MASTER THESIS OFFER OF CEPLAS

(FOR COMPUTATIONAL MASTER STUDENTS FROM TECHNICAL UNIVERSITY OF MADRID, UPM)

Title of Master Thesis

Identification of transcriptional modules coordinating nutrient homeostasis in plants.

Description of student´s tasks

The student will perform analysis of multiple transcriptomic datasets, and identify and validate transcriptional modules connecting multiple nutrients.
This work will be performed under the supervision of Prof. Dr. Stanislav Kopriva and Dr. Daniela Ristova at the Botanical Institute of the University of Cologne.

Prerequisites (languages, informatics skills, bioinformatic skills, other knowledge, etc)

Is expected that the student is fluent in English. Experience in coding and scripting is essential. Previous experience is RNA-Seq. analysis is desirable. Motivation to learn about plants is advantageous.

Training Project

During this project the student will be integrated in Prof. Kopriva group, and she/he will experience working in international environment at a German research institution, in the heart of Cologne. This will give an opportunity to the student to gain real-life experience in academic research, and be able to manage her/his own schedule, plan and execute research tasks. At the end of the project is expected that the student will gain valuable experience in both analyzing –omics data, and deciphering and testing new biological hypothesis. Our research models are plants, but the same approaches could be applied to other models of interest.

Background

As sessile organisms, plants are continuously adopting their growth and development to myriads of abiotic and biotic factors. For instance, nutrients in the soil that are essential for plant growth have heterogeneous distribution, and they are perceived in the plant not only as a nutrient, but also as a signal. While the effect of single nutrient is well documented at different levels including plant signaling, development and metabolism, the effect of multiple nutrients is just emerging. In the past decade more evidence is accumulating, suggesting that multiple nutrients are interconnected at many levels and that for optimal performance a nutrient balance is essential, and therefore nutrient signaling and homeostasis has to be well coordinated [1, 2]. The mechanistic understanding of such integration of signaling networks is rather limited.

References:

1. Bouain, N., Krouk, G., Lacombe, B., & Rouached, H. (2019). Getting to the root of plant mineral nutrition: combinatorial nutrient stresses reveal emergent properties. *Trends in plant science*, *24*(6), 542-552.
2. Jobe, T. O., Zenzen, I., Rahimzadeh Karvansara, P., & **Kopriva, S.** (2019). Integration of sulfate assimilation with carbon and nitrogen metabolism in transition from C3 to C4 photosynthesis. *Journal of Experimental Botany*, *70*(16), 4211-4221.
3. Krouk, G., & Kiba, T. (2020). Nitrogen and Phosphorus interactions in plants: from agronomic to physiological and molecular insights. *Current Opinion in Plant Biology*, *57*, 104-109.
4. Günal, S., Hardman, R., **Kopriva, S**., & Mueller, J. W. (2019). Sulfation pathways from red to green. *Journal of*

Biological Chemistry, *294*(33), 12293-12312.

Activities that will be performed in the academic internship/Master Thesis:

This project aims to:

1. Re-analyze publically available, mainly transcriptomic data (including RNA-Seq. and microarray) that are available for different nutrients, as well few dataset that are available for combinatorial provision of two or more nutrients. We are particularly interested in nitrogen (N), phosphorus (P) and sulfur (S) modules, because interactions between these micro nutrients are well known [2, 3], but the molecular mechanisms connecting them are far from understood [4]. Therefore, the goal here is to identify nutrient-specific modules, as well as common-modules connecting multiple nutrients. (link: https://git.embl.de/provazni/rna-seq-tutorial).
2. Second goal is to validate some of the identified transcriptional modules, by using qPCR.

Findings from this project can help understanding how plants integrate and adapt to multiple signals, which can be implemented in future breeding strategies. Additionally, it can have impact in reducing the environmental and energy cost in agriculture.

Nº of positions offered:	**1**
Has the student dealings with underage persons?	**NO**
Starting date:	01/02/2021 preferred but flexible
End date:	Flexible
Weekly hours *(only for internship in CEPLAS lab):*	Flexible
Working hours *(only for internship in CEPLAS lab):*	Flexible
Fellowhips *(if any, NOT REQUIRED):* **Remuneration (€/month):**	
Academic tutor (UPM/CBGP): *(you need a Tutor from UPM Master, not involved in the research activity)* **Email**:	
Department/Research Group of UPM/CBGP Academic tutor:	
CEPLAS Internship/Master Thesis Tutor/Director:	**Prof. Dr. Stanislav Kopriva**

Email CEPLAS tutor:	**skopriva@uni-koeln.de**
Department CEPLAS tutor:	**Botanical Institute**
Location of the internship (telecommuting?):	**Cologne University, possible telecommuting**
CEPLAS Institution:	**Cologne University**
To be completed by Internship Office ETSIAAB-UPM: **Number of ECTS (Nº ECTS):**	

Send by email to: international.cbgp@upm.es (Pablo Gómez)