# XVII. Congress of the European Society for Agronomy

August 29 – September 2, 2022
Potsdam, Germany

Diversification & Digitalisation
Trends that Shape Future Agriculture

# BOOK OF ABSTRACTS

# Modeling the impacts of climate and nutrient management on soil nitrogen cycling and balance in a diversified cropping system

Dr. Ixchel Hernandez-Ochoa PhD[1]; Dr. Kathrin Grahmann[2]; Dr. Thomas Gaiser[1]; Prof. Frank Ewert[2]

[1] University of Bonn; [2] ZALF - Leibniz-Zentrum für Agrarlandschaftsforschung e.V.

Over the last decades, agricultural farms in Germany have become large (from 11.1 ha in average size to 60.5 ha in 2016), with high input use of synthetic nutrients and pesticides and highly mechanized. Moreover, crop rotations have been greatly simplified over the last 50 years and the proportion of land under monocultures has increased. Despite their high crop productivity, the current agricultural systems have led to a series of environmental problems such as increased nutrient leaching to water bodies and increased greenhouse was related emissions, drastic decline in biodiversity and increased yield risk in a changing climate. Crop diversification together with new spatial arrangements can contribute to improve cropping systems to become more sustainable and resilient in the future. Spatio-temporal crop diversification offers multiple benefits in terms of delivery of ecosystem services related to nutrient cycling, soil fertility, and pest control while maintaining or improving crop yield. Moreover, the use of management zones, to divide the field in smaller field sizes to account for within field heterogeneities of soil chemical and physical properties, can contribute to better resource and crop allocation and increase resource use efficiency. Smaller field units also contribute to an increase in plant and farmland species biodiversity. However, limited studies have explored how the diversified cropping fields and smaller field arrangements may affect N cycling and N balance and how responses may vary depending on environmental changes in spatially heterogeneous soils.

Agroecosystem models are a powerful tool to aid on the design and evaluation of diversified cropping systems as they offer the flexibility to explore cropping system responses to the multiple environment and management practices. Virtual experiments can be conducted that otherwise will not be possible in reality and their results can inform subsequent field experimentation. Crop growth and development are calculated based on environmental (solar radiation, daylength, temperature, rainfall) variables and nutrient (particularly N). Simulated soil N dynamics include, crop N uptake, N retention, N leaching, and nitrous oxide emissions. Therefore, the main goal of the current study is to explore how climate patterns and management, particularly N fertilization, can impact the dynamics of N cycling and N balance of a spatio-temporally diversified cropping field. For this, an agroecosystem model within the SIMPLACE (Scientific Impact assessment and Modelling Platform for Advanced Crop and Ecosystem management) modeling framework was calibrated and validated for a 5-year crop rotation in a heterogeneous soil. The crop rotation includes winter and summer crops (winter wheat, winter barley, rapeseed, soybean and maize), spatially arranged in “patches” (small field subunits of ~0.5 ha size). Input data for model calibration and validation includes the experimental data (e.g. soil characteristics and initial conditions, crop growth and development, management and daily weather) collected from the patchCROP experiment in

Tempelberg, Brandenburg. The crop rotation was simulated for a 30-year period and findings on soil N cycling and N balance dynamics for the crop rotation system as affected by climate patterns and nutrient management will be presented. This presentation is the second part of the "System based Analysis of N cycling in a spatio-temporal diversified cropping system".