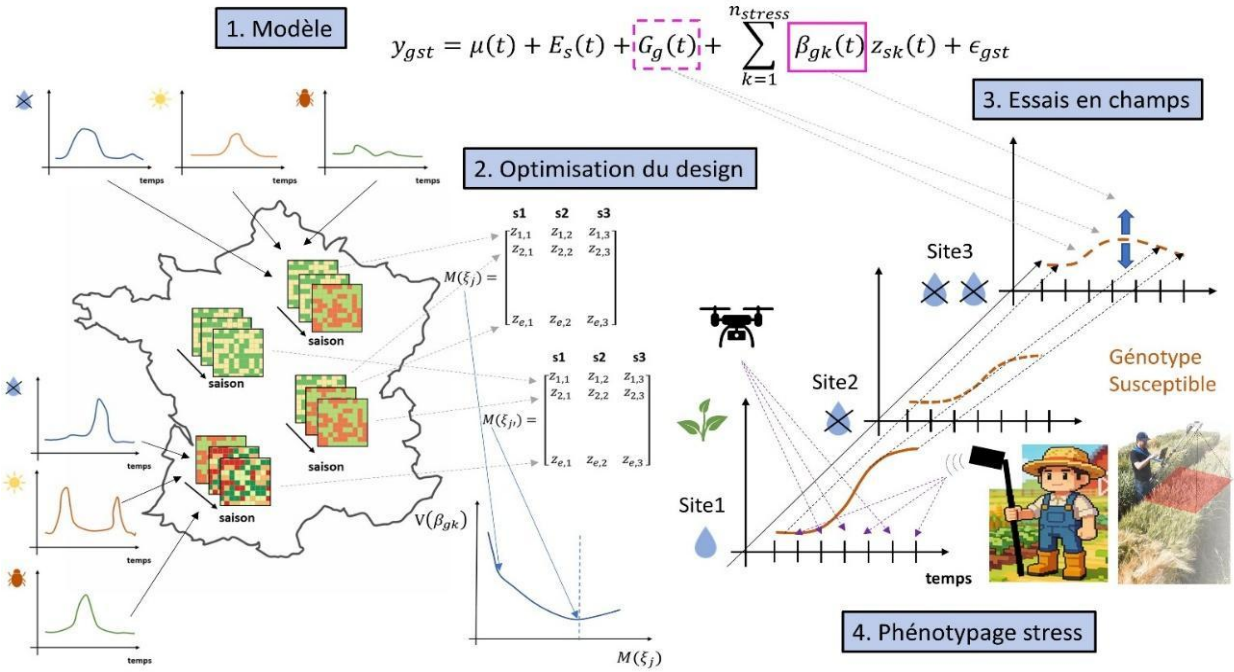
PhD Position – PlantAlliance Projet DEStress

(Application deadline: Friday 4th of September at midnight)

Project description

Adapting agriculture to climate change is a major challenge of our time. To study the impact of multiple stresses on plants, the PlantAlliance consortium has chosen to fund the DEStress project (Experimental Design for Variety Trial Networks Subjected to Multiple Stresses), whose objective is to optimize experimental conditions and measurements of multiple stresses on crops such as sorghum, wheat, and corn under field conditions, which means as close as possible to the conditions faced by farmers. More broadly, the DEStress project aims to improve crop resilience by enabling the selection of plants better adapted to climate variations. More specifically, DEStress aims to develop a comprehensive methodology for measuring the effects of stress on plants. This methodology includes experimental design, modeling, and high-resolution data-capture devices (LITERAL pole, drone).

The primary objective of the project is to develop a tool for optimizing the experimental design of trial networks. Specifically, the goal is to determine the set of environments (locations, planting dates) that will maximize the ability to measure genotype X stress interactions, as well as the precision of these measurements. Based on a predefined statistical model, we aim to implement optimization procedures grounded in optimal design theory[1] or Bayesian optimal design[2]. Simulation of trial networks and longitudinal phenotypic data will be essential for this exercise.



Project visual description

Unité Mixte de Recherche Amélioration Génétique des Plantes méditerranéennes et tropicales (AGAP)
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The second objective is to explore and propose approaches for modeling genetic response as well as the influence of environmental covariates on that response over time[3]. We will prioritize approaches based on linear mixed models, which have proven effective in genotype X environment modeling[4]. This more theoretical part of the project will be combined with a practical component involving data collection over two growing seasons in grain sorghum trial networks. The use of the LITERAL pole[5] and drone-based aerial measurements[6] will enable us to measure changes in plant stress over the course of the season, feed the models, and compare these tools. The ultimate goal of the project is to develop a pipeline capable of modeling a plant's genetic potential over time and estimating the influence of stress on this genetic component in order to guide breeding efforts.

Desired profile

You enjoy the quantitative and analytical aspects of science (statistics, mathematics, etc.) and their application to real-world problems, particularly in agronomy and even plant breeding. You're comfortable with digital tools and data analysis, enjoy coding and computer programming, and follow the latest developments in artificial intelligence with interest. Even though you spend most of your time in front of a screen, you enjoy getting some fresh air and engaging with the realities of the field. You even appreciate the work of collecting data in the field, which can sometimes be tedious. You demonstrate adaptability and flexibility in order to integrate effectively into a collaborative project involving numerous partners and areas of expertise. You value feedback and critical perspectives on your work. You also have an affinity for and interest in working within a multicultural institution committed to sustainable development and the improvement of agriculture in Europe and the Global South.

Skills

- Holds a master's degree or equivalent training in statistics, mathematics, applied mathematics, quantitative genetics, (bio)informatics, or another discipline with a strong emphasis on quantitative methods
- An experience in the field of experimental design and/or optimisation will be strongly valued
- Skills in linear mixed model appreciated
- Experience in at least one data analysis program like R (preferred) or Python
- Programming skills, in particular, their application in collaborative projects using version control tools like Git
- Ability to work in a multidisciplinary team with different skills and expertise composed of statisticians, technicians, plant breeders, and geneticists
- Interest for plant breeding and/or agronomy as well as field work

Practical Information

Place

The project will be carried out at the UMR AGAP Institut (https://umr-agap.cirad.fr) and, more specifically, within CIRAD's GIV team based in ***Montpellier, France***. The UMR AGAP Institut is a multidisciplinary research unit that studies plant improvement and adaptation in Mediterranean and tropical environments. Within the UMR AGAP, the GIV team specializes in breeding strategies for tropical crops such as sorghum, cotton, and rice, using a wide range of approaches from functional genomics to participatory breeding, with an increasingly strong emphasis on quantitative methods. Throughout the project, you will be affiliated with the GAIA Doctoral School—Biodiversity, Agriculture, Food, Environment, Earth, Water. During the DEStress project, you will have access to the facilities (e.g., restaurant) and network of CIRAD, which is ideally located within the rich research ecosystem of Montpellier and its surrounding region and has a strong international focus. You will be required to travel for fieldwork, as well as to interact with partners and present your work at national and international conferences.

Supervision

During the project, you will benefit from the supervision of a multidisciplinary team composed of geneticists and statisticians:

- David Pot (UMR AGAP Institut - CIRAD)
- Vincent Segura (UMR AGAP Institut - INRAE)
- Bénédicte Fontez (UMR MISTEA – Institut Agro Montpellier)
- Vincent Garin (UMR AGAP Institut - CIRAD)

PlantAlliance

The DEStress project is funded by the PlantAlliance consortium. PlantAlliance (https://www.plantalliance.fr/) is a public-private partnership in plant genetics and biology whose partners aim to contribute to the development and implementation of the agriculture of the future. PlantAlliance aims to fund pre-competitive projects (PPCs), complementing existing research activities among consortium members. PlantAlliance also supports the training of students (master's and doctoral candidates). The DEStress project will involve a significant number of PlantAlliance partners with whom you will have the opportunity to interact.

Dates and timeline: Beginning of the project expected in ***December 2026*** for a duration of ***3 years***.

Application: Please submit your application (CV, motivation letter, contact one reference person) using the following link https://forms.gle/kGetVYnUNNxcc3mZ6

Application deadline: Friday ***4th of September at midnight***.

Contact

For extra information you can contact Vincent Garin (vincent.garin@cirad.fr)

Références

1. Atkinson, A., Donev, A., & Tobias, R. (2007). *Optimum experimental designs, with SAS* (Vol. 34). OUP Oxford.

2. Greenhill, S., Rana, S., Gupta, S., Vellanki, P., & Venkatesh, S. (2020). Bayesian optimization for adaptive experimental design: A review. *IEEE access*, *8*, 13937-13948. https://doi.org/10.1109/ACCESS.2020.2966228

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4. Tolhurst, D. J., Gaynor, R. C., Gardunia, B., Hickey, J. M., & Gorjanc, G. (2022). Genomic selection using random regressions on known and latent environmental covariates. *Theoretical and Applied Genetics*, *135*(10), 3393-3415. https://doi.org/10.1007/s00122-022-04186-w

5. De Solan, B., Daubige, G., Thomas, S., & Serouart, M. (2024). LITERAL, un système de phénotypage haut débit portable, léger et précis pour le suivi des cultures. *Innovations Agronomiques*, *94*, 303-312.

6. Jin, X., Liu, S., Baret, F., Hemerlé, M., & Comar, A. (2017). Estimates of plant density of wheat crops at emergence from very low altitude UAV imagery. *Remote Sensing of Environment*, *198*, 105-114. https://doi.org/10.1016/j.rse.2017.06.007