Predoctoral position, Plants Genomics and Biotechnology Group, IBMCP-CSIC, Valencia, Spain.

Project: Programming the spatiotemporal patterns of an autonomous bioluminescence pathway in plants in response to endogenous and external inputs. Group leaders: D. Orzaez and A. Granell

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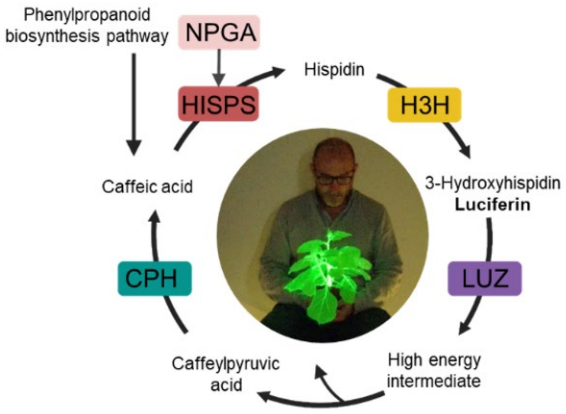
Background. Our research group is interested in the design of innovative agricultural goods using genomics, biotechnology and synthetic biology tools. In our lab, we have learnt how to build increasingly complex genetic instructions at the DNA level. One of our goals is to program plants with augmented capacities, so that they can work as e.g., environmentally friendly factories of highly demanded bioproducts, or as self-sustained biosensors for pathogens or environmental threats. To create such new functions, we need to control gene expression robustly using synthetic gene circuits.



Description of the PhD project. Understanding the design rules of gene circuits in plants requires agile and data-rich reporter systems that allow rapid experimental iterations. In this PhD project, we propose the use of a bioluminescent pathway derived from the fungus *Neonothopanus nambi*, which, when transferred genetically to plants, provides autonomous light emission levels detectable with the naked eye. During his/her thesis, the successful candidate will exploit autoluminescence in plants primarily as a model output to learn how to engineer robust gene circuits. The candidate will be involved the development of two plant prototypes, each one operating a different challenging control circuit: (i) plants that glow when detecting an infection, and (ii) plants whose light emission can alternate between ON and OFF status by spraying two different chemicals. These circuits will serve as prototypes with immediate applications: the design of plant sentinels remotely informing of biotic threats, and the control of production in high capacity biofactories.

Education Planning

The education plan involves learning: 1) how to carry out experiments in the context of a larger project, 2) to analyze the results of the experiments and discuss possible ways to proceed; 3) to present and discuss results to different audiences; 4) to write reports, abstracts for meetings and drafting and finishing research papers. Next to daily experimental work, education activities involve:

- Weekly supervision in individual progress meetings.
- Participation in weekly lab progress meetings (own presentations every 2 months).

- Participation in monthly department meetings (own presentations every year).
- Participation in national and (1) international congresses and in Transferible Skills courses.
- Possibility to join collaborative labs (abroad) in short training mission (3-4 months).

Selected recent publications of the group:

1. C. Calvache, M. Vazquez-Vilar, E. Moreno-Giménez, D. Orzaez. A quantitative autonomous bioluminescence reporter system with a wide dynamic range for Plant Synthetic Biology. Plant Biotechnol J. 2023. In press. DOI: 10.1111/pbi.14146.
2. M. Vazquez-Vilar, A.Fernandez-del-Carmen, V. Garcia-Carpintero, M. Drapal, S. Presa, D. Ricci, G.Diretto, JL Rambla, R. Fernandez-Muñoz, A. Espinosa-Ruiz, P. D. Fraser, C. Martin, A. Granell, D. Orzaez. Dually biofortified cisgenic tomatoes with increased flavonoids and branched-chain amino acids content. Plant Biotechnol J. 2023. In press. DOI: 10.1111/pbi.14163
3. Ranawaka B, An J, Lorenc MT, Jung H, Sulli M, Aprea G, Roden S, Llaca V, Hayashi S, Asadyar L, LeBlanc Z, Ahmed Z, Naim F, de Campos SB, Cooper T, de Felippes FF, Dong P, Zhong S, Garcia-Carpintero V, Orzaez D, Dudley KJ, Bombarely A, Bally J, Winefield C, Giuliano G, Waterhouse PM. A multi-omic Nicotiana benthamiana resource for fundamental research and biotechnology. Nat Plants. 2023 Aug 10. doi: 10.1038/s41477-023-01489-8.
4. Selma S, Sanmartín N, Espinosa-Ruiz A, Gianoglio S, Lopez-Gresa MP, Vázquez-Vilar M, Flors V, Granell A, Orzaez D. Custom-made design of metabolite composition in N. benthamiana leaves using CRISPR activators. Plant Biotechnol J. 2022 Aug;20(8):1578-1590.
5. Calvache C, Vazquez-Vilar M, Selma S, Uranga M, Fernández-Del-Carmen A, Daròs JA, Orzáez D, Strong and tunable anti-CRISPR/Cas activities in plants. Plant Biotechnol Journal 2022 Feb;20(2):399-408.
6. Moreno-Giménez E, Selma S, Calvache C, Orzáez D. GB_SynP: A Modular dCas9-Regulated Synthetic Promoter Collection for Fine-Tuned Recombinant Gene Expression in Plants. ACS Synth Biol. 2022 Sep 16;11(9):3037-3048.
7. Bernabé-Orts JM, Quijano-Rubio A, Vazquez-Vilar M, Mancheño-Bonillo J, Moles-Casas V, Selma S, Gianoglio S, Granell A, Orzaez D. A memory switch for plant synthetic biology based on the phage ϕC31 integration system. Nucleic Acids Res. 2020 Apr 6;48(6):3379-3394.
8. Selma S, Bernabe-Orts JM, Vazquez-Vilar M, Diego B, Ajenjo M, Garcia-Carpintero V, A Granell A, Orzáez D (2019). Strong gene activation with genome-wide specificity using a new orthogonal CRISPR/Cas9-based Programmable Transcriptional Activator. Plant Biotechnology Journal 17(9):1703-1705.
9. Bernabé-Orts JM, Casas-Rodrigo I, Minguet EG, Landolfi V, Garcia-Carpintero V, Gianoglio S, Vázquez-Vilar M, Granell A, Orzáez D (2019) Assessment of Cas12a-mediated gene editing efficiency in plants. Plant Biotechnology Journal 17(10):1971-1984.
10. Vazquez-Vilar M, Quijano-Rubio A, Fernandez-Del-Carmen A, Sarrion-Perdigones A, Ochoa-Fernandez R, Ziarsolo P, Blanca J, Granell A, Orzáez D (2017) GB3.0: a platform for plant bio-design that connects functional DNA elements with associated biological data. Nucleic Acids Research 45, 2196-2209.