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Spatial patterns in winter wheat development related to soil properties and historic management. A case study from central Belgium.

Dimitri Goffart[1], Klara Dvorakova[2], Yannick Curnel[1], Quentin Limbourg[1], Giacomo Crucil[2], Viviane Planchon[1], Kristof Van Oost[2], and Bas van Wesemael[2]

[1]Walloon Agricultural Research Center, Production in agriculture - Agriculture, territory et technologies integration, 5030 Gembloux, Belgium (d.goffart@cra.wallonie.be)

[2]Georges Lemaître Centre for Earth and Climate Research, Earth and Life Institute, Université Catholique de Louvain, 1348 Louvain-la-Neuve, Belgium

Intra-field heterogeneity of soil properties is function of complex interaction between biological, physical factors and historic agricultural management. Quantifying the spatial patterns of soil properties such as soil organic carbon (SOC), nitrogen (N), phosphorous, exchangeable cations, pH, soil texture will contribute to an optimization of fertilizer application and crop yields. We tested the capacity of the multispectral Micasense rededge camera mounted on a UAV in order to map the development of winter wheat and related the Red-Edge NDVI (RENDVI) from the sensor to the Plant Area Index (PAI) measured in the field. The geo-referenced grain yield of the winter wheat was measured by a combine harvester and the top soil characteristics analysed by a grid based sampling. The spatial patterns in RENDVI at three phenological stages were mapped together with the yields. For each of these images conditional inference trees were used to derive the soil properties that significantly influenced these spatial patterns. Within-field variation in PAI (cv 41 % in March, 27% in April and 9 % in May) and yield (cv 4%) can be observed. The spatial patterns of RENDVI are rather constant and their correlation with yields is highest in March and April (r=0.64). Soil properties explain between 67 to 79 % of the variance in vegetation index throughout the growing season as well as 67 % of the variance in yield. Legacy effects of land consolidation two years earlier reflected in the field lay-out, pH and exchangeable K are significant factors explaining around 12-18 % of the variance in crop yield each. The SOC contents were overall low (8-15 g kg-1). Hence, the N supply resulting from SOC mineralization throughout the growing season covered less than 10% of the crop needs and the yield patterns did not reflect the variation in SOC contents.