

PhD PROPOSAL FOR THE DOCTORAL SCHOOL « Ecologie, Géosciences, Agronomie, ALimentation »

THESIS NUMBER (completed by ED EGAAL): Cliquez ou appuyez ici pour entrer du texte.

GENERAL INFORMATION

Thesis title: Genotype-specific architectural, physiological and molecular responses to light in rose bush
Acronym: PHOTON
Disciplinary field 1: Agronomy Disciplinary field 2: Ecology
Three keywords: Plant architecture, light quality, genotype x light interaction
Research unit : IRHS UMR 1345 – ARCH-E team
Registration establishment(s): AGROCAMPUS OUEST
Name of the thesis director: Name of the thesis co-supervisor 1 (if applicable): SAKR Soulaïman Name of the thesis co-supervisor 2 (if applicable): CRESPEL Laurent
Thesis grant (funding origin and amount): CIFRE
Contact(s) (mailing address and E-mail): IRHS, UMR 1345 – ARCH-E team 42, rue Georges Morel 49071 BEAUCOUZE Cedex, France laurent.crespel@agrocampus-ouest.fr
Recruitment process: Recruitment process depends on thesis funding. To select the corresponding recruitment process, please visit the EGAAL website here . This information is needed for proposal publication. <input type="checkbox"/> Doctoral school contest <input type="checkbox"/> Interview <input checked="" type="checkbox"/> Other (indicate) : CIFRE

ED EGAAL

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All sections must be filled. Once filled, please save the proposal form in pdf format using the following naming: Supervisor Name_Unit_Subject Acronyme_EN.pdf

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SCIENTIFIC DESCRIPTION OF THE PhD PROJECT

Socio-economic and scientific context : (10 lines)

The French and European populations are more and more urban; in 2050, 85 % of this population will live in a city. Thus, the space dedicated to the garden will be more and more reduced, while the 'Nature' request is more and more pressing. Thus, it is necessary to adapt the range of plants for city use, in particular by looking for more compact and branched plants.

Badly controlled, the cultural conditions under greenhouse lead to the etiolation, resulting in a depreciation of the visual quality of plants. The etiolation is the consequence of a modification/change of the light spectra perceived by plants.

Today, the development of the LED lighting in horticulture allows a better control of morphogenetic process controlled by the light (stem elongation and branching). Used in artificial environment, they open up interesting opportunities to produce plants all year round, regardless of seasons, with a reduced duration of culture. So, we started the evaluation of the effect of various combinations of wavelengths, i.e. light modalities, on the architecture of young plants grown in controlled conditions in rose bush. Strong genotype x light interactions were highlighted.

Assumptions and questions (8 lines)

A better knowledge of the genotype x light interaction, i.e. genotype-specific responses, would allow a better control of the plant architecture, and thus its shape, by LED lighting.

So, the identification of expressed differentially biomarkers according to the light modalities will allow i) to better understand the mechanisms underlying these responses; ii) to choose cultivars best responding to the most effective light modality, in order to obtain compact and branched plants. So, the cultivar responses to various light modalities will be characterized on the architectural, physiological and molecular level.

The main steps of the thesis and scientific procedure (10-12 lines)

The thesis will be carried out within the framework of the IRRADIANCE CASDAR project. It will benefit from CIFRE funding and will be supported by the technical Institute of the horticulture, ASTREDHOR. The thesis will articulate in three complementary actions:

Action 1 - Year 1 - Architectural and physiological characterization of the genotypic response to two light modalities (white LEDs and combination of white and red LEDs). The characterization will concern two cultivars, chosen for their contrasted response to light, grown in climatic room, until the development of the order 3 axes (approximately 2 months of culture).

Action 2 - Year 2 and 3 - Transcriptomic characterization of the genotypic response to both light modalities. It will allow to identify the expressed differentially genes according to the light modalities.

Action 3 - Year 2 and 3 – Follow-up of experiment implemented by ASTREDHOR within the framework of the IRRADIANCE project and analysis of results.

Methodological and technical approaches considered (4-6 lines)

The architectural characterization will be carried out by digitalisation 3D, through the plant development and at the final stage defined above.

The physiological characterization will concern eco-physiological analyses on leaves (photosynthetic activity, stomatal conductance, concentration in chlorophyll) and biochemical on stems, buds and leaves (concentrations in mineral elements, sugars and hormones).

The analysis of the transcriptome will be carried out by mRNA sequencing (RNAseq).

Scientific and technical skills required by the candidate

Vegetal biology and physiology, molecular biology, bio-informatics and statistics.

THESIS SUPERVISION

Unit name: IRHS UMR 1345	Team name: Biologie intégrative de l'Architecture et Environnement (ARCH-E) team
Unit director name: Jean Pierre RENOUE	Team director name: Alain vian
Mailing address of the unit director: jean-pierre.renou@inra.fr	Mailing address of the team director: alain.vian@univ-angers.fr
<p>Thesis director</p> <p>Surname, first name: SAKR Soulaïman</p> <p>Position: Professor</p> <p>Obtained date of the HDR (Habilitation thesis to supervise research): 2006</p> <p>Employer: AGROCAMPUS OUEST</p> <p>Doctoral school affiliation: EGAAL</p> <p>Rate of thesis supervision in the present project (%): 40%</p> <p>Total rate of thesis supervision in ongoing theses (supervisions and co-supervisions) (%): 90%</p> <p>Number of current thesis supervisions/co-supervisions: 2</p>	
<p>Thesis co-supervisor 1 (if applicable)</p> <p>Surname, first name: CRESPEL Laurent</p> <p>Position: Associate professor</p> <p>Habilitation thesis to supervise research <input type="checkbox"/> yes <input checked="" type="checkbox"/> no If yes, date diploma received:</p> <p>Employer: AGROOCAMPUS OUEST</p> <p>Doctoral school affiliation: EGAAL</p> <p>Rate of thesis supervision in the present project (%): 30%</p> <p>Total rate of thesis supervision in ongoing theses (supervisions and co-supervisions) (%): 0%</p> <p>Number of current thesis supervisions/co-supervisions: 0%</p>	
<p>Thesis co-supervisor 2 (if applicable)</p> <p>Surname, first name:</p> <p>Position:</p> <p>Habilitation thesis to supervise research <input type="checkbox"/> yes <input type="checkbox"/> no If yes, date diploma received:</p> <p>Employer:</p> <p>Doctoral school affiliation:</p>	

Rate of thesis supervision in the present project (%):

Total rate of thesis supervision in ongoing theses (supervisions and co-supervisions) (%):

Number of current thesis supervisions/co-supervisions:

Private partner (if CIFRE funding, private funding,...)

Surname, first name: ROBERT Fabien

Position: Technical and Research Director

Employer: ASTREDHOR

Rate of thesis supervision in the present project (%): 30%

Total rate of thesis supervision in ongoing theses (supervisions and co-supervisions) (%): 0%

Number of current thesis supervisions/co-supervisions: 0%

International partner (if Cotutelle thesis)

Surname, first name:

Position:

Employer:

Rate of thesis supervision in the present project (%):

Total rate of thesis supervision in ongoing theses (supervisions and co-supervisions) (%):

Number of current thesis supervisions/co-supervisions:

Professional status of previous PhD students supervised by both director and co-supervisors (from 5 years)

Please provide the following information for each PhD students supervised

Surname, first name: LI-MARCHETTI Camille

Date of PhD beginning and PhD defence: January 1st, 2013- December, 31st, 2015

Thesis supervision: Professor SAKR Soulaïman

Professional status and location: ASTREDHOR, Angers

Contract profile (post-doc, fixed-term, permanent): Permanent (C. LI-MARCHETTI left its post in May, 2018 for personal reasons)

List of publications from the thesis work:

Li-Marchetti C, Le Bras C, Relion D, Citerne S, Huché-Thélier L, Sakr S, Morel P, Crespel L (2015) Genotypic differences in architectural and physiological responses to water restriction in rose bush. *Front Plant Sci* 6:355. doi:10.3389/fpls.2015.00355

Li-Marchetti C, Le Bras C, Chastellier A, Relion D, Morel P, Sakr S, Hibrand-Saint Oyant L, Crespel L (2017) 3D Phenotyping and QTL analysis of a complex character: rose bush architecture. *Tree Genet Genomes* 13:112. doi 10.1007/s11295-017-1194-0

Five main recent publications of the supervisors on thesis subject:

Barbier F, Peron T, Lecerf M, Perez-Garcia MD, Barriere Q, Rolcik J, Boutet-Mercey S, Citerne S, Lemoine R, Porcheron B, Roman H, Leduc N, Le Gourrierec J, Bertheloot J, Sakr S (2015). Sucrose is an early modulator of the key hormonal mechanisms controlling bud outgrowth in *Rosa hybrida*. *J Exp Bot* 66:2569–2582. doi: 10.1093/jxb/erv047

Corot A, Roman H, Douillet O, Autret H, Perez-Garcia MD, Citerne S, Bertheloot J, Sakr S, Leduc N, Demotes-Mainard S (2017) Cytokinins and Abscisic Acid Act Antagonistically in the Regulation of the Bud Outgrowth Pattern by Light Intensity. *Front Plant Sci* 8:1724. doi: 10.3389/fpls.2017.01724

Demotes-Mainard S, Péron T, Corot A, Bertheloot J, Le Gourrierec J, Travier S, Crespel L, Morel P, Huché- Théliier L, Boumaza R, Vian A, Guérin V, Leduc N, Sakr S (2016) Plant responses to red and far-red lights, applications in horticulture. *Env Exp Bot* 121:4-21. doi.org/10.1016/j.envexpbot.2015.05.010

Henry C, Rabot A, Laloï M, Mortreau E, Sigogne M, Leduc N, Lemoine R, Sakr S, Vian A, Pelleschi-Travier S (2011). Regulation of RhSUC2, a sucrose transporter, is correlated with the light control of bud burst in *Rosa* sp. *Plant Cell Environ*. 34:1776–1789. doi: 10.1111/j.1365-3040.2011.02374.x

Huché-Théliier L, Crespel L, Le Gourrierec J, Morel P, Sakr S, Leduc N (2016) Light signaling and plant responses to blue and UV radiations – Perspectives for applications in horticulture. *Env Exp Bot* 121:22-38. doi.org/10.1016/j.envexpbot.2015.06.009

Li-Marchetti C, Le Bras C, Relion D, Citerne S, Huché-Théliier L, Sakr S, Morel P, Crespel L (2015) Genotypic differences in architectural and physiological responses to water restriction in rose bush. *Front Plant Sci* 6:355. doi:10.3389/fpls.2015.00355

Rabot A, Henry C, Ben Baaziz K, Mortreau E, Azri W, Lothier J, Hamama L, Boummaza R, Leduc N, Pelleschi-Travier S, Le Gourrierec J, Sakr S (2012). Insight into the role of sugars in bud burst under light in the rose. *Plant Cell Physiol* 53:1068–1082. doi: 10.1093/pcp/pcs051

Rameau C, Bertheloot J, Leduc N, Andrieu B, Foucher F, Sakr S (2015) Multiple pathways regulate shoot branching. *Front Plant Sci* 5:741. doi: 10.3389/fpls.2014.00741

THESIS FUNDING

Origin(s) of the thesis funding: CIFRE
Gross monthly salary: 1957 euros
Thesis funding state : Partly acquired (co-funding)
Funding beginning date/Funding ending date: January 1st, 2019

Date: 29/06/2018

Name, signature of unit director: Jean Pierre RENOU

Name, signature of team director: Alain VIAN



Name, signature of thesis project director: Soulayman SAKR

A grey ink signature, likely belonging to Soulayman SAKR, is written on the page.

