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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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]. Because of the important role it plays for the plants, the enhancing of the root system of crops is seen as a major possible way to sustainably improve yields [2]. The objective of this thesis 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.).

This research is based on the application of an innovative procedure of crop root system quantification constituted by the combination of near infrared hyperspectral imaging (NIR-HSI) and chemometric tools [3]. Its ability to rapidly perform measurements is a main advantage. Two different modalities of tillage (conventional tillage on 25 centimeters and reduced tillage on the 10 first centimeters 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. The soil samples will be washed and the extracted elements will be dried. These elements will be scanned by a NIR hyperspectral camera working in the 1100-2498 nm spectral range and taking a spectrum for each pixel. The NIR images will be analyzed by a classification tree based on successive Support Vector Machines (SVM) 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, these data will allow to calibrate and validate the root growth module of the crop growth model STICS under the Belgian pedoclimatic conditions [4].

Preliminary results show 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.

References:

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