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The role of smart farming in optimizing the use of agrochemicals towards maximum profitability and minimum environmental footprint

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Abstract

The need for intensive crop production accompanied by the significant increase in use of agrochemicals, makes it more than ever urgent to optimise the field application technology for sustainable production. Nevertheless, farmers tend to use more agrochemicals than biologically necessary to ensure the highest possible yield. This traditional application method increases unnecessary application cost, and more importantly, seriously impacts the environment. With ever-decreasing financial margins, but mainly under pressure of the growing environmental concerns, a diversity of strategies has been deployed in an attempt to mitigate this problem. Precision agriculture is one of the modern methods to optimise the use of agrochemicals according to the crop needs and soil fertility. It aims at managing within field variability, by deploying site-specific or variable-rate solutions, with the objective to apply the right product, and amount in the right time and place, using advanced sensing, modelling and control technologies. This work aims at presenting recent findings about the potential of variable rate technologies in arable crop production in increasing yield and profitability, at reduced environmental impacts. The approach concerns the use of multi-sensor data fusion approach to map the spatial variability in crop and soil characteristics at the field scale using remote and proximal sensing technologies. Recommendations for variable rate applications are based on mapping the yield limiting factors. Results of both simulation and field experiments carried out over 10 years in different European and associated countries are reported. Results showed, in the top majority of cases, that variable rate applications increase crop yield by 10%, and profitability, while reduces environmental impact by reducing the amount of agrochemicals applied by up to 20%. It is recommended to promote the adoption of this technology, as current figures show limited adoption rates by farmers, and the rate vary among different countries. The limited adoption can be attributed to manifold factors, including the absence of a profitability estimation-based decision support system to guide farmers making a decision on adoption.

Keywords

Precision agriculture; synthetic fertilisers; manure; sensing; data fusion; simulation; field experiments.