ClimCoffea : Drought and temperature stress adaptation in Robusta coffee: from candidate genes to drought tolerant variants.

ABSTRACT

Drought and temperature stress adaptation in Robusta coffee: from candidate genes to drought tolerant variants.

{{Context:}}
Climate change will have strong negative impacts in coffee production. The world's foremost climate science group, the Intergovernmental Panel on Climate Change (IPCC 2014), has indeed included the negative effects of warming on coffee as part of a landmark report on the global impacts of climate change. Adaptive strategies to mitigate these effects may largely depend on our knowledge of how crops respond to climate variability and on the availability of genetic resources within wild populations, as a basis for drought- and heat-tolerance traits.

{{Objectives: }}
Franco-Brazilian project that aims to better understand the genetic and biological bases of water tolerance of Robusta coffee (Coffea canephora) and characterize the underlying diversity in cultivated and natural populations of Uganda.

{{ Actions: }}
An international collaborative effort for exploiting Robusta natural variability trough a genomics approach is the fastest way to guaranty a worldwide coffee sustainability under adverse climatic conditions.
The research addressed this issue by:
(1) Diversity analysis of wild populations of C. canephora in Uganda
(2) Characterization of allelic diversity (SNP variants) of drought tolerance candidate genes (CGs) using capture and sequencing enrichment techniques.
(3) Analysis of the relationships between environmental climate variations and genetic variation in candidate genes of C. canephora to estimate their adaptive potential and the vulnerability of populations to climate change.
(4) Study of the mechanisms and diversity of traits associated with drought tolerance in these populations

{{Results: }}

(1) A large set of wild accessions (from 7 native forests) have shown new genetic diversity and have been introduced into collections at NARO (Fig. 1, 2)
(2) Key genes involved in drought tolerance have been sequenced and showed associations with local climate variation. They represent potential pre-adaptations for future climate change;
(3) Under future climate scenarios (2050), some populations are predicted to be more vulnerable while others exhibit better pre-adaptation potential, such as the Zoka forest. Hence the need to be concerned about their preservation (Fig. 3)
(4) A differential physiological response to drought was observed under controlled conditions for individuals from different forests (Fig. 2).
(5) Two PhDs and a master's degree were completed in the framework of the project. Six papers with IF are or will be published.

Kiwuka, C., E. Goudsmit, R. Tournebize, S. O. Aquino, J. C. Douma, L. Bellanger, D. Crouzillat, ...V. Poncet 2021 Genetic Diversity of Native and Cultivated Ugandan Robusta Coffee (Coffea Canephora Pierre Ex A. Froehner): Climate Influences, Breeding Potential and Diversity Conservation. PLOS ONE 16, no 2 (8 février 2021): e0245965. https://doi.org/10.1371/journal.pone.0245965.

{{Prospects }}

The results obtained in the framework of this project will be valorized in terms of conservation (ex- and in-situ) and breeding of Robusta. However, it is essential to rapidly identify the molecular determinants of the plant involved in drought adaptation and to integrate them into the breeding process.

Year : 2017
Project number :
Type of funding :
Project type : AAP
Research units in the network : AGAP
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End date : -0001-11-30
Flagship project : no

Project leader : Valérie Poncet
Project leader's institution : IRD
Project leader's RU : DIADE

Budget allocated : 45 000 €
Total budget allocated (including co-financing) : €
Funding : Labex