

Meiotic recombination: from genetic determinants to molecular and super-molecular mechanisms

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Thesis subject : "Meiotic recombination: from genetic determinants to molecular and super-molecular mechanisms"

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Profile and subjects

Masters Modélisation, Génétique

Génétique, Biologie intégrative

Abstract

We wish to understand the mechanisms behind meiotic recombination, especially the regulation of crossover formation and the corresponding distribution patterns.

The framework of this thesis is centered on Arabidopsis. Thanks to the exceptional plant material we are constructing, it will be possible to observe the respective roles of two pathways for crossover formation; this extends our work in which we unveiled the second pathway in Arabidopsis a few years ago. The student will also conduct state of the art modeling, incorporating statistical and physical features so as to analyze in depth the recombination events.

Scientific context and stakes

Understanding the mechanisms at work during meiosis is an outstanding problem of cell biology.

The existence of two pathways for crossover formation has been exhibited first in yeast and then by our group in *Arabidopsis* in 2005.

A control of such processes would have a tremendous impact. In particular, it would open up the way to far more effective plant improvement programs, a need that is now widely recognized on the scale of the planet, and France is well equipped to tackle the associated challenges.

Lab's publications

Macaisne N, Novatchkova M, Peirera L, Vezon D; Jolivet S., Froger N., Chelysheva L., Grelon M., Mercier R*. SHOC1, an XPF endonuclease-related protein, is essential for the formation of class I meiotic crossovers. *Curr Biol*, 2008 Sep 23;18(18):1432-7.

Vignard J, Siwiec T, Chelysheva L, Vrielynck N, Gonord F, Armstrong SJ, Schlögelhofer P, R. Mercier .The interplay of RecA-related proteins and the MND1-HOP2 complex during meiosis in *Arabidopsis thaliana*. *PLoS Genet*. 2007 Oct 12;3(10):1894-906

M. Falque, R. Mercier, C. Mézard, D. de Vienne and O. C. Martin. Patterns of crossing-over and MLH1 foci density along mouse chromosomes: role of interference and obligate chiasma. *Genetics*. 2007 Jul;176(3):1453-67

J Drouaud¹ , R Mercier¹, L Chelysheva , A Bérard , M Falque , O Martin , V Zanni , D Brunel , C Mezard* .Sex-specific crossover distributions and variations in interference level along *Arabidopsis thaliana* chromosome 4. *PLoS Genet*. 2007 Jun;3(6)

Mezard C, Vignard J, Drouaud J, Mercier R. The road to crossovers: plants have their say. *Trends in Genetics*. 2007 Feb;23(2):91-99. Review

Mercier R*, Jolivet S, Vezon D, Huppe E, Chelysheva L, Giovanni M, Nogue F, Doutriaux MP, Horlow C, Grelon M, Mezard C. Two meiotic crossover classes cohabit in *Arabidopsis*: one is dependent on MER3, whereas the other one is not. *Current Biology* 2005. 26;15(8):692-701

S. Ciliberti, O.C. Martin and A. Wagner (2007), Robustness can evolve gradually in complex regulatory gene networks with varying topology, *PLoS Computational Biology* 3(2), e15.

S. Ciliberti, O.C. Martin and A. Wagner (2007), Innovation and robustness in complex regulatory gene networks, *PNAS* 104, 13591-13596.

C. Saintenac, M. Falque, O.C. Martin, E. Paux, C. Feuillet, P. Sourdille, (2009) Detailed Recombination Studies along Chromosome 3B Provide New Insights on Crossover Distribution in Wheat (*Triticum aestivum* L.), *Genetics* 181: 393-403.