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GLOBAL CLIMATE CHANGE

MINI-FACE EXPERIMENT TO ANALYZE THE EFFECTS OF ELEVATED CO_2 AND WARMING ON PHOTOSYNTHESIS, GENE EXPRESSION, BIOCHEMISTRY, GROWTH, NUTRIENT DYNAMICS AND YIELD OF TROPICAL FORAGE SPECIES

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SCIENCE QUESTIONS AND OBJECTIVES

The observed and predicted rise in global atmospheric carbon dioxide concentration (CO_2), together with potential global warming and changes in precipitation, will undoubtedly have a significant economical and ecological impact on world agricultural crop plants, grasslands and forests. However, the response of tropical species to elevated CO_2 and warming has received little attention to date. The major contribution of this research proposal to FAPESP Research Program on Global Climate Change (RPGCC) is regarding the production of new and relevant scientific knowledge with emphasis in adaptation of tropical grazing species to a conservative climate change scenario. This proposal has been specifically designed to address a number of highly focused scientific questions in an interdisciplinary approach, in a national and international collaborative effort among agronomists, biologists, plant physiologists, molecular biologists and zootechnicians, in order to provide milestones and scientific deliverables regarding the responses of two contrasting tropical plants to global climate change. This research proposal aims to determine the effects of elevated CO_2 (600 ppm) and warming (+2°C), induced by infrared heaters, on the physiological, gene expression, biochemical, growth, carbon and nitrogen dynamics and yield responses of two tropical grazing species, *Panicum maximum* (C_4 grass) and *Stylosanthes guianensis* (C_3 legume), grown in consortium on a climate-change impact experiment using a mini-Face (Free air CO_2 enrichment) system. The hypothesis of the proposal is that exposure of plants to high CO_2 impact positively the performance of both functional groups grown in consortium, but the responses of plants will be modified by effect of warning. The major challenge of this project is that it will provide the first study concerning adaptation of grass and leguminous plants growing in consortium to the climate expected 50 years from now and regarding the ability of grazing plants to act as CO_2 sink in Brazilian tropics.

Figure 1. Physiological evaluation of plants through non-invasive and non-destructive methodology

CURRENT RESULTS AND PERSPECTIVES

Plant function is inextricably linked to climate and CO_2. In comparison to plants grown under ambient CO_2, plants growing at elevated CO_2 show higher rates of photosynthesis, decreased water use, lowered tissue concentrations of nitrogen and protein and increased growth and biomass production. However, some species, as the C_4 plants show lower response to elevated CO_2 than do C_3 plants. The stimulation of performance of C_3 plants is one of the most established aspects of rising CO_2, and it has been described in numerous studies. In contrast, the response of plants to future elevated CO_2 interacting with elevated temperature is still uncertain (Ainsworth & Ort, 2010). The major challenge to investigate the effects of elevated CO_2 on plants was the development of the Face (Free air CO_2 enrichment) systems, in which plants are exposed to elevated CO_2 with minimal disturbance of their natural environment like climate and radiation. Across a range of FACE experiments, has been determined that the stimulation of photosynthesis and yield by elevated CO_2 in crop species is much smaller than expected. In Brazil some experiments to determine the effects of elevated CO_2 in plants were carry out using open top chambers in forest species (Martinez et al., 2008) and crops as potato (Olivo et al., 2002) and sugar cane. However, tropical grasslands have been largely neglected despite the fact they cover 50% of the earth's surface, and are in theory as important as forests for the sequestration of carbon. In this study will be monitored the crop performance of the tropical forages Panicum maximum (C_4) and Stylosanthes guianensis (C_3) growing in consortium and exposed to elevated CO_2 and temperature using a miniFACE facility. These studies will offer a mechanistic comparison of the responses of a C_4 grass and C_3 legume to elevated CO_2 and warming.

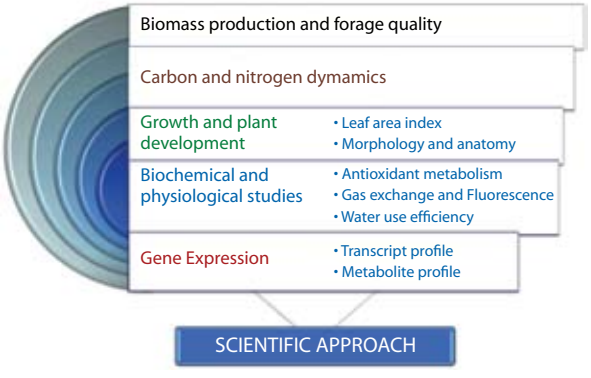

Figure 2. Scientific approach of the project describing the scaling of the impact of elevated CO_2 and temperature on molecular, biochemical and physiological processes that combine to determine the whole plant performance

RELATED PUBLICATIONS

Ainsworth EA, Ort DR. 2010. How do we improve crop production in a warming world? *Plant Physiology.* **154**: 526-530.

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