UNIVERSITÉ Clermont Auvergne

MASTER BIOLOGIE SANTE

Track « Integrative Biology, Physiopathologies »

Proposal for a Master 2 internship – 2023-2024

Title :

Study of the regulators of DNA recombination between related genomes

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Summary : A key step in the developmental cycle of **sexually reproducing organisms** is the production of **gametes** during **meiosis**. This specialized cell division, which reduces **ploidy** by half, is complementary to fertilization. During meiosis, **DNA recombination** increases genetic diversity of gametes and ensures balanced chromosome segregation. An abnormality in this process can be responsible for **sterility** or for **major genetic disorders** in the offspring.

Recombination also plays an essential role in agronomy since it mediates the transfer of exotic and powerful alleles (allowing for example the resistance to biotic or abiotic stresses) from **related species** into elite varieties. This involves recombination between the genomes of the two species. These events are however extremely infrequent, which limits the production of **innovative varieties** better adapted to the changing climate.

The objective of this project is to better understand the molecular mechanisms controlling recombination between related genomes. This study will be carried out in the plant model ***Arabidopsis suecica***, a polyploid species which contains (like durum wheat, rapeseed, cotton etc.) two sub-genomes originated from related species. A combination of complementary techniques will be used: **cytogenetics** (FISH, GISH), **transcriptomics** and **genome editing** (CRISPR / Cas12). This project will allow to identify potential targets for improving plant breeding programs, but also to better understand the evolutionary processes underlying the stabilization of meiosis - and therefore fertility - of polyploid species.

Methodologies (key words): Genetics, Molecular biology, Microscopy, Immunofluorescence, CRISPR / Cas12, High throughput sequencing

Publications of the research group on the proposed topic

- Serra H, Svačina R, Baumann U, Whitford R, Sutton T, Bartoš J, Sourdille P (2021) *Ph2* encodes the mismatch repair protein MSH7-3D that inhibits wheat homoeologous recombination. **Nature Communications** 12, 1-10
- Serra H, Lambing C, Griffin CH *et al.* (2018) Massive crossover elevation via combination of HEI10 and *recq4a recq4b* during Arabidopsis meiosis. **PNAS** 115(10):2437-2442
- Serra H, Choi K, Zhao X, Blackwell A, Henderson I (2018) Interhomolog polymorphism shapes meiotic crossover within the Arabidopsis *RAC1* and *RPP13* disease resistance genes. **PLoS Genetics** 14(12): e1007843