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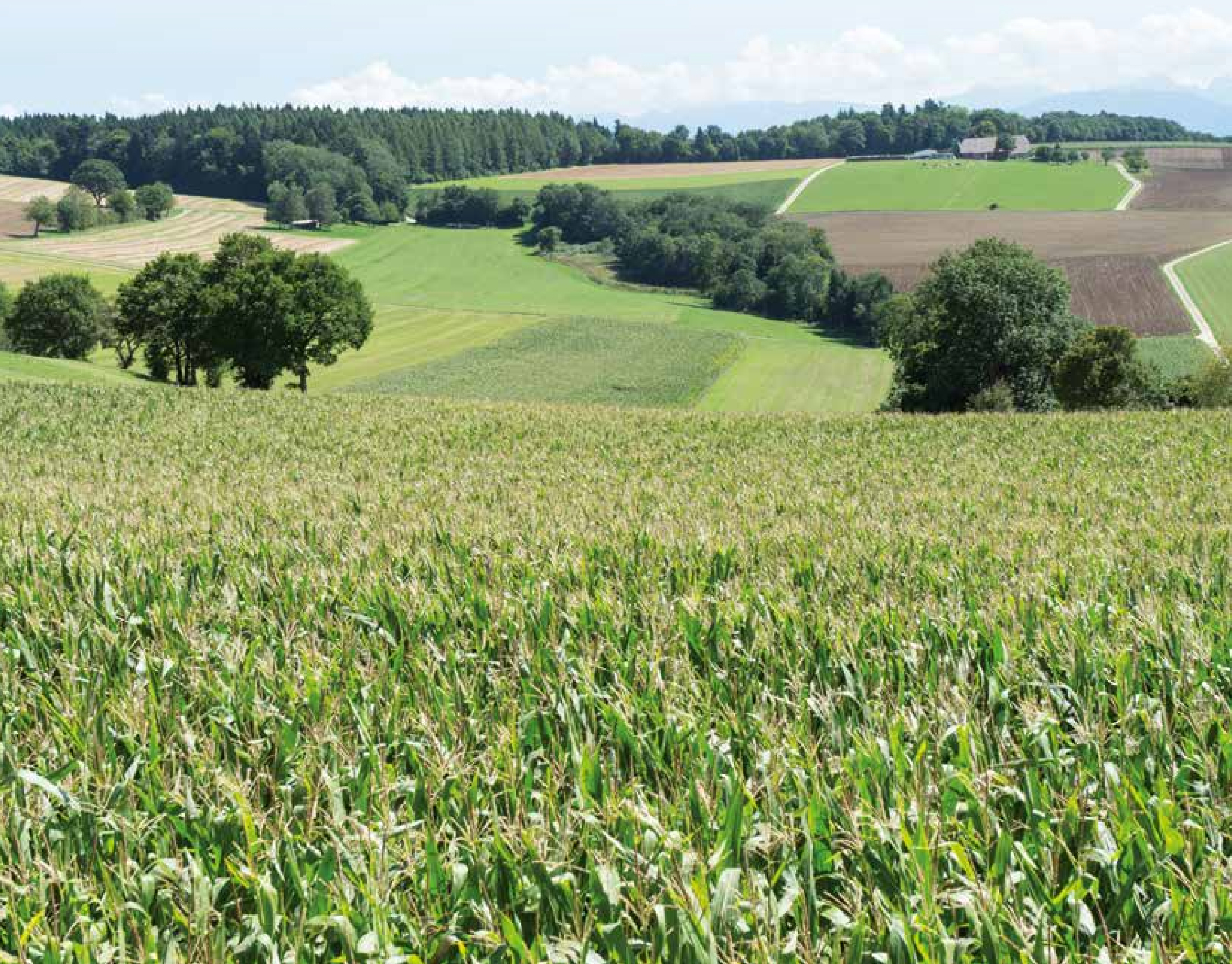
ABSTRACT BOOK



INNOVATIVE CROPPING AND FARMING SYSTEMS FOR HIGH QUALITY FOOD PRODUCTION SYSTEMS

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Predicting Sunflower Grain Yield Using Remote Sensing Data and Models

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Abstract: Predicting grain yield (GY) and quality (oil, protein) a few weeks before harvest is of strategical interest for the cooperatives which collect, store and market grains. Several approaches have been used for that on various crops: (a) monitoring a network of representative fields using sensors and crop indicators; (b) running agroclimatic or process-based models at field level then upscaling the predictions at landscape level; (c) combining observations from remote sensing (satellite) and models (statistical or dynamic) for improving GY prediction. Climate variability and water deficit related to global warming both increase the uncertainty on model predictions. Correcting the predictions by assimilating vegetation and soil data into crop simulations is a way to reduce this uncertainty. Among field crops, sunflower has been scarcely used in remote-sensing studies in spite of the plasticity of green area index (GAI) and its key role in yield and oil achievement. In this study, we combined remote sensing and two types of models (statistical and dynamic) to predict sunflower yield for a range of cultivars and crop practices.

In 2014 and 2015, 187 sunflower fields were monitored in Midi-Pyrénées (SW France) at different periods of the growing season and GY was provided by the farmers. GAI was estimated by the inversion of a radiative transfer model from satellite images (Landsat 8 and Deimos in 2014; Landsat 8 and Spot 5 in 2015) at 6 (2014) and 11 (2015) dates throughout the growing season. From these estimations, GAImax and GAD (Green Area Duration) on 10 August were calculated and used in several predictive linear models of GY. In parallel, the crop model SUNFLO was run on farmer's fields using soil conditions, daily weather, and management data (incl. variety). Both inversion and assimilation techniques based on GAI from remote sensing were used to correct the poor representation of environmental conditions (initial N and water conditions, soil type) and reduce the error on GY prediction. As statistical models used robust relations between GY and GAD and/or GAI_{max}, a better performance was achieved with these models. However, assimilating GAI and correcting initial conditions improved the predictions of GY by SUNFLO although GY was still overestimated after correcting it by limiting factors (weeds, fungal diseases, low plant population). Predicting oil will be the next issue to address with this approach.

Keywords: crop growth model, statistical model, green area index, green area duration

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Nitrogen Budgets and Soil Nitrogen Stocks of Organic and Conventional Cropping Systems: Trade-Off between Efficiency and Sustainability of Nitrogen Use

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Abstract: Organic and conventional cropping systems differ in the nature and amounts of nitrogen (N) inputs, which may affect efficiency and sustainability of N use. In the DOK (bio-Dynamic, bio-Organic, Konventionell) field experiment, organic and conventional cropping systems have been compared since 1978 at two fertilization levels. Nitrogen inputs via manure and/or mineral fertilizers, and N exports from plots with harvested products have throughout been recorded. For all treatments, N outputs with harvests have exceeded the inputs with fertilizers. Over the past years, symbiotic N_2 fixation by soybean and clover grown in the trial has additionally been assessed, indicating average annual inputs of about 100 kg ha^{-1} yr^{-1} of N fixed from the atmosphere. Soil surface budgets opposing N inputs via fertilization, symbiotic fixation, seeds and deposition to N outputs via harvested products have been computed at the plot level for the duration from 1985 to 2012. The resulting balances range from negative values of about -20 kg N ha^{-1} yr^{-1} (where outputs exceed the sum of said N inputs) to surpluses of about +50 kg N ha^{-1} yr^{-1}. The budget based N use efficiency (NUE; N output via harvested products divided by sum of N inputs) in the case of negative balances suggests irrationally high NUE (>100%), while positive balances are related to lower NUE for treatments with inputs exceeding outputs. Negative balances, however, indicate soil N mining, while surpluses point to a risk of N losses, and/or N accumulation in the soil. Estimation of soil N stock changes based on yearly total N concentration measurements in the topsoil layer is currently ongoing. Preliminary results suggest that soil N stocks in the topsoil decreased under all treatments more than expected from the N balance, and that positive N balances are needed to maintain topsoil N stocks. An increase in soil N concentration was observed in none of the treatments. In conclusion, the results indicate an efficiency-sustainability trade-off. Treatments with a higher NUE lose more soil stock N than those with a lower NUE. Treatments with lower NUE indicate higher N losses from the studied crop-topsoil system. Sustainable soil N management in addition to organic fertilizer inputs might at this site require reduced soil tillage. The significance of N contained in deeper soil layers, and deep rooting crops in recovering leached N should as well be investigated.

Keywords: cropping system, nitrogen use efficiency, nutrient budget, soil nitrogen stock, nitrogen loss, organic cropping