Characterization of the impact of tillage and nitrogen fertilization on the root development of a winter wheat crop by use of NIR hyperspectral imaging combined to chemometrics

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Introduction

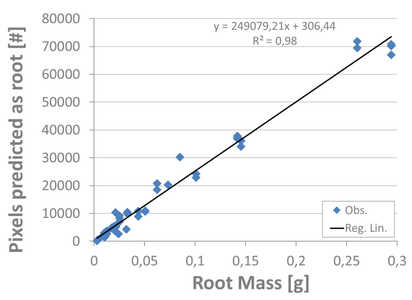
The root system of plants has many functions among which the anchorage of the shoot, the uptake of water and nutrients, the storage of carbohydrates and other reserves, the biosynthesis of compounds or the interactions with microorganisms [1]. Consequently, enhancing the root system of crops is seen as a major possible way to sustainably improve yields [2]. The objective of this work is to **characterize the impact of tillage management and nitrogen fertilization on the development of the root system of a winter wheat crop** (*Triticum aestivum* L.) by the use of **an innovative procedure that combines hyperspectral NIR imaging and chemometric tools**.

Methodology

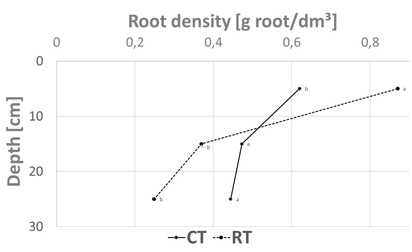
Two different modalities of tillage (conventional tillage on 25 cm and reduced tillage on the 10 first cm of the soil) and **five modalities of nitrogen fertilization** will be studied. A total of 2016 measurements will be performed during 3 years. The roots will be quantified using soil core sampling, discretising the **0 to 90 cm soil profile by 10 cm layers**.

These soil samples will be washed by a water current and the **extracted elements** will be dried.

These elements will be scanned using a **NIR hyperspectral imaging system** working in the 1100-2498 nm spectral range and taking a spectrum for each pixel [3]. The NIR images will be analyzed by a classification tree based on successive chemometric models to separate the spectra into 4 spectral classes: background, soil, crop residues and roots.



Finally, a regression line allows to convert the number of pixels classified as root into grams of roots [3].



The so-observed root densities will be used **to assess the impact of tillage and nitrogen fertilization on the development of the root system**. Moreover, the root development of the winter wheat crop will be put in parallel with nitrogen measurements in the soil profile. Finally, these data will allow to **calibrate and validate the root growth module of the crop growth model STICS [4] under the Belgian pedoclimatic conditions**.

Preliminary results and perspectives

Preliminary results have indicated that tillage has a significant impact on the development of the root system of a wheat crop in the 30 first centimeters of soil [5]. These results will allow to have a better comprehension of the impacts of cultural practices on the root system development and will present applications in breeding, guidance to farmers and crop science research.

Acknowledgment

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