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Data fusion of soil and vegetation maps for site-specific nitrogen recommendations in cereal crops

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In the context of nitrogen (N) fertilization, the implementation of precision agriculture's approaches allows a better use efficiency of the element and reduces economic and environmental losses. To achieve this goal is crucial to study the intra-field spatial and temporal variability. Then, data integration within a Decision Support System (DSS) is needed to prepare a prescription map containing the recommended site-specific fertilizer doses. Current DSSs available to farmers are based on empirical models with low integration of the different data sources.

For this reason, this study aimed to develop a DSS able to integrate soil and crop variability maps to define the site-specific N dose during the 2021 maize season of the ConSensi project (funded by rural development 2014-2020 for Operational Groups). The proposed DSS modifies the most widespread empirical DSS (GreenSeeker) used to calculate the optimal N doses proposed by Oklahoma State University. It relies on the hypothesis that a vegetation index can predict both in-season crop response to nitrogen fertilization and yield potential. Soil variability contribution is not considered. Therefore, the modification proposed identifies different zones of the field by integrating soil variability maps of electrical conductivity, considered stable over time, and vegetation index maps, which take into account seasonal variability. Then values of the vegetation index are used to define site-specific N doses by estimating crop yields (with a calibration curve, R^2= 0.75, specific for maize in Lombardy, Italy) and maize response to nitrogen. The DSS was tested on two maize fields of 2.5 ha in Lombardy. Potential economic benefits were estimated compared to uniform fertilization management: the average rate applied was 190 kg N/ha compared to 250 kg N/ha applied by farmer's common practice (an average of 24% less of applied N) also leading to possible environmental benefits to be tested in future field experiments.