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patchCROP

Sensing Nitrogen dynamics in spatially and temporally diversified cropping systems

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Introduction

- Proximal and remote sensing technologies have been widely applied to study crop biophysical parameters and soil properties related to nitrogen (N) .
- However, tracking soil N is challenging due to its dynamic relationship with soil moisture, crop species and management, and its complex transformation processes taking place at different temporal and spatial scales.

Objectives

- Investigate the relationship among plant N, soil N_{min} (in particular NO_{3}-), N_{tot} and remote sensing data
- Unfold the applicability of very high resolution multispectral imagery for monitoring soil N dynamics in a heterogeneous cropping systems.

Research approach

Study site

- The experiment is conducted at the patchCROP experimental fields in Tempelberg, Brandenburg (Figure 1).
- A large 70 ha field was divided into 30 smaller fields of ~0.5 ha (72m x 72m) by considering the small-scale soil heterogeneity, defined as patches (Grahmann et al., 2021).
- Six patches were selected for this study (Table1).
- Micro-plots(1.8 m^2) were implemented as non-fertilized (0-N) and fertilized (+N) along the transect of each patch to catch the spatial heterogeneity (Figure 1)
- Sampling is conducted over three cropping cycles in 2021, 2022 and 2023 (Table 1).

Table 1: arrangements of crops within six patches for consecutive seasons.

Year	Patch 73	Patch 74	Patch 89	Patch 95	Patch 65	Patch 96
20-2021	Rapeseed	W. Wheat	W. Rye	W. Oat		
21-2022	W. Barley	Rapeseed	Sunflower	Maize		
22-2023		W.Barley			Rapeseed	Maize

Collected Data

- Soil (0-30, 30-60, 60-90 cm depth) for N_{min}, N_{tot}, and soil moisture
- Biomass samples for biomass N and dry matter.
- Sampling at three different growth stages (stem elongation, flowering and harvest).
- Soil texture (% sand, silt, clay) up to 25cm by GEOPHILUS (Lueck & Ruehlmann 2013).
- Digital elevation model (1m), Slope and aspect downloaded from https://data.geobasis-bb.de/geobasis/daten/dgm/
- Multispectral (8 band) 3m Planet imageries covering three seasons

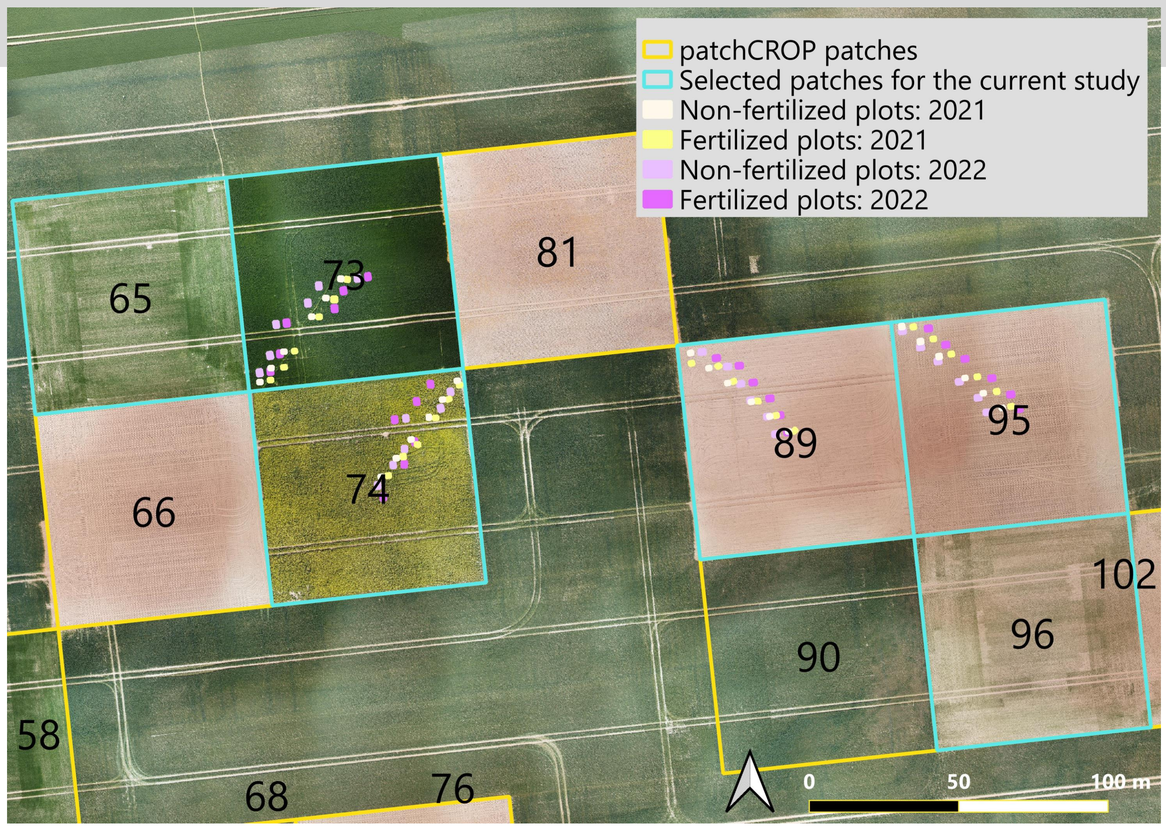

Figure 1: Sampling locations along transect from the edge towards the centre of the patch. Image: UAV mounted Parrot Sequoia+ Multispectral Camera 31.05.2021

Workflow

Correlation and multivariate regression (Figure 2) will be conducted to find suitable indices using data from field samples, environmental variables and proximal-remote sensing datasets (Preza Fontes et al., 2019).

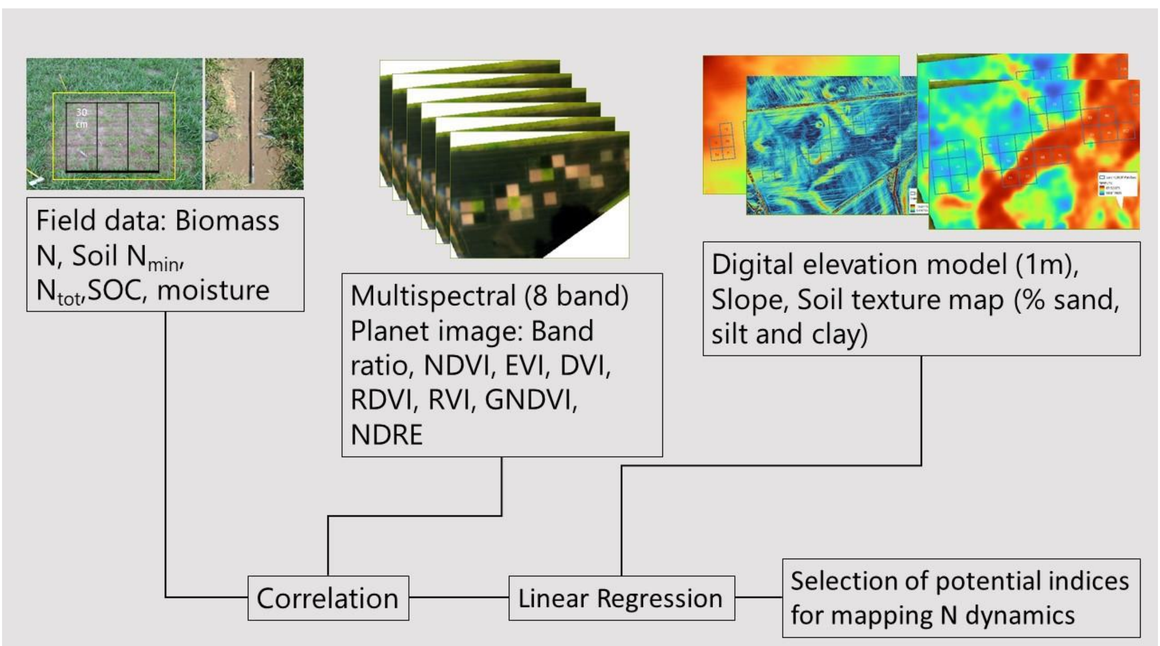

Figure 2: Simple workflow of the proposed study design

Challenges

- Collection of representative samples (biomass, soils), current sampling design is limited to 6 points along transect
- Availability of representative satellite imageries matching the field sampling days
- This study involves 7 crops grown simultaneously in a heterogeneous cropping systems, remote sensing of different crop phenology stages and nitrogen status may impact the correlation to be studied.

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References

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Preza Fontes, G., Bhattarai, R., Christianson, L.E., Pittelkow, C.M., 2019. Combining Environmental Monitoring and Remote Sensing Technologies to Evaluate Cropping System Nitrogen Dynamics at the Field-Scale. Frontiers in Sustainable Food Systems 3, 8. https://doi.org/10.3389/fsufs.2019.00008

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