PROJECT TITLE

Influence of elevated CO2 concentration on potato plants, late blight resistance, and effectiveness of plant resistance inducers (PRIs)

CONSORTIUM

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SUMMARY OF THE REPORT

Climate change will bring challenges to agriculture, and one concern is that plant protection measures to safeguard food security will be affected. In the quest to reduce fungicide application [1], the so-called plant resistance inducers (PRIs) can be employed to boost the plant's own immune system. But their performance in a future climate with elevated CO_2 (eCO_2) remains unanswered [2]. Recent studies on plant-pathogen interactions under eCO_2 show that responses to CO_2 vary according to the pathosystem.

In this project, we suggested the study of potato late blight (PLB), caused by the oomycete *Phytophthora infestans*, which is by far the most serious potato disease worldwide. The spraying of fungicides and the introgression of resistance genes from wild *Solanum* species are the most common strategies of disease control. *P. infestans* has a great capacity of developing resistance to fungicides, as already shown for metalaxyl [3], and can break down plant resistance in a few growing seasons [4]. Integrated disease management is therefore highly encouraged, with PRIs as a good alternative since they work indirectly by controlling the pathogen through the plant's own immune system, thus having less impact on the environment.

The effects of eCO_2 on the efficiency of PRIs in controlling plant disease remains untested and was the main goal of this project. We proposed the use of Free-Air CO_2 Enrichment (FACE) at BreedFACE, Forschungszentrum Jülich, to assess the efficiency of β-aminobutyric acid (BABA) and potassium phosphite on two potato cultivars, Bintje and Désirée, susceptible to PLB, as well as to study *P. infestans* ability to infect potato plants under eCO_2.

Visual scores were used for calculating the area under the disease progress curve (AUDPC), which will be used for determining the efficiency of the PRIs by checking their relative control of PLB compared to untreated plots. We also took additional measurements of the canopy using UAV-based spectral imaging and fluorescence measurement techniques (FloX, Fluorescence Box, and LIFT, Light-Induced Fluorescence Transient) to estimate the photosynthetic efficiency of the plants and estimate different vegetation indices related to plant biophysical properties such as chlorophyll and water content. Leaf samples were also sampled for further molecular analysis to identify how differences in gene expression and protein/metabolite composition between PRI-treated and untreated potato plants alter resistance to *P. infestans* in both atmospheric CO_2 (aCO_2) and eCO_2.

This project provides valuable data towards a more holistic research approach by incorporating different types of data (e.g., sensor-based and -omics) that may indicate specific signalling compounds or pathways to be targeted, which could improve not only the selection of crops with higher inducibility and better resilience to climate change but also the development of better disease management strategies.