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Mapping legume roots can determine best performing crops

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What is this research about?

The researchers investigated a novel way to measure roots and describe their characteristics. All legumes have different amounts of nodules on their roots. These outgrowths provide a home for beneficial bacteria that capture nitrogen, necessary for a plant to grow. In turn, the plant provides sugar for the bacteria to manufacture energy. Both the plant and the bacteria benefit in this symbiotic relationship.

Until recently there was no way to systematically measure and locate the nodules found on roots. This software and method to measure roots allow comparisons between different plant varieties as well as a quick and accurate measurement of root and their nodules in experimental treatments, and therefore permit a way to measure better growth outcomes.

What did the researchers find?

Guinel and her team found that it was possible to use software to represent a root system. Being able to have a digital representation of root systems allows the researchers to mine information about the root, compare different images of roots, and have records of these measurements.

It is thought that the best legume crops are those that have roots with an optimal density of nodules for hosting bacteria that fix nitrogen for the plant to achieve optimal growth. The plant must control the number of nodules because it cannot give too much of its sugars to the bacteria.

What you need to know:

Legume plants have a mutually beneficial relationship with bacteria. These beneficial bacteria live in nodules found on plant roots. Until recently there was no way to systematically measure the roots the nodules are found on and to place accurately the nodules on these roots.

The research team created software and a method to measure multiple root parameters which were not available previously. This allows different plant varieties to be compared with precise measurements of the root structure in order to figure out which plants will grow better.

How can you use this research?

- **Legume root researchers** can use this research method to analyze the roots of their experimental plants.
- **Post-Secondary Students** can apply this new methodology in their graduate work to create better data more quickly.
- **Seed Manufacturers** can use this research to know how to evaluate the robustness of their crop varieties.
- **Farmers** can benefit from this research to choose which crop varieties to plant.

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What did the researchers do?

Frédérique Guinel, a faculty member in Laurier's Department of Biology, and collaborators Lauren Remmler, Lindsey Clairmont and Anne-Gaëlle Rolland-Lagan explored how comparing roots of plants can determine what crops to grow. To do this they grew pea plants, and then prepared the roots to be photographed after 31 days of growth. The roots that develop nodules were then laid out flat and photographed.

The root photos were analysed using software to detect the nodules. To confirm the accuracy of the software, nodules were counted manually which is a time-consuming process.

Finally, the data analysis software extracted measurements about the root and the nodules including: number of roots, root length, number of nodules, distance from the base of the root to the first nodule, etc. The researchers then calculated density of nodules on maps specific for each specific root system.

About the researchers:

Frédérique Guinel is a Professor with Department of Biology at Wilfrid Laurier University.

L. Clairmont is a Ph.D. student at Laurier in the department of Biology, L. Remmler is a Program Officer at NSERC, and A-G. Rolland-Lagan is in the Department of Biology and the School of Electrical Engineering and Computer Science at the University of Ottawa respectively.

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Article citation:

Remmler, L., Clairmont, Lindsey, Rolland-Lagan, A-G., and Frédérique C. Guinel. (2014). Methods: Standardized mapping of nodulation patterns in legume roots. *New Phytologist, 202, 1083-1094.* doi: 10.1111/nph.12712 Retrieved from http://journals1.scholarsportal.info/details/0028646x/v202i0003/1083_smonpilr.xml

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Keywords:

Image analysis, analysis software, nodule density, root systems, plant growth, crops.

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Laurier promotes the use of knowledge mobilization to maximize the impact of Laurier research on professional practice, public policy, and community engagement. Written by S. Reibling.

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