root measurements

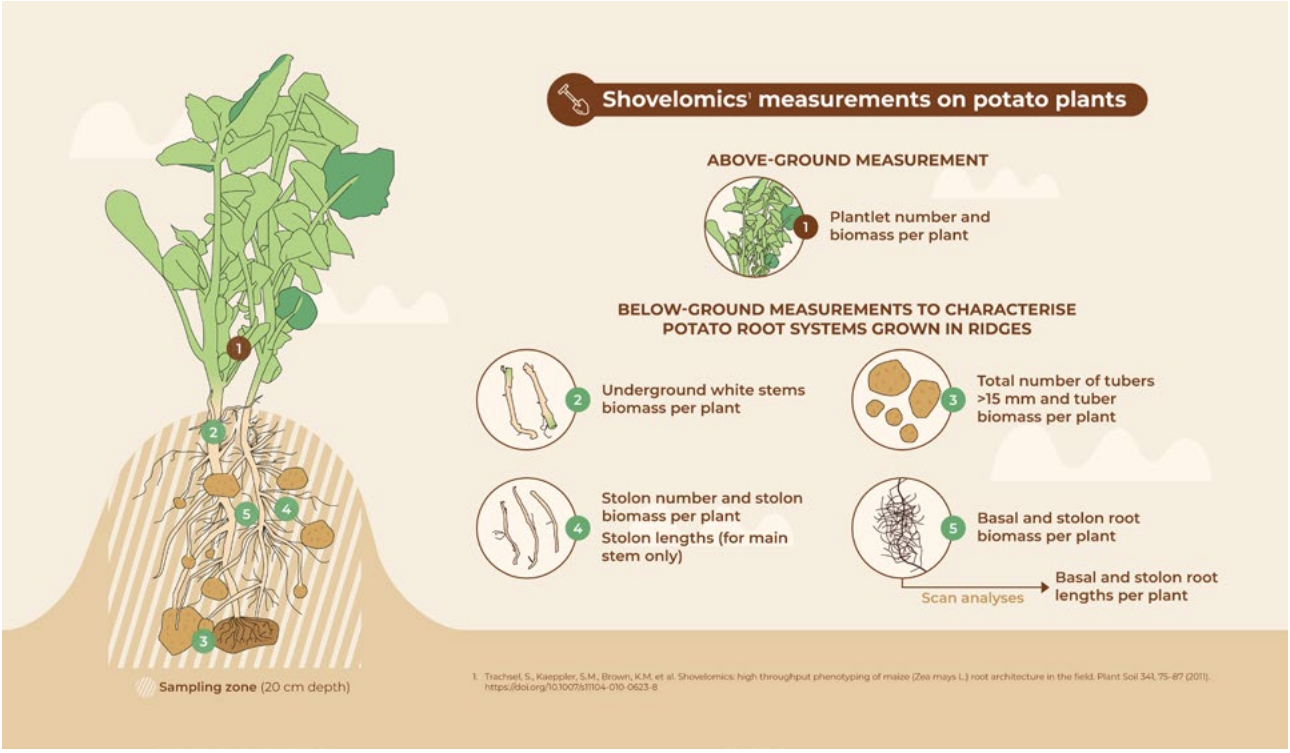
Relevance: Shovelomics enables measuring root traits of potatoes grown in the ridge

Best in: Potato; moist and soft soils; prior to flowering and tuberization

Measured traits per plant:
Plantlet number/biomass,
stolon number/length/biomass,
stolon root number/length/biomass,
basal root number/length/biomass,
tuber biomass/humidity
white stems biomass

Required time: Choose 1–3 plants per plot, 1–2 hours per plant

Equipment: Spade, bags, secator, balance, oven, scanner, software (e.g. WinRhizo, RhizoVision)



Shovelomics enables the characterisation of below-ground measurements of potato root systems.

Practical recommendations

In the field

- In each plot, excavate 1–3 plants using a spade ensuring that the full root crown is removed with the mother tuber and all other tubers (greater or less than 15 mm in diameter). Shake the root crowns gently to leave as much soil as possible in the field. Take all the roots, stolon, and tubers you can see by mixing the ridge soil with the spade.

In the lab

- For above-ground measurements count the number of plantlets per plant. Cut the above-ground stems at ground level. Put them in a bag to dry them in the oven at 70 °C during 48 h. Measure dry matter and calculate biomass.
- For below-ground measurements, wash the root crowns in buckets filled with water. Then, gently move the root crowns to assist soil removal without causing damage. Leave them in water until scoring.
- Evaluate the root traits by selecting the main stem and detaching it from the mother tuber. Then measure number and length of stolons, number and length of stolon roots, and number and length of basal roots, that are attached to the mother tuber. Count and separate tubers >15 mm, tubers <15 mm and mother tuber.
- Scan roots to apply a software able to measure total root length and average root diameter.
- Dry material for 48 h in an oven at 70 °C to determine biomass of each organ.

Further information

- Trachsel, S., et al. (2010). Shovelomics: high throughput phenotyping of maize (Zea mays L.) root architecture in the field. Plant and Soil; Available at: doi 10.1007/s11104-010-0623-8.
- York, L. M. et al. (2018). Wheat shovelomics I: A field phenotyping approach for characterising the structure and function of root systems in tillering species. BioRxiv; Available at: doi 10.1101/280875.
- Slack, S., et al. (2018). Wheat shovelomics II: Revealing relationships between root crown traits and crop growth. BioRxiv; Available at: doi 10.1101/280917.
- Fradgley, N., et al. (2020). Effects of breeding history and crop management on the root architecture of wheat. Plant and Soil; Available at: doi 10.1007/s11104-020-04585-2.

About this practice abstract and Root2Resilience

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Root2Resilience: The project is running from September 2022 to August 2027. The overall goal of Root2Resilience – Root phenotyping and genetic improvement for rotational crops resilient to environmental change – is to develop root phenotyping, genetic and modelling tools and use them to define and test innovative genotype ideotypes able to enhance the tolerance to abiotic stress and carbon sequestration in soils

Project website: root2res.eu

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