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BOOK OF ABSTRACTS

System-based analysis of N cycling in a spatio-temporal diversified cropping system

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Agricultural landscapes in Germany are often defined with few crop species, narrow crop rotation and large field sizes as consequence of intensive crop production. Current crop production involves high levels of inputs, including pesticides and fertilizers causing detrimental environmental impacts and adversely affecting ecosystem service and economic benefits for farmers. There is a rising demand for crop diversification to increase sustainable intensification by replacing sole-cropped large fields with new cropping system approaches that increase the temporal, spatial and genetic dimension of diversity at the field and landscape level (Ditzler et al., 2021). Spot-farming, pixel cropping or patch cropping conceptually address diversified cropping systems with small-scale and site-specific diverse crop mosaics at different spatial scales with highly varying nutrient demands. Although site-specific management strategies by precision agriculture are established to exploit small-scale heterogeneities and to increase efficiency of N fertilization, they focus on sole-cropped fields. Best fitting land use, and therefore a selection of different suitable crops for the respective zones of the field (e.g. unproductive, low and high yield potential zones) differ in their nutrient requirements, especially Nitrogen (N). There is a lack of understanding how spatial and temporal diversification affect N dynamics and how sustainable cropping systems of the future call for a rethinking in above-belowground interactions regarding N cycling. We present a systems-based approach to evaluate N balance and N cycling in patchCROP, an experimental platform established in 2020 in Brandenburg, Germany were a 70 ha intensively managed field was re-designed into smaller field units of 0.5 ha (patches) following high and low yield potential zones with varying soil texture and topography and two site-specific five-year crop rotations. The high yield potential crop rotation includes: Rapeseed - Barley - cover crops - Soybean - cover crops - Maize - Wheat, while the low yield potential crop rotation is comprised by cover crops – Sunflower – Oats - cover crops – Maize - Lupin - Rye. For each individual crop rotation element, three patches were implemented. Surrounding sole cropped fields were used as reference areas. We will investigate if higher crop diversity at the field level caused a tightening of the soil N cycling by wider crop rotations, if there was a N scavenging effect by cover crops and if previous crops have created positive local soil legacies for the subsequent crop. For this purpose, mineral soil N (Nmin) was determined in spring, after harvest and in autumn for each crop in 2020 and 2021 in three different depths (0-30, 30-60, 60-90 cm). Biomass N was measured four times over the vegetation cycle and grain and straw N were determined after harvest. For the estimation of the inputs (deposition, soybean and lupin N fixation) and the outputs (gaseous and leaching losses) for each crop and patch, predictive and crop models are used. To compare both crop rotations of the high and low yield potential with simplified crop production, a system nitrogen use efficiency (NUE) will be applied using crop and soil-based balances and NUE indices (Martinez-Feria et al., 2018). The N balance was calculated as changes in soil N storage during the course of the experiment and reveals N flows, N retention and N losses (Sainju, 2017). Preliminary results from the spring sampling 2021 suggest that Nmin levels were similar across depths for all crops in the high yield potential crop rotation. In addition, overall Nmin contents were lower after harvest in the second experimental year, which points towards a tighter N cycle and crop-specific N fertilization. The drop between the autumn and spring sampling indicates high risk of N losses, since the plants can hardly take up Nmin.