Gembloux Agro-Bio Tech
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Innovative methods in agricultural production

Root system, Plant nutrition and Soil fertility

Characterization of the impact of tillage on the root development and distribution of crop residues of a winter wheat crop by the use of NIR hyperspectral imaging

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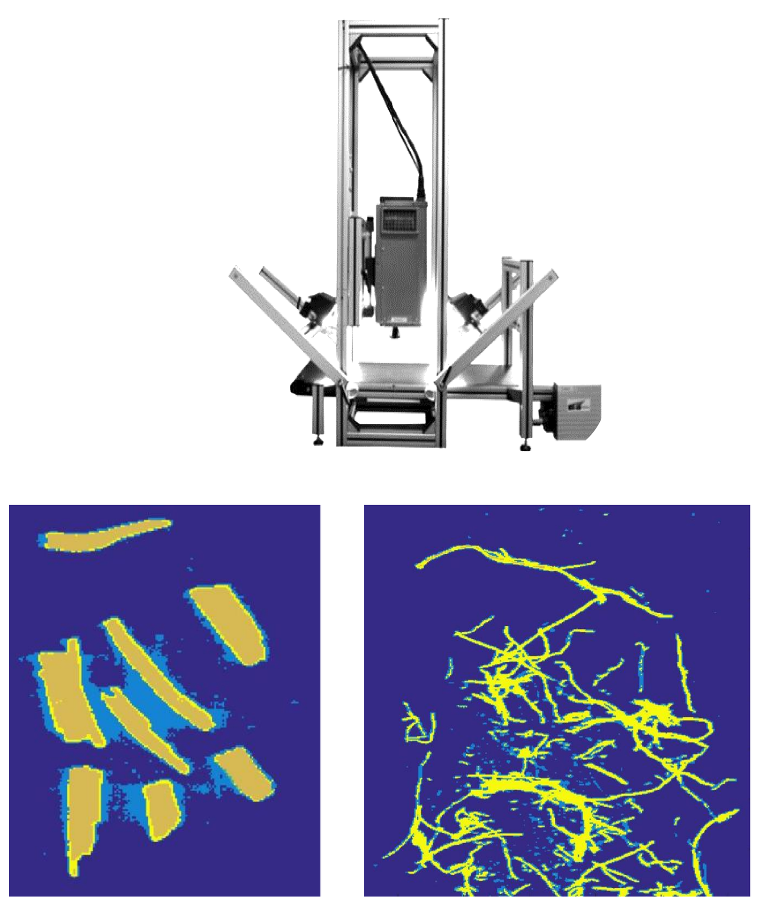
Introduction

The tillage practice applied on a field has a significative impact on multiple soil parameters, among which, the root development and the distribution of crop residues in the soil profile [1]. The objective of this study is to **characterize the impact of tillage management on (1) the evolution of winter wheat crop residues (*Triticum aestivum* L.) and on (2) the development of the root system of a winter wheat crop in the framework of the long-term field trial SOLRESIDUS located in Gembloux (Belgium).**

Methodology

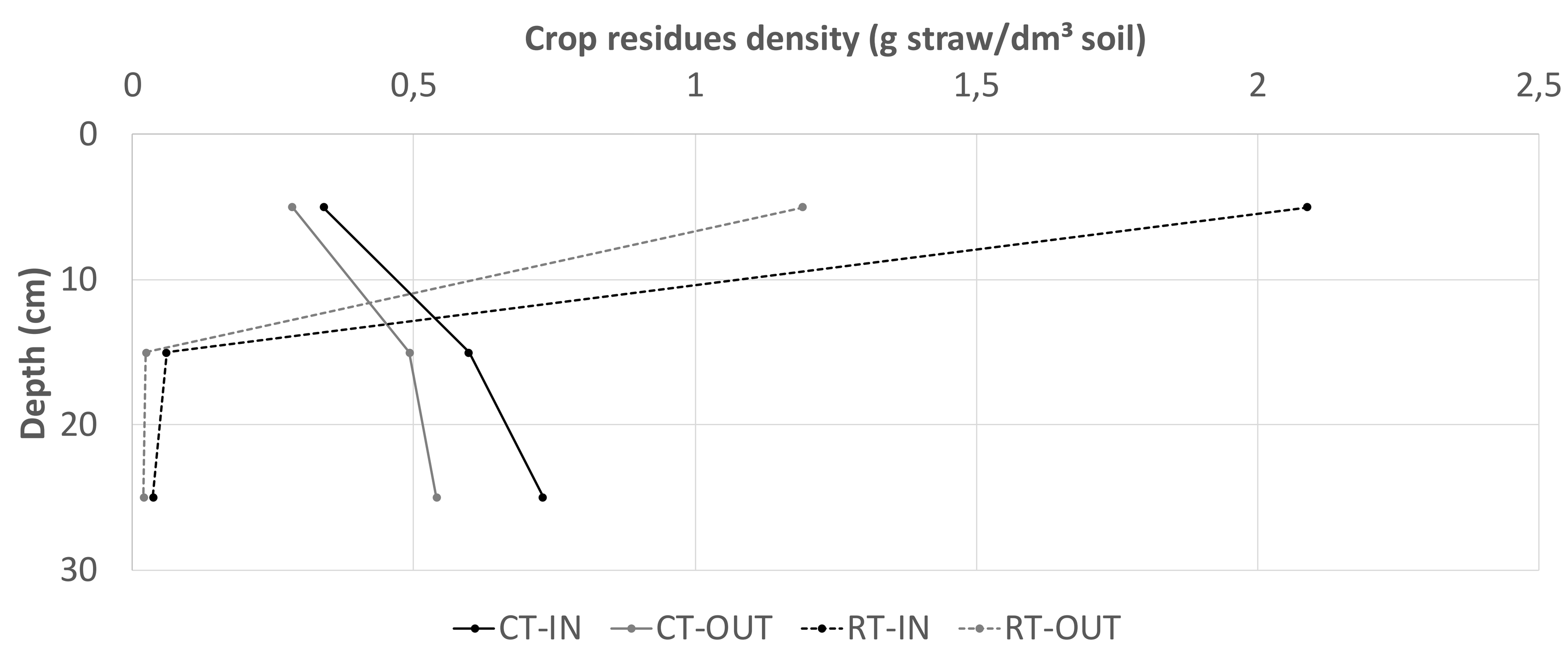


The long-term field trial SOLRESIDUS aims to study **the impact of two modalities of tillage** (conventional tillage (CT) on 25 cm and reduced tillage (RT) on the 10 first cm of the soil) and **two modalities of crop residues restitution** on different components of the agroecosystem.

The crop residues and roots were quantified using soil core sampling, discretising the **0 to 30 cm soil profile by 10 cm layers**. These soil samples were washed by a water current and the **extracted elements_**were dried. These elements were scanned using a **NIR hyperspectral camera line-scan** working in the 1100-2498 nm spectral range and taking a spectrum for each pixel (Camera installed in the CRA-W, Burgermetrics). The NIR images were analyzed by a classification tree based on successive Support Vector Machines (SVM) models to discriminate 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 or crop residues into grams of elements [2].

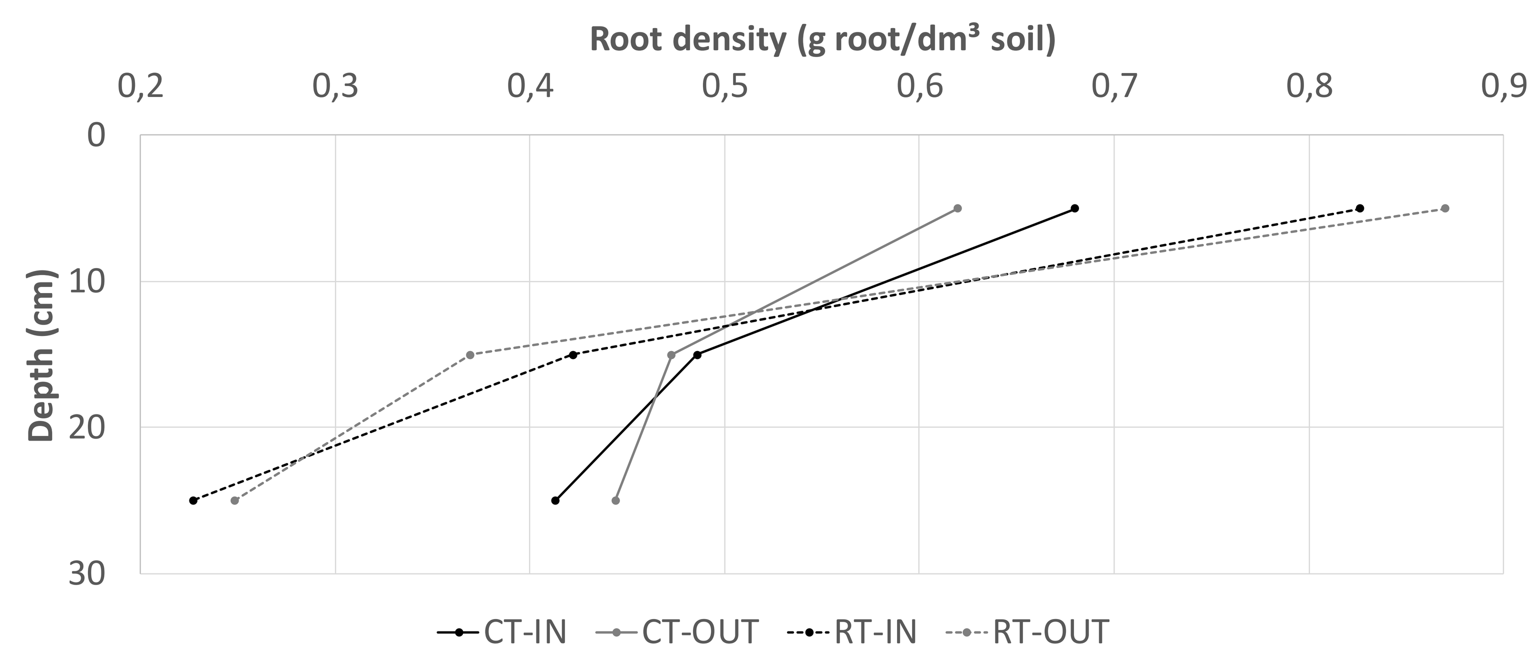
Results and discussion

8th May 2012 – Crop residues distribution



A significant influence of tillage on the crop residues distribution has been observed. Indeed, on the basis of the predicted data, **a mix of 90% of total crop residues has been measured in the 10 first cm of soil in reduced tillage (RT). In conventional tillage (CT), 77% of the crop residues were buried between 10 and 30 cm.** Moreover, the crop residue density was higher in the modality of restitution (In) than in exportation (Out) of crop residues.

8th May 2012 – Root distribution



A significant influence of tillage on the root system distribution has been observed. **The conventional tillage allowed a more homogeneous development of the root system in the 30 first cm in contrary to reduced tillage that concentrates a large part of the root system in the 10 first cm.** These differences between the two systems has been linked to differences in **soil compaction** and **humidity**.

Conclusion

The use of this rapid and innovative root quantification method based on the use of the NIR-HSI technology and it's ability to discriminate the different soil components allowed a better comprehension of the subterranean part of the long-term field trial SOLRESIDUS.

Acknowledgment

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[1] Fraipont, G. *Détection et quantification des racines et des résidus de culture de froment d'hiver (Triticum aestivum L.) par imagerie hyperspectrale proche infrarouge*. Mémoire présenté en vue de l'obtention du diplôme de master bioingénieur en sciences agronomiques, Faculté Gembloux Agro-Bio Tech (ULg), Gembloux (2015).
[2] Eylenbosch, D., Fernández Pierna J.A., Baeten, V., & Bodson, B. *Use of NIR-HSI and dichotomist classification tree based on SVMDA models in order to discriminate roots and crop residues of winter wheat*. In: Proceedings of the 9th EARSeL SIG Imaging Spectroscopy workshop, Luxembourg, 237-238 (2015).