PhD POSITION AVAILABLE

Modelling short and long term plant responses to water deficit, temperature, atmospheric CO_2 concentration and their interactions

Starting date: The position is available immediately; **Gross monthly salary:** 1 750 euros – Duration : 3 years;
Funding : FACCE/JPI – INRA – ANR Climate Smart Agriculture project MODCARBOSTRESS

Project description: Climate change is already ongoing with continuous temperature and atmospheric CO_2 rise, more frequent drought episodes, extreme heat waves and higher climate variability. At the same time, agriculture is urged to be more efficient with resource usage, in particular water. There is thus a need to breed efficient cultivars adapted to those conditions. A difficulty is that complex traits such as yield components integrate many "genotype by environment interactions". This means that the best genotype in one environment does not perform necessarily better than others in other climatic scenarios or locations. An avenue is to use crop models that account for environmental impact on crop performance and can be coupled with models of climate change. However, (i) current crop models do not perform well under climatic scenarios combining drought and high temperatures, (ii) only few crop models consider the rise of atmospheric CO_2 as interacting with temperature and drought responses, (iii) crop models do not consider the acclimation of plant processes to a changing environment and (iv) crop models rarely incorporate genotypic differences.

To overcome these limitations, we propose to make better use of ecophysiological models and phenotyping platforms to dissect the responses of plant processes to environmental variations. Such models and associated cultivar specific parameters can then be inserted into crop growth models in order to predict which cultivar could perform better in a range of current or future environments. In this project two crop growth models differing by the way growth in surface is driven, either by carbon assimilation (the GECROS model) or by physical limitations to organ expansion (the *SiriusQuality* model), will considered.

The PhD student will carry out experiments in controlled environment to analyze the responses of plant processes such as development, transpiration, photosynthesis, and leaf elongation rate to temperature, water deficit, atmospheric CO_2 concentration and their combination, with a special focus on acclimation of plant processes to temperature. Moreover, he/she will develop biological hypotheses and propose new mathematical formalisms to account for the observed behaviors. Finally, these formalisms will be tested by insertion into the crop models GECROS and *SiriusQuality* and comparisons of simulations with measurements from field experiments.

The project will be performed on wheat, one of the three most consumed cereal worldwide and for which ample breeding programs are going on. The project will use a range of cultivars and will take place in strong interactions with partners of the European project MODCARBOSTRESS aiming at dealing with stress interactions and revisiting crop model hypotheses.

The PhD student will be co-supervised by Pierre Martre and Boris Parent at INRA-SupAgro LEPSE (Montpellier, France). The phenotyping experiments will be carried out in state-of-the-art phenotyping platforms in Montpellier (M3P).

Application conditions: Applicants should hold a relevant master degree in Biological Science or equivalent. A previous experience in plant ecophysiology and/or in crop modelling would be appreciated. The incumbent is expected to have excellent oral and written communication skills. Candidate of any nationality may apply.

Applications: Applications (CV, copies of degrees, 1-page motivation letter) can be sent to pierre.martre@supagro.inra.fr. Applications will be received until a suitable candidate is found.

Related material:

http://www6.montpellier.inra.fr/lepse_eng/
http://www6.montpellier.inra.fr/lepse_eng/M3P
https://www.faccejpi.com/FACCE-Joint-activities/ERA-NET-Plus-on-Climate-Smart-Agriculture/MODCARBOSTRESS

Asseng S et al., 2013. *Nature Clim. Change* 3: 827-32 / Asseng S et al., 2015. *Nature Clim. Change* 5: 143-7 / Martre P et al. 2015 *Glob. Chang. Biol*. 21: 911–25 / Muller B et al. 2011. *J. Exp. Bot.* 62: 1715-29 / Parent B, Tardieu F 2014. *J. Exp. Bot.* 65: 6179-89 / Tardieu F. 2011. *J. Exp. Bot.* 63: 25-31