POLITÉCNICA

E.T.S. DE INGENIERÍA AGRONÓMICA, ALIMENTARIA Y DE BIOSISTEMAS

Título de las prácticas (Title of the internship):

Metagenomic analysis of barley root-associated microbiomes and elucidation of regulatory networks involved in root-microbe interactions.

Descripción de las funciones del alumno (Description of the student´s tasks)

In nature, plants coexist with a variety of microbes, including bacteria, fungi, and oomycetes, which together form the plant-associated microbiota. This microbiota is found on leaves, in roots, in the rhizosphere, and in the soil, and has beneficial effects on plant health and growth (e.g., increased resistance to biotic and abiotic stresses). However, the underlying mechanisms by which plants recruit beneficial microbes are still largely unknown, and the respective roles of microbe-microbe and plant-microbe interactions in the assembly of the microbial community are poorly understood. To fill the knowledge gap in this area, we are using metagenomic analysis of plant-associated microbial communities to investigate community dynamics and architecture, and to identify key players in community structure and function. One of the goals of this project is to develop reductionist approaches, such as deconstruction and reconstruction of microbial communities through amplicon and metagenome analysis. More specifically, we aim to **use computational tools to support the design of microbiota reconstruction experiments by building a Synthetic Community of microbes** that are then tested in the laboratory for their effects on plant health under different stress conditions.

In addition, the Zuccaro lab has long studied the effects of beneficial endophytic fungi (order *Sebacinales*) that provide protection from and promote growth of their various host plants against certain pathogens. Effector proteins are used by plant-associated fungi to facilitate colonization through effector -triggered susceptibility and manipulation of host defenses and metabolism. Previous research has focused on the identification and functional characterization of pathogenic fungal effectors during colonization of a single host plant species. The additional goal of this project is to **understand how beneficial and detrimental fungi regulate effector gene expression and function in different plant hosts and in response to other microbes**. This will require large-scale integration of data from multiple sources (transcriptome data, gene cluster co-expression analyses, comparative genomics, orthology, and phylogenetic footprinting) and the use of workflow managers (Snakemake or NextFlow) to bring them together in a reproducible framework.

This work will be performed under the supervision of Prof. Dr. Alga Zuccaro (https://www.ceplas.eu/en/research/research-area-2/ and https://ag-zuccaro.botanik.uni-koeln.de/), Dr. Gregor Langen and Sinaeda Anderssen (UoC).

Requisitos (Prerequisites): *(indicar titulación y curso) (give Grade and academic year); otros requisitos adicionales (idiomas, informática, otros conocimientos, etc) (other aditional prerequitistes (languages, informatics, other knowledge, etc)*

- Proven proficiency in programming (e.g., Python/Perl and/or R) as well as command line.
- Genuine interest in plant microbe interactions and microbiome studies is advantageous.
- The student is expected to be fluent in English.

Proyecto formativo (Training Project)

EXTERNAL PRACTICES/MASTER THESIS. The fundamental goal of the external practices is to guide the student in applying their previously acquired knowledge to contemporary biological questions/challenges, in a group work environment the realistically represents the work conditions the students will encounter in their future roles. In this way, the student will be able to get familiar with a working environment (work schedule, responsibility, attitude, organization, etc.), and with the adequate working methodology in professional settings, and applying acquired academic knowledge.

Actividades a desarrollar en la práctica académica (Activities that will be performed in the academic internship):

Exploring plant-microbe interactions through (i) meta-analysis of microbial community recruitment by different barley genotypes, as well as (ii) targeted analysis of regulatory networks governing the expression of microbial effectors.

(i) Metagenome analysis: from quality control, filtering and taxonomic assignment to interpretation of results in a biological context. A pipeline for amplicon sequence analysis will be tested and improved, using various available command-line and R-based tools.

(ii) Comparative genomics: integration of weighted gene co-expression analysis (WGCNA), gene network inference with ensemble of trees (GENIE3), as well as phylogenetic footprinting (by applying Expectation Maximisation and Gibbs sampling algorithms), to predict DNA binding sites associated with transcriptional regulators involved in plant-microbe interaction modulation. Comparison of these results with DAP-seq (DNA-affinity purification sequencing).

As a member of the Institute for Plant Sciences and CEPLAS you will have the opportunity to attend a journal club, weekly group seminars and CEPLAS meetings and offered courses at the UoC. You will present your progress on a regular basis and will give presentations during the group seminars.

Nº de plazas: **(Nr. of places)**	**1**

¿El alumno tendrá trato habitual con menores? **(Has the student dealings with underage persons?)**	**NO**
Fecha de inicio: **(Starting date)**	01-02-2024 (but flexible)
Fecha de fin: **(End date)**	**Flexible**
Horas semanales: **(Weekly hours)**	**Flexible**
Horario jornada laboral: **(Working hours)**	**Flexible**
Importe Ayuda/Bolsa de estudio: **(Amount of fellowship / remuneration)**	We request a UPM fellowship for the student for the visiting time to cover travel expenses and housing. We will cover project expenses and if the student performs the internship / Master Project in Cologne some remuneration will be provided.
Tutor académico: (Academic tutor (UPM)) Email:	
Departamento tutor académico: **(Dept. of academic tutor)**	
Tutor empresa:	Prof. Alga Zuccaro (UoC)

(External tutor)	
Email tutor empresa: **(Email external tutor)**	azuccaro@uni-koeln.de
Departamento tutor empresa: **(Dept. of external tutor)**	Institute for Plant Sciences, University of Cologne
Ubicación de la estancia de las practicas **(Location of the internship)**	Telecommuting possible, but visiting Cologne and working with experimental colleagues at the UoC and MPI would be preferred for at least some of the internship.
ENTIDAD COLABORADORA: **(Collaborating Entity)**	University of Cologne
A cumplimentar por Oficina Prácticas ETSIAAB: **Créditos a reconocer (Nº ECTS)**:	

Enviar por email a: OFICINA DE PRÁCTICAS ACADEMICAS EXTERNAS – ETSIAAB
secretaria.pei.etsiaab@upm.es – Secretarias: Visitación Pérez / Susana Pardo - Tfno: 913363686)