Genetic-environment interactions and climatic variables effect on bean physical characteristics and chemical composition of Coffea arabica

29th Conference ASIC 2023

Leave empty for poster number

Thuan Sarzynski[1,2,3], Clément Rigal[4,5], Pierre Marraccini[1,2], Philippe Vaast[6], Hervé Etienne[1,2].

[1] CIRAD (Centre de Coopération Internationale en Recherche Agronomique Pour le Développement), UMR DIADE, F-34398 Montpellier, France.[2] UMR DIADE (Diversity, Adaptation, Development of Plants), University of Montpellier, CIRAD, IRD, F-34398 Montpellier, France.[3] NOMAFSI (Northern Mountainous Agriculture Forestry Science Institute) Mai Son research centre, Son La, Vietnam[4] CIRAD UMR ABSYS, Montpellier, France. [5]ABSYS, Université Montpellier, CIRAD, INRAE, Supagro, Montpellier, France. [6] UMR Eco & Sols, CIRAD, 34398 Montpellier, France

Introduction

Coffee bean chemical compounds and quality depends in part on genetic factors (1). F1-hybrids developed by CIRAD and ECOM in the last decades have shown better bean physical characteristics and sensory quality. Climate change across the globe is predicted to altering temperature and rainfall patterns, and therefore changing coffee quality. The effect of the interaction of the genetic factor with the environment and climate change on chemical composition and coffee quality is not well understood (2).

Materials/Methods

The effects of the environment and genotype in the coffee bean chemical composition were studied using nine trials covering an altitudinal gradient [600–1100 m above sea level (a.s.l.)] with three genotypes of *Coffea arabica* in the northwest mountainous region of Vietnam. The impacts of the climatic conditions on bean physical characteristics and chemical composition were assessed.

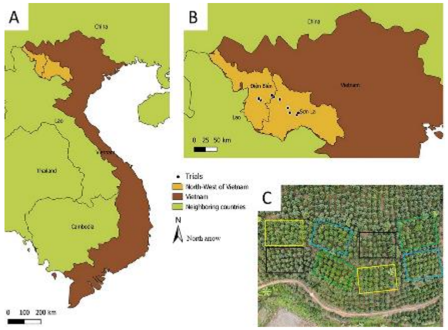

Figure 1: Design and location of the trials studied in the North-West of Vietnam.

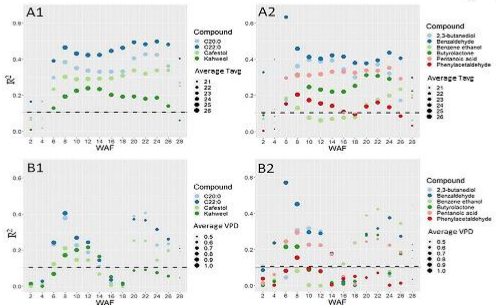

Figure 2: Scatterplots of the coefficients of determination (R^2) in function of time in weeks after flowering (WAF) for the regression model of bean chemical compounds with the moving average of Teamperature (Tavg) and Vapor pressure deficit (VPDavg).

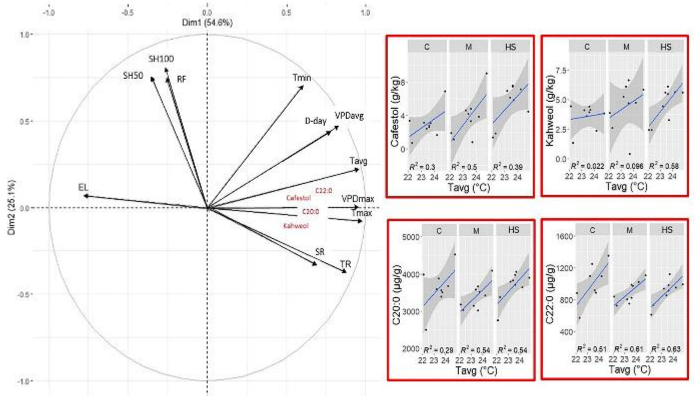

Figure 3: PCA and regression of climatic variables from 9 trials in the Northwest of Vietnam with secondary metabolites from the bean content of 3 genotypes

Results/Discussion

We showed that the environment had a significant effect on the bean density and on all bean chemical compounds. The environment effect was stronger than the genotype and genotype-environment interactions for cafestol, kahweol, arachidic (C20:0), behenic acid (C22:0), 2,3-butanediol, 2-methyl-2-buten-1-ol, benzaldehyde, benzene ethanol, butyrolactone, decane, dodecane, ethanol, pentanoic acid, and phenylacetaldehyde bean content. Temperature was positively correlated with lipids and volatile compounds. We showed that correlation of air temperature, vapor pressure deficit (VPD) with lipids and volatiles was higher between the 10^{th} and 20^{th} weeks after flowering highlighting this period as crucial for the synthesis of these chemicals. Genotype specific responses were evidenced and should be considered in future breeding programs to maintain coffee beverage quality in the midst of climate change.

Conclusion/Perspectives

This is the first study on the effect of the genotype–environment interactions on chemical compounds, enhancing our understanding of the sensitivity of coffee quality to genotype environment interactions. This work addresses the growing concern of the effect of climate change on specialty crops and more specifically coffee physical and chemical characteristics.

References:

(1) Campa C, Ballester JF, Doulbeau S, Dussert S, Hamon S, Noirot M. Trigonelline and sucrose diversity in wild Coffea species. Food Chem 88(1):39-43 (2004).

(2) Ahmed S, Stepp JR. Beyond yields: Climate change effects on specialty crop quality and agroecological management. Kapuscinski AR, Méndez E, editors. Sci Anthropocene 4(1):92 (2016).