



Impact of available water capacity uncertainty at the watershed scale on agronomic and hydrological variables

Julie Constantin, Robin Lalu, Christine Le Bas, Bernard Lacroix, Victor Picheny

► To cite this version:

Julie Constantin, Robin Lalu, Christine Le Bas, Bernard Lacroix, Victor Picheny. Impact of available water capacity uncertainty at the watershed scale on agronomic and hydrological variables. 15. ESA Congress, Aug 2018, Genève, Switzerland. 180 p. hal-02736203

HAL Id: hal-02736203

<https://hal.inrae.fr/hal-02736203>

Submitted on 2 Jun 2020

HAL is a multi-disciplinary open access archive for the deposit and dissemination of scientific research documents, whether they are published or not. The documents may come from teaching and research institutions in France or abroad, or from public or private research centers.

L'archive ouverte pluridisciplinaire **HAL**, est destinée au dépôt et à la diffusion de documents scientifiques de niveau recherche, publiés ou non, émanant des établissements d'enseignement et de recherche français ou étrangers, des laboratoires publics ou privés.



ESA2018

XV^e European Society for Agronomy Congress

August 27-31, 2018 - Geneva, Switzerland

www.esa-congress-2018.ch

ABSTRACT BOOK



5. PARALLEL SESSION 9.3 – FARMING SYSTEMS

PS-9.3-01

Impact of Available water capacity uncertainty at the watershed scale on agronomic and hydrological variables

Julie Constantin¹, Robin Lalu¹, Christine Le bas², Bernard Lacroix³, Victor Picheny⁴
¹INRA AGIR, France, ²INRA Infosol, France, ³ARVALIS - Institut du végétal, France, ⁴INRA MIA-T, France

Abstract: Achieving sustainable quantitative water management represents a major environmental challenge for rural watersheds with water scarcity. In these areas, agriculture uses large volumes of water for irrigation compared to available resources. The agro-socio-hydrological MAELIA model (Therond et al., 2014) was developed to test alternative strategies for water management (change in land use, construction of dams, optimization of irrigation strategies, ...). The model simulates hydrology, agricultural lands and management by various stakeholders such as farmers and dam managers. It requires spatialized input data, including soil data, which are not easily available for large scale study. The objective of this study was to quantify the impact of the uncertainty on Available Water Capacity of soil (AWC) on outputs of the MAELIA model at the watershed scale. The study was conducted on the Aveyron Aval - Lère Watershed (~800 km²) in France which is largely covered by agricultural land and where irrigation is largely spread. Soil data were extracted from the Soil Geographical Database of France (Jamagne et al., 1995) with AWC estimations and uncertainty. An experimental design was developed to evaluate the effect of uncertainty associated with the AWC on agronomic variables (yield, irrigation) and hydrological variables (stream flows) predicted by the MAELIA model. Spatial samples of AWC were generated to quantify uncertainty using a Monte-Carlo approach. Results were analyzed on the regional yields, water irrigation consumption and water flows. Yield predictions were more sensitive to uncertainty of AWC for spring crops than for winter crops. The effect on yield was also greater for rainfed crops as compared to irrigated ones. Overall, the predictions were little impacted by AWC uncertainty, provided that an appropriate AWC sampling accounting for correlation was performed, particularly when analyzing at watershed scale output and pluriannual average.

Keywords: uncertainty quantification, modelling, irrigation, water balance, soil water content

PS-9.3-02

Ecological Pathways to High Yields in Conventional Cereal Systems

Sarah Redlich, Emily A. Martin, Ingolf Steffan-Dewenter
University of Würzburg, Germany

Abstract: Agrochemical inputs have contributed significantly to increases in yield. However, pesticide and fertilizer applications often lead to the loss of natural enemies and enhanced risk of pest infestations. The dysfunction of biological pest control services weighs particularly heavy in light of the urgent need to rethink conventional farming in the context of large-scale threats for biodiversity, the environment, food security and human health.

Here, we use a holistic ecosystem approach to explore alternative, ecological pathways to high yields in cereal systems in central Germany, whereby natural pest control is enhanced to allow for extensification of agricultural processes. On 28 conventional winter wheat fields

selected along a landscape gradient, we conducted field experiments with crossed insecticide-fertilizer treatments, and compiled data on a range of on- and off-field drivers of agroecosystem functioning which are usually studied in isolation. We then used path analysis to assess the direct and indirect effects of landscape complexity, pesticide use, soil characteristics, weed and disease pressure, historic and current field management, pest and natural enemy abundances on yield components.

Our results underline the detrimental effect of pest infestations, and the importance of mineral fertilizer to yield. At the same time, however, we identify a range of soil and management characteristics that enhanced productivity independent of external agrochemical inputs (e.g. frequency of organic fertilizer application, soil type, crop rotation diversity). Our data also suggests that some of the missing regulating relationships between predators and pests could be restored by strengthening observed links between natural enemies and landscape or local management aspects. For example, leaf- and ground-dwelling predators were strongly correlated with crop rotation diversity and soil management (e.g. conservation tillage), respectively. Pests were reduced by management extensification (crop rotation diversity, reduced mineral fertilizer application). Cereal leaf beetle larvae were the only pest species effectively regulated by insecticide application, yet their presence did not influence yield. We therefore show that wheat systems offer a range of alternative pathways by which natural enemy abundances could be enhanced while reducing agrochemical usage. These linkages deserve further attention to fully evaluate their potential as tool for ecological intensification.

Keywords: ecological intensification, biological pest control, conventional farming, natural enemies, pests, ecosystem approach, landscape context, soil management, historic crop management, winter wheat, farm design

PS-9.3-03

Problems and solutions for High Country sheep farmers in New Zealand

Derrick Moot¹, David Anderson², Lisa Anderson², Keith Pollock¹
¹Lincoln University, New Zealand, ²Bog Roy Station, New Zealand

Abstract: The New Zealand High country is the coldest pastoral region in the country. It experiences winters of 100-120 days and low summer rainfall which restricts the growth season to about three months. Maximizing spring water use efficiency is the key to successful stock production in this extensively grazed region. This paper will outline how the farming system and stock performance were transformed by introducing lucerne to on a merino sheep station. The pasture yield increased from 6 t DM/ha on unimproved pasture to 9 t DM/ha on rainfed (450 mm) lucerne. Traditionally lucerne has been grown in the area for conservation as hay to support winter feeding of stock. The system change introduced direct feeding of lucerne with ewes and lambs in early spring. The benefits have been seen over five years through increased production of young stock with ewe lambs increasing from 35 to 38 kg/hd, and two-tooth lambing from 84 to 100%. The mixed age ewes have increased their mating weight from 57 to 60 kg/hd and lambing from 115 to 137%. The extra lambs increase the feed demand during the high spring growth period but have also gained more weight at 235 g/hd/d compared with 205 g/hd/d previously. This means they can be sold earlier at heavier (29 vs 27 kg/hd) live-weights to reduce feed demand during the dry summer months. The total lamb production has increased from 115 t/year to 128 t/yr from 300 extra ewes. Wool weight has remained constant on ewes but increased from 2.0 to 2.6 kg/hd for young stock. The consequence is more feed per ewe