

Proposition of Master thesis: «Meta-analysis of nitrogen use efficiency in maize cropping system worldwide»

We are offering the possibility to conduct a master project related to the analysis of nitrogen use efficiency in maize cropping system worldwide.

Location of the work:

Sveriges lantbruksuniversitet (SLU)
Department of Crop Production Ecology
Ekologikum, Ulls väg 16 -Box 7043 750 07 Uppsala

Supervision: Scientific responsibility: Pierre Chopin, Researcher, Department of Crop Production Ecology. Tel. : 07 62 32 32 74 Mail : pierre.chopin@slu.se. The master student will be integrated in the research group « Agricultural Cropping Systems » from the department of Crop Production Ecology composed of two professors, 5 researchers and postdocs and 4 PhD student.

For more details: <https://www.slu.se/en/departments/crop-production-ecology/>

Scientific and socioeconomic context of the master thesis proposition:

Introduction: Maize has become a major production system and is now the most important staple food in many parts of the world, with its total production surpassing wheat or rice. Adapted fertilization strategies is required to manage to get the most sustainable production in various part of the world. Currently, nitrogen fertilization strategies vary among maize production systems worldwide. Some of these strategies are responsible for nitrogen losses in the environment from denitrification, leaching, volatilization, and surface run-off with increasing N availability at planting or pre-planting. An appropriate fertilization strategy can have better respond to plant needs and increase synchrony between plant N demand and fertilizer N supply to reduce N losses at a crop level e.g., for wheat (Salim & Raza 2020)).

Understanding the factors driving NUE efficiency (NUE) is necessary to promote high and sustainable development of maize production. Many factors are influencing the maize NUE efficiency including the fertilization strategy itself (e.g., (Zhang *et al.* 2019)) and other factors related to the cropping system. Hence, the fertilization strategy includes the overall dose of nitrogen provided to the crop, the type of fertiliser used and the number of applications. Classic N-response curves show that increasing doses of nitrogen are less and less efficient and the response of yield is null at certain high quantities. The type of fertilisers drive the availability of N to the crop and it is generally known that organic fertilizers release nitrogen in a long time making it difficult to fully respond to crop needs. Splitting N application seems to be positive in terms of efficiency but with a cost for the farmers in terms of labour. Some other aspects of cropping systems may have a role also such as tillage, which increase mineralization of organic matter and N availability to the crop, while the type of variety used by farmers may be prone to low or high level of nitrogen in the soil.

Understanding the magnitude with which the above-mentioned factors drive NUE efficiency and yield level is of major importance to make recommendation for fertilization of maize in various parts of the world. For this purpose, we have collected data from 936 studies worldwide describing data on yield and potential factors of NUE in maize cropping systems from on-station and on-farm experiments.

Objectives: The overall objective of master thesis is to identify factors driving the variability in NUE in maize production system around the world.

Potential method: The method to be used in by the master student is a meta-analysis (e.g., (Rodriguez *et al.* 2020)), which is a statistical analysis that combines the results of multiple scientific studies. The first task will be to prepare the database by reducing the level of factors and identifying the control treatment for each experiment. Then, description of data will be realized to observe the variability in crucial factors and variables. Finally, statistical analysis including various regression models will be conducted to help identify factors responsible for low NUE.

Profil of the candidates :

- Master 2 in agronomy, agroecology, agricultural sciences, plant or environmental sciences
- Knowledge of database management and analysis
- Use of programming language especially R is a plus
- Aptitude for synthesizing information, rigor and organizational skills
- Interest for agronomy and statistics
- Good level in spoken and written english

Starting date: beginning of 2021- spring 2021

If you are interested, send your CV and a letter of motivation to: pierre.chopin@slu.se up until the 11th of December

References:

- Rodriguez, C., Carlsson, G., Englund, J.-E., Flohr, A., Pelzer, E., Jeuffroy, M.-H., *et al.* (2020). Grain legume-cereal intercropping enhances the use of soil-derived and biologically fixed nitrogen in temperate agroecosystems. A meta-analysis. *Eur. J. Agron.*
- Salim, N. & Raza, A. (2020). Nutrient use efficiency (NUE) for sustainable wheat production: a review. *J. Plant Nutr.*, 43, 297–315.
- Zhang, W., Liang, Z., He, X., Wang, X., Shi, X., Zou, C., *et al.* (2019). The effects of controlled release urea on maize productivity and reactive nitrogen losses: A meta-analysis. *Environ. Pollut.*