THE IMPACT OF CLIMATE CHANGE VARIABLES ON VEGETATIVE AND REPRODUCTIVE DEVELOPMENT OF SIX GENOTYPES OF CACAO



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CLIMATE CHANGE

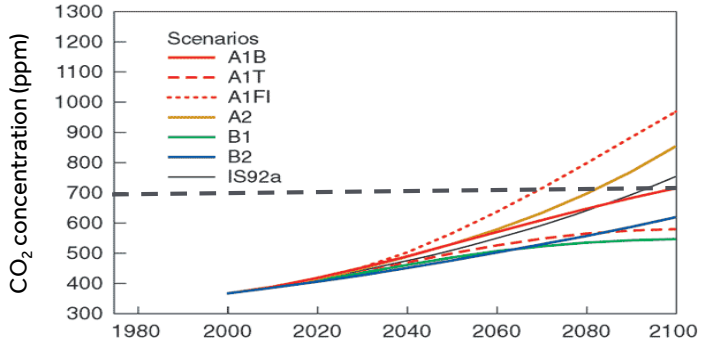
-impacts on cacao

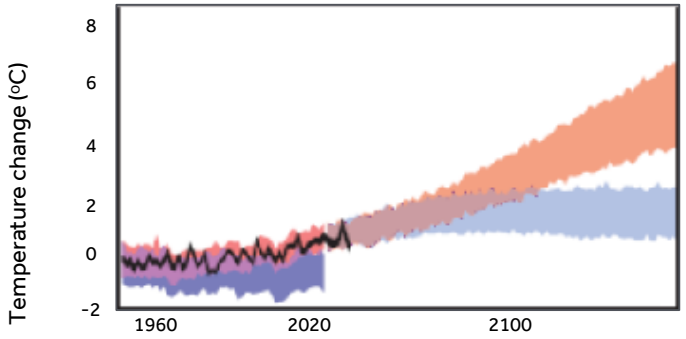
- Atmospheric CO_2 concentration is predicted to rise to about 700 ppm by 2100

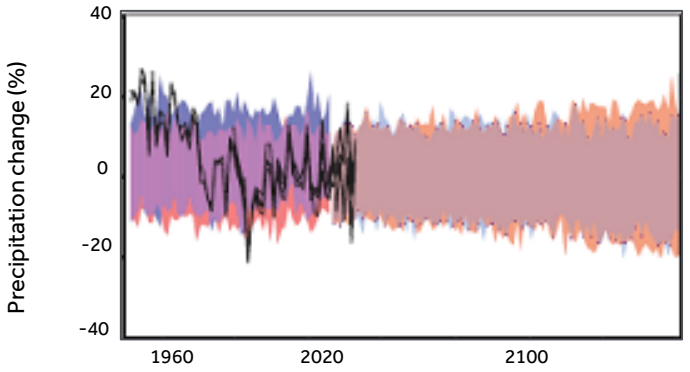
- In West Africa, temperature increase projections for 2100 range between 3 and 6 °c

- Increased variation in precipitation, changes to the intensity and length of wet and dry seasons

- Considering its importance relatively little research on how climate change will impact on cacao



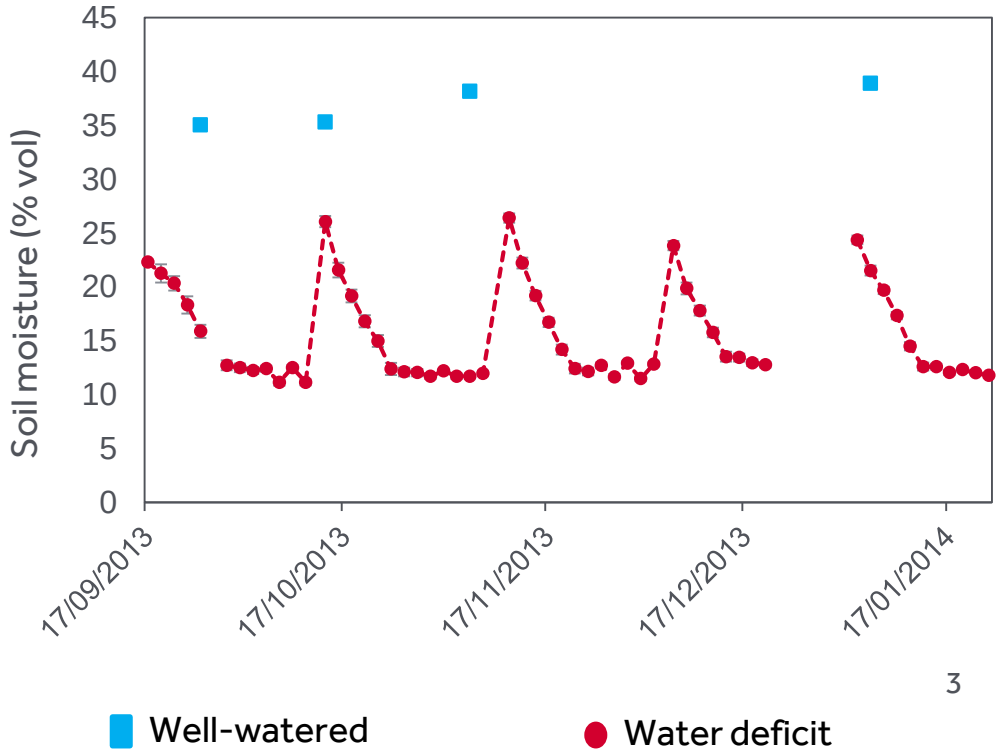




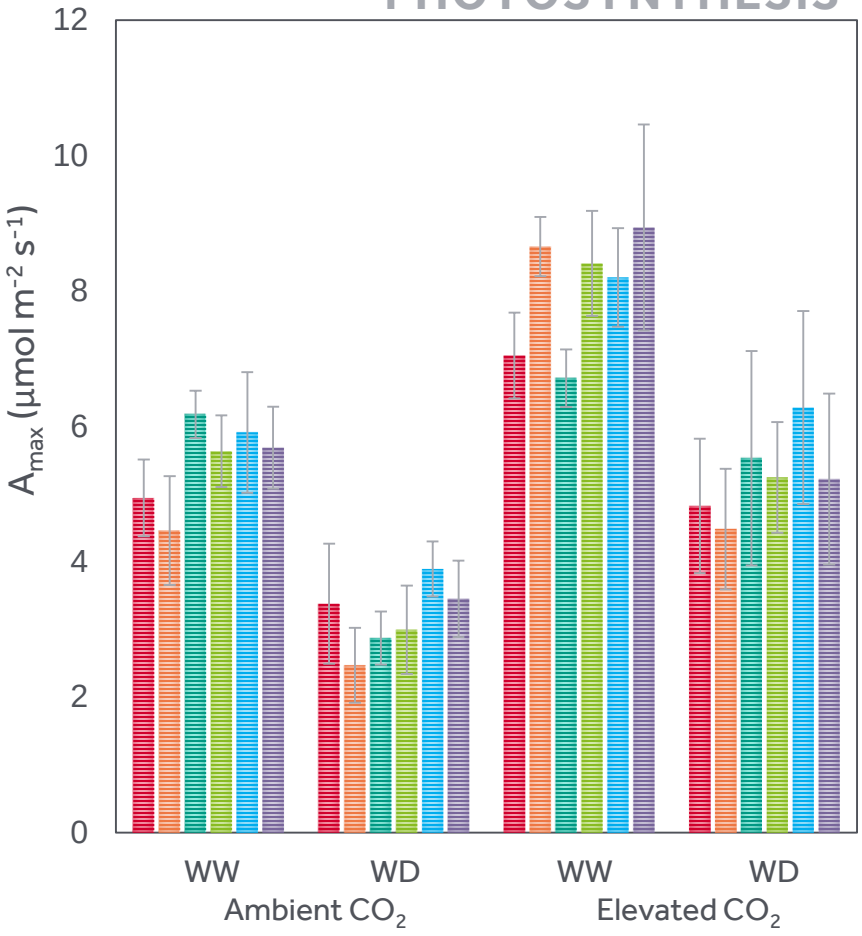
EXPERIMENTAL SET UP

- Clones of 6 genotypes grown to flowering under 'normal' conditions
- Grown under elevated CO_2 and water deficit treatments for ~ 2 years in greenhouses
- Photosynthetic measurements
- Manual pollinations – pod and bean measurements
- Destructive harvest – aboveground biomass
- Clones: CL19/10, ICS 1, IMC 47, POUND 7/B, SCA 6, SPEC 54/1

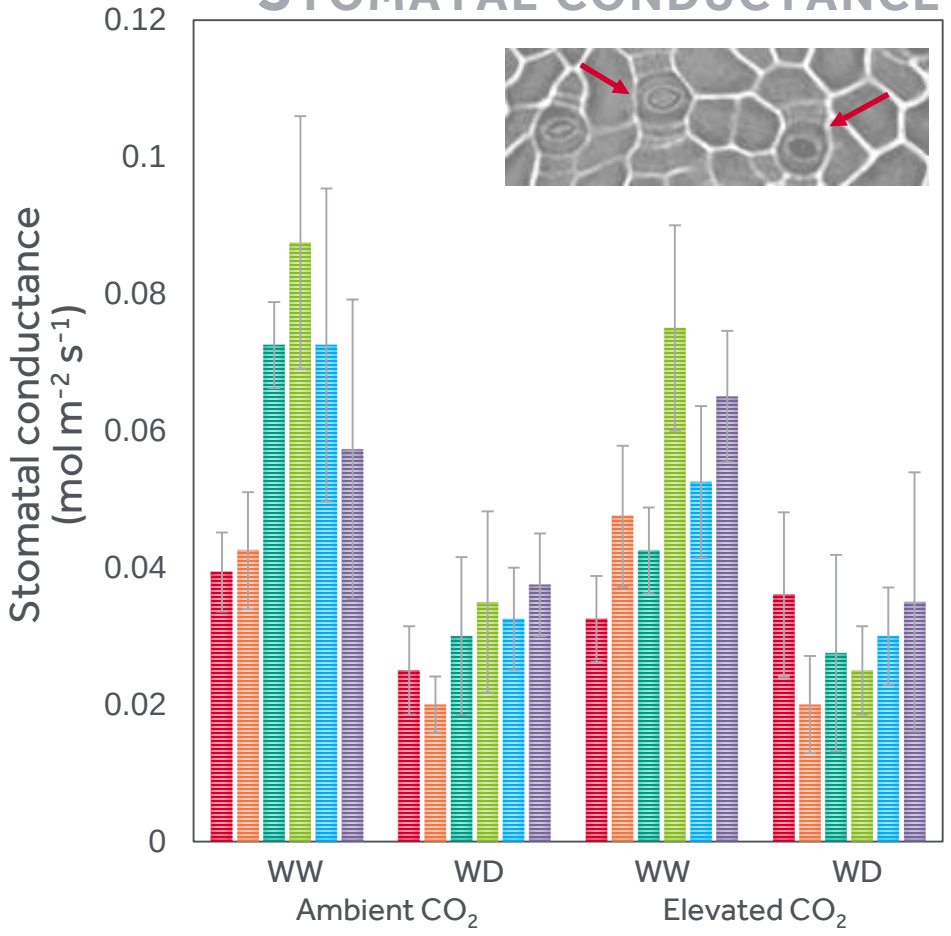
Ambient CO_2	Elevated CO_2
Elevated CO_2	Ambient CO_2



PHOTOSYNTHESIS



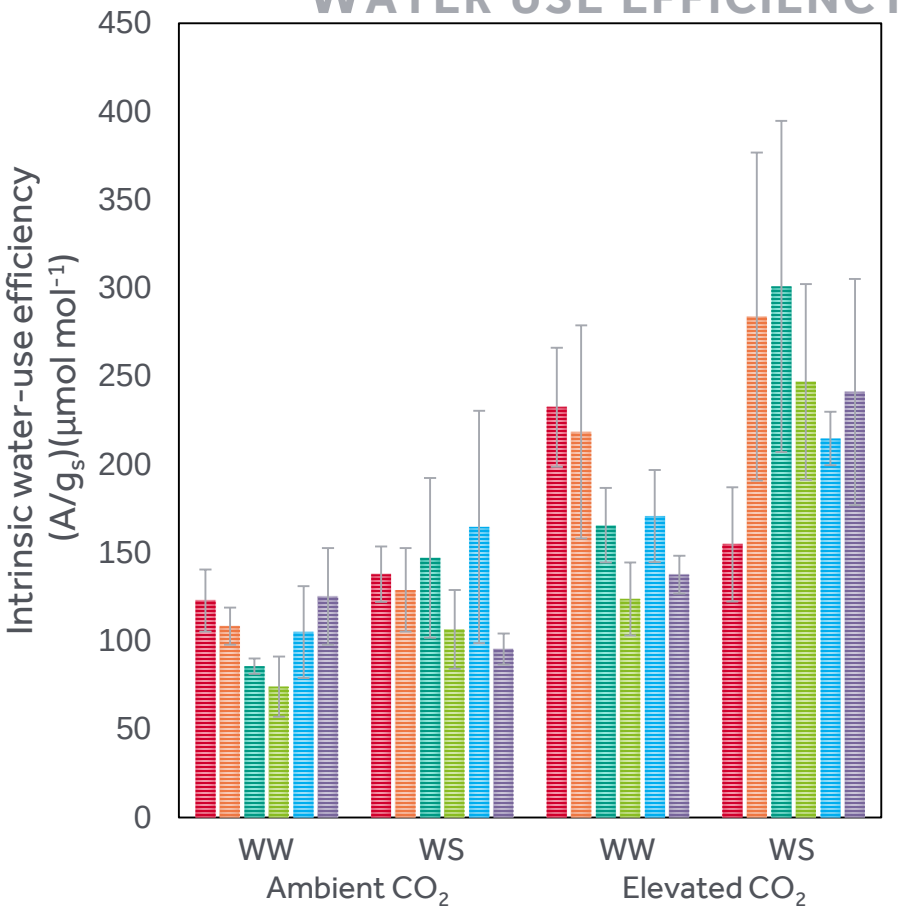
STOMATAL CONDUCTANCE



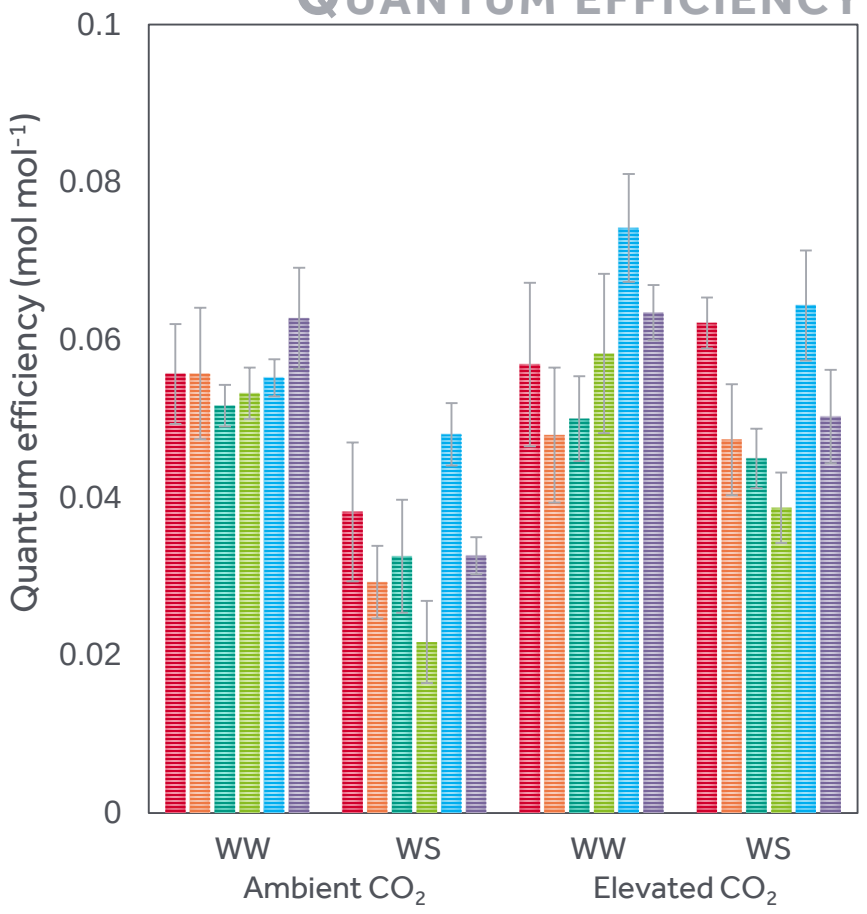
CL19/10 ICS1 IMC47 POUND7/B SCA6 SPEC54/1

- Elevated CO_2 significantly increased photosynthetic rate.
- The reduction in photosynthesis due to water deficit was less in ECO_2 compared to ACO_2
- Water deficit reduced photosynthesis and stomatal conductance – limiting water loss from the tree.

WATER USE EFFICIENCY



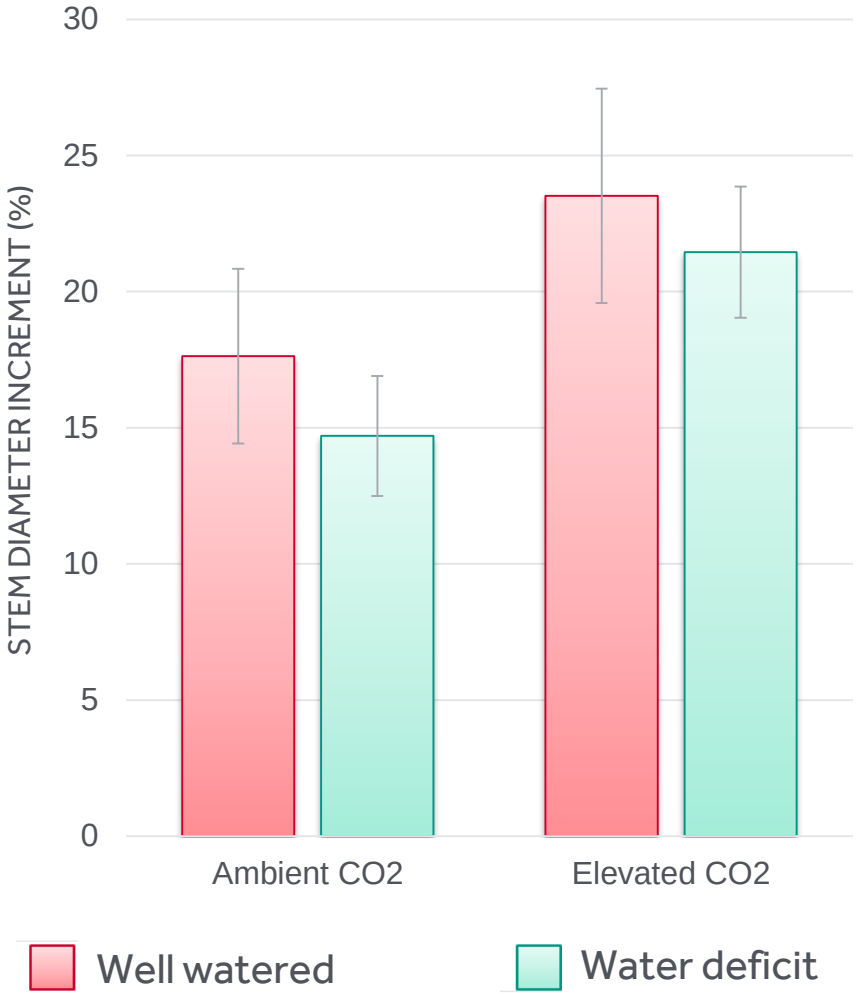
QUANTUM EFFICIENCY



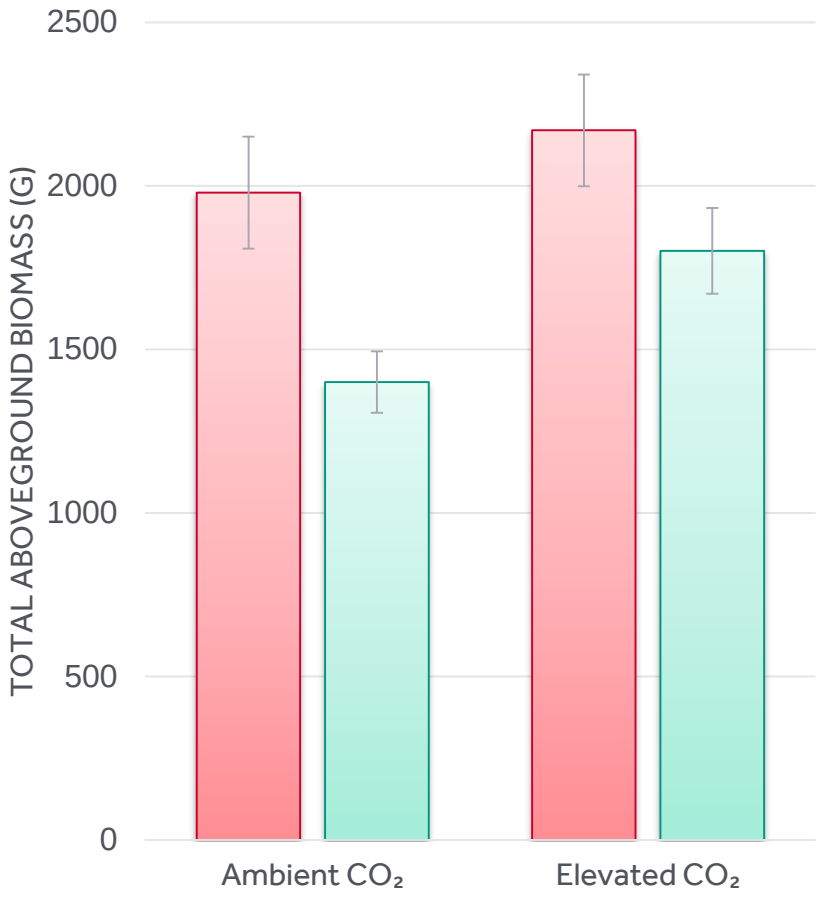
CL19/10 ICS1 IMC47 POUND7/B SCA6 SPEC54/1

- Water use efficiency significantly increased in trees grown at ECO_2. Greater carbon uptake per unit water loss.
- Quantum efficiency- interaction between CO_2 and water treatment. Increase in QE in response to ECO_2 and water stress. Potentially beneficial if growing cocoa under shade to alleviate high temperature stress.

STEM DIAMETER INCREMENT



ABOVEGROUND BIOMASS

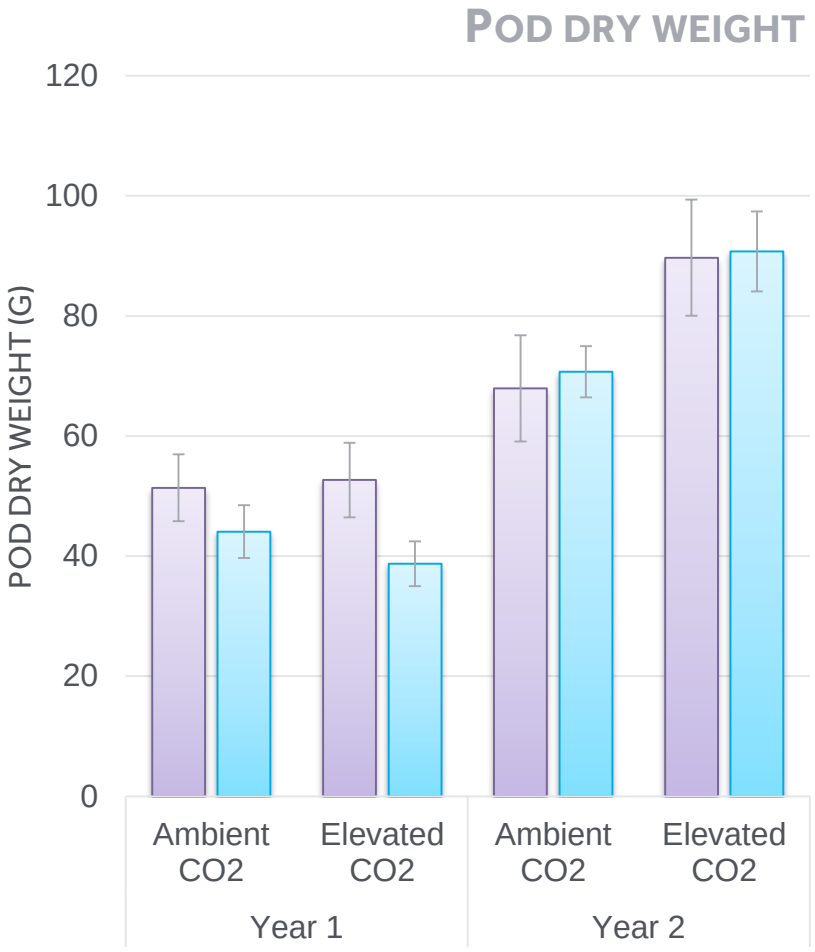


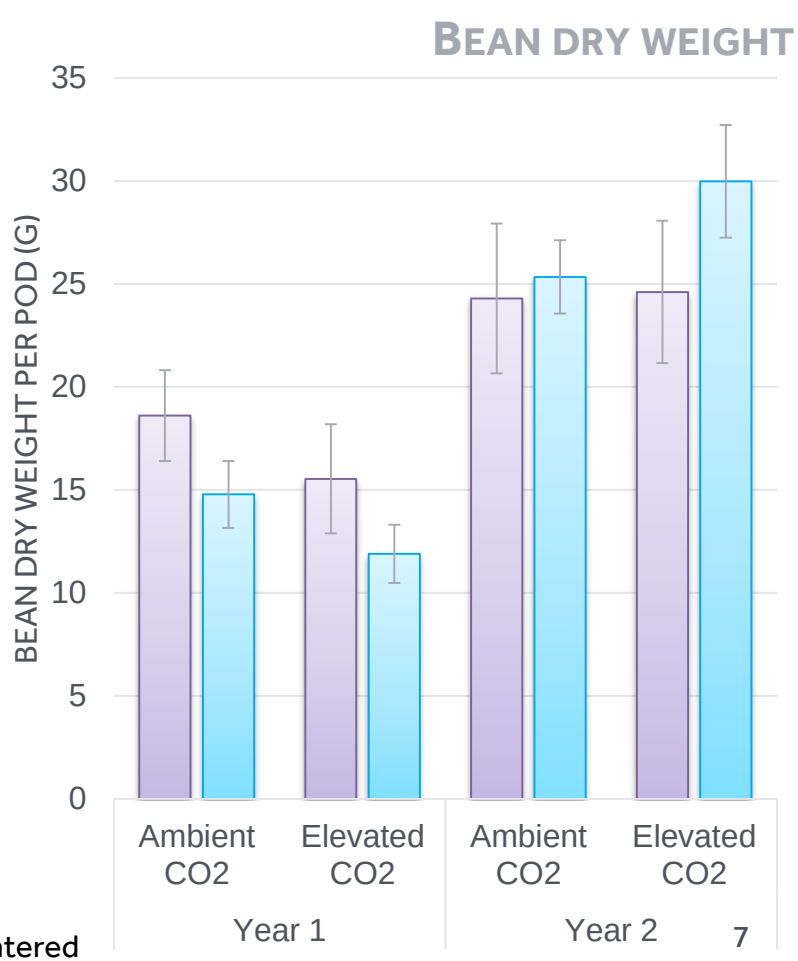
Vegetative growth

- Stem diameter increment greater under elevated CO_2 at early stages of treatment
- At end of experiment, greater vegetative biomass accumulated under elevated CO_2

Pod yield components

- Lag in effect of CO_2
- Total pod weight increase at ECO_2 but bean weight unaffected in year 2
- Negative effect of water stress in year 1



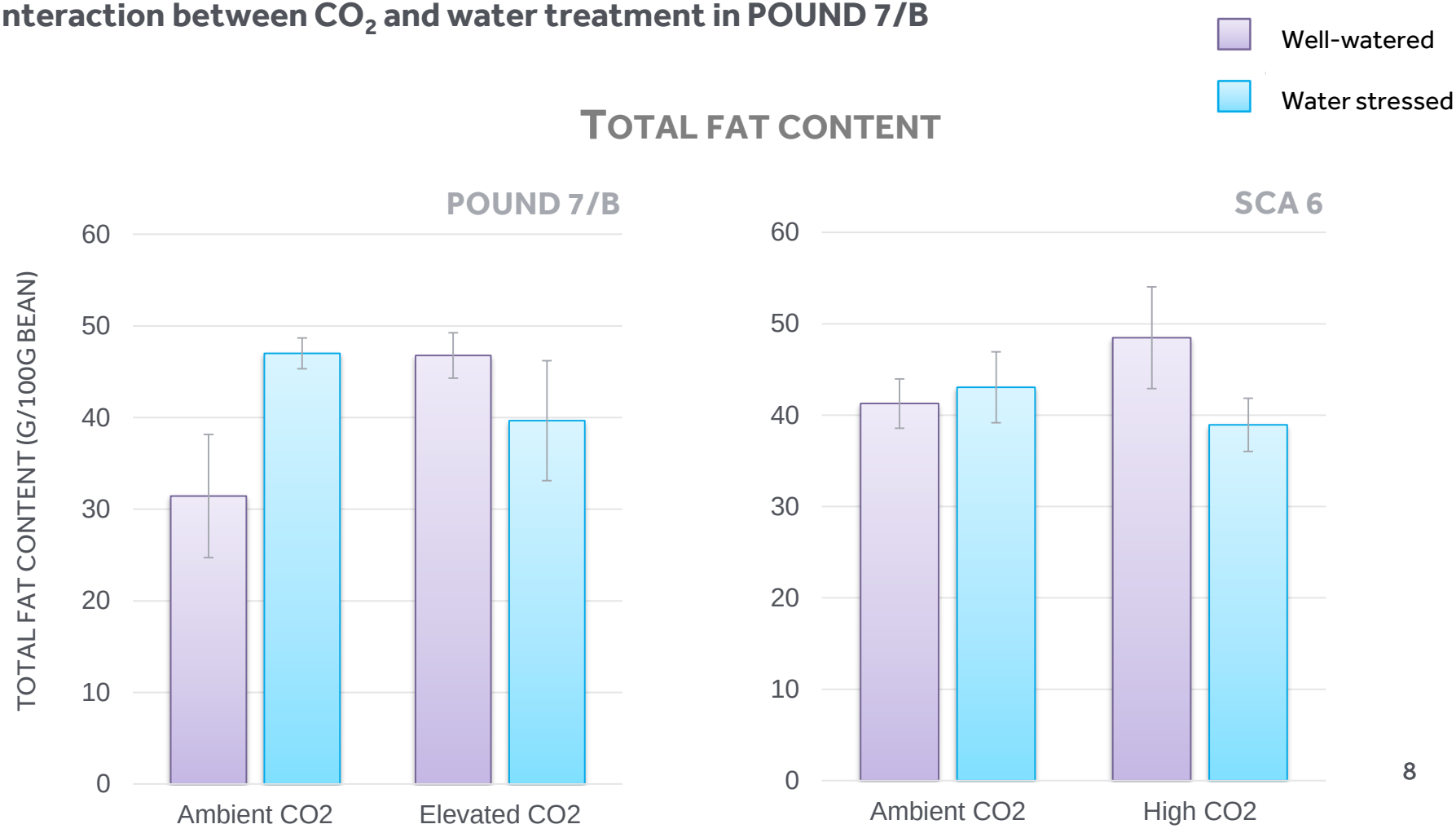


Well-watered

Water stressed

Bean analysis

- Genotypic variation in response
- Interaction between CO_2 and water treatment in POUND 7/B



DEVELOPING A PLATFORM FOR CLIMATE CHANGE RESEARCH ON CACAO - FUNDED BY COCOA RESEARCH UK

- Identification of traits underlying resilience to water deficit
- Development of method to screen for high temperature tolerance
- Study interactions of high temperature x elevated CO_2 and high temperature x water deficit
- Development of a physiological model for cacao

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THANK YOU FOR YOUR ATTENTION!