Challenges in a Free Air CO2 Enrichment (FACE) coffee crop experiment to prospect strategies for mitigation and adaptation to climate change.

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INTRODUCTION

From an agricultural point of view, global warming and climate change, affect directly the food production. However, in a cycle of cause and effect, agriculture is not only a fundamental activity at risk with the advent of climate change, is also one of the anthropogenic activities that drives climate and environment changes (IPCC, 2014). Contributing to changes in the dynamics of the C and N cycles through emissions of the main greenhouse gases (GHGs), mainly carbon dioxide (CO₂), methane (CH₄) and nitrous oxide (N₂O). The global atmospheric concentration of CO₂ has increased from a pre-industrial value of about 280 ppm to 406. 4 ppm, measured in February 2017 (NOAA, 2017). After 2015, the increase of the CO₂ annual concentration reached the highest value since the start of monitoring in 1958, averaging 3.05 ppm per year. Achieve this levels serves as a reminder that mitigation and adaptation actions must be taken as soon as possible (Betts et al., 2016).

In Brazil, agriculture is responsible for the emissions of something around 30%, totaling 4.2 Gigatonne of CO2eq, corresponding to approximately 10% of the total issued worldwide (Brasil, 2016). On the other hand, agriculture can become the victim of the problem it is helping to create. Highly dependent on climatic factors, such as temperature, rainfall, soil moisture and solar radiation, agricultural production can be directly affected by yield, biodiversity, water availability, inducing changes in the demographic dynamics, and in the local social and economic structure.

Huge research efforts have been undertaken to understand how plants and ecosystems, natural or agroecosystems, will respond to increasing CO2 in the atmosphere. In this context, several FACE field experiments were implemented and are underway, with the mission of subsidizing responses to diverse crops, forests, pastures and desert areas (Ainsworth et al., 2008; Ghini et al., 2015). FACE experiments allows the exposure of the plants to high concentrations of CO2 (eCO2) in natural environments, providing ideal conditions for the study impact of CO₂ increase.

METHODS

The CoffeFACE is the third stage of project been held in the FACE facility located at Embrapa Environment, in Jaguariúna (22°43'S, 47°01'W, 570 m above sea level), SP, Brazil. This FACE-type experiment was the first one installed in Latin America, and the only one in the world with coffee crop. The choice for coffee came from its importance as a globally traded commodity and due to growing concerns regarding the vulnerability of the crop throughout the climate change. The system have twelve 10 m ring plots, six with eCO_2 and six under ambient [CO2] used as control plot, located within a 7 ha coffee plantation (Ghini et al., 2015).

DISCUSSION

The project will provide the interaction between crop and ecosystem response to elevated CO₂, as a function of several research. The results include ecophysiological, edaphic, climatic, pests and diseases evaluations, associated to coffee production and beverage quality that will foment modeling tools for coffee growth simulation and production in future climate change scenarios. Additionally, the same generated scenarios will generate results to calculate the environmental impacts by the Life Cycle Assessment (LCA) tool, in order to present mitigation and adaptation strategies (Fig. 1).



Fig. 1. Main priorities and challenges to be considered for the next experiment with coffee crop under elevated CO₂ conditions.

Therefore, the scientific information obtained through the implementation of the project and the aggregation of partners from other research institutions, can supply with information several policies on Climate Change. Specifically for Brazil, the results could point out the vulnerability of the tropical agricultural ecosystem to climate change and support public policies for the Brazilian National Policy on Climate Change (PNMC), as well as the development of sectorial mitigation and adaptation strategies at the local, regional and national levels. Strategies that could help the commitments assumed by Brazil at the COP21 in Paris, in which from iNDC (Wanted Nationally Determined Contributions) Brazil committed to reduce the GHG emissions in 37% below 2005 levels by 2025 and 43% below 2005 levels by 2030.

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