



Overview of advances in cacao and climate change research and future perspectives

International Symposium on Cocoa Research

Lima, 13th – 17th November 2017

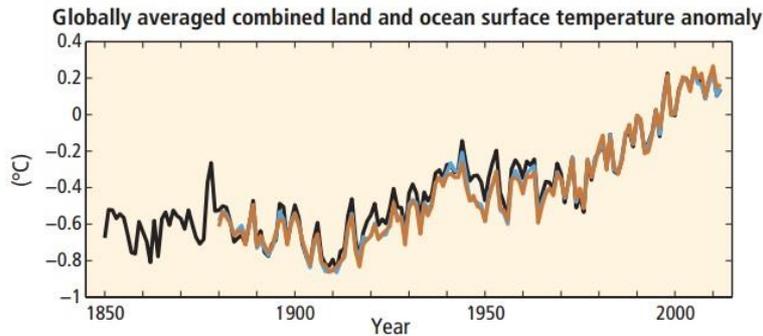
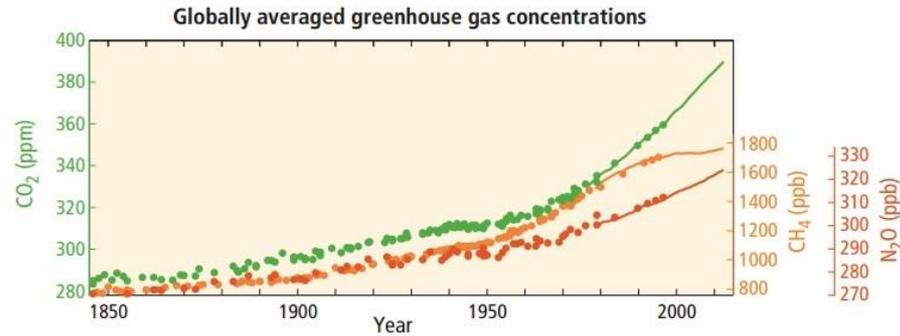
Paul Hadley

Cocoa Research Group

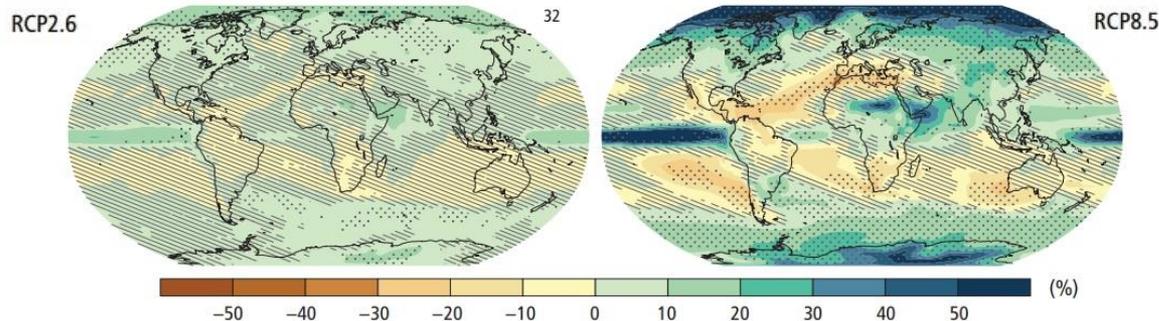
School of Agriculture, Policy and Development, University of Reading

A Changing Climate

- Increased atmospheric levels of CO₂ and other greenhouse gases are contributing to changes in climate
- CO₂ currently around 400ppm
- Changes in
 - Surface temperatures
 - Ocean temperatures
 - Precipitation patterns
 - Seasonal patterns



Change in average precipitation (1986–2005 to 2081–2100)

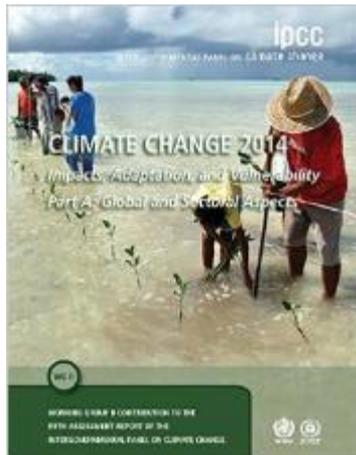


A Changing Climate

‘Human influence on the climate system is clear’

‘Warming of the climate system is unequivocal, and since the 1950s, many of the observed changes are unprecedented over decades to millennia.’

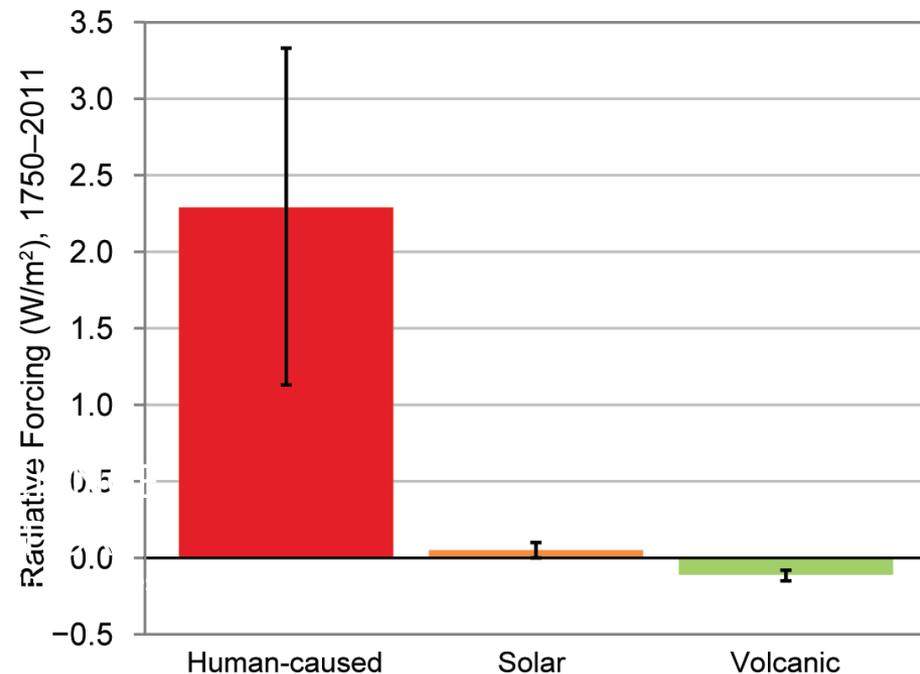
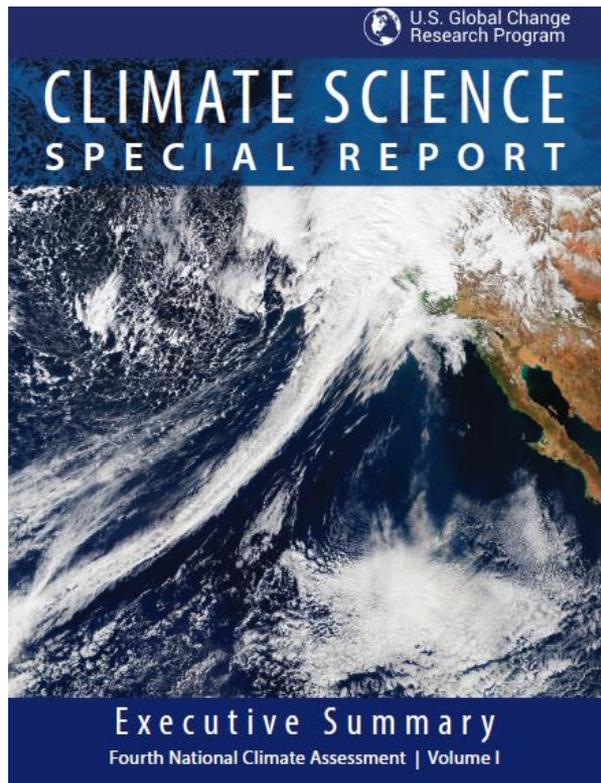
Intergovernmental Panel on Climate Change
5th Assessment Report, SPM 2014



A Changing Climate

'Human Activities Are the Primary Driver of Recent Global Temperature Rise'

Wuebbles, D.J., D.W. Fahey, K.A. Hibbard, B. DeAngelo, S. Doherty, K. Hayhoe, R. Horton, J.P. Kossin, P.C. Taylor, A.M. Waple, and C.P. Weaver, 2017: *Executive Summary of the Climate Science Special Report: Fourth National Climate Assessment, Volume I* [Wuebbles, D.J., D.W. Fahey, K.A. Hibbard, D.J. Dokken, B.C. Stewart, and T.K. Maycock (eds.)]. U.S. Global Change Research Program, Washington, DC, USA, 26 pp.



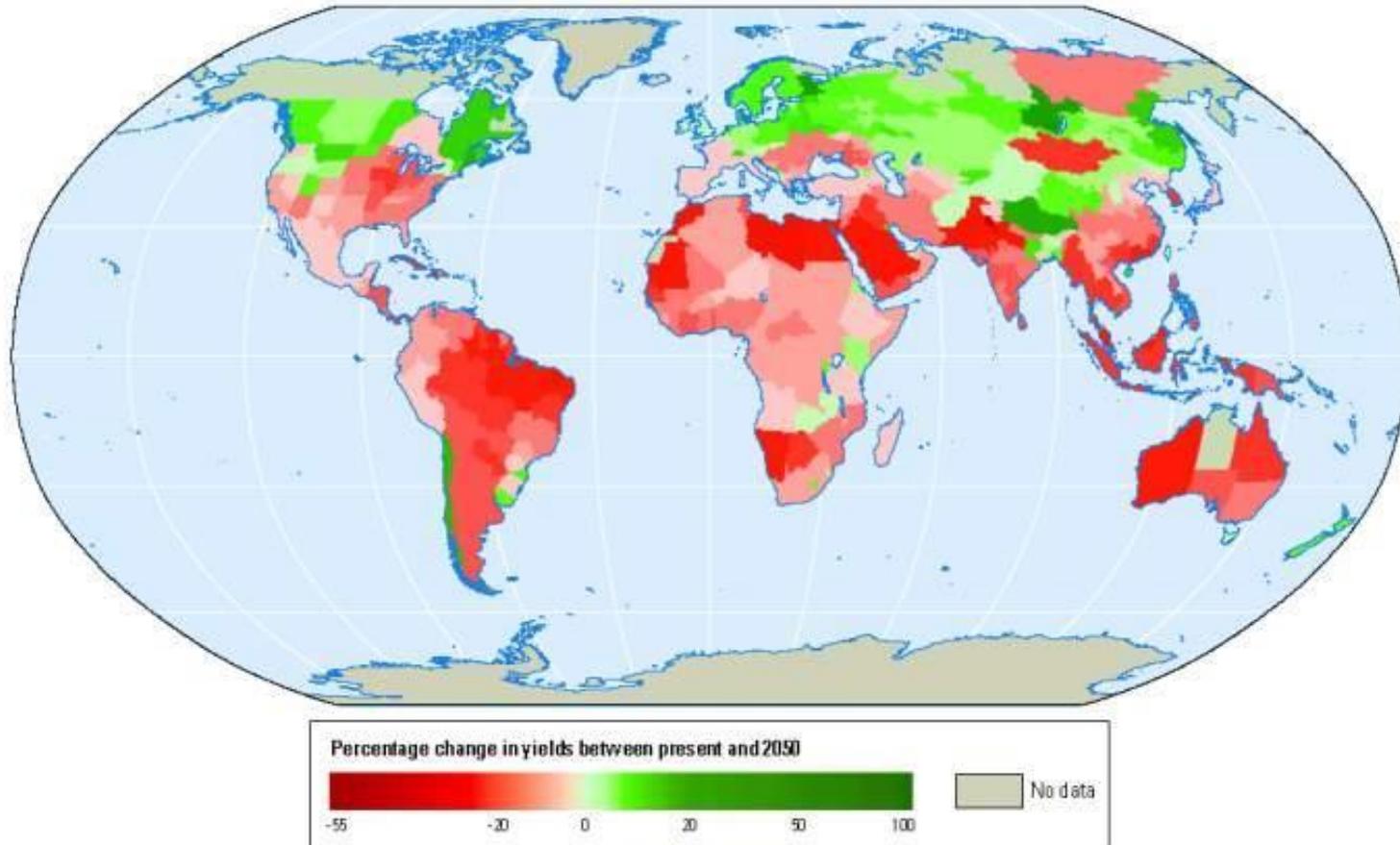
Impacts of Climate Change

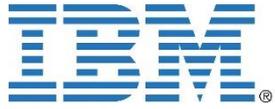
- enhanced growth at elevated CO₂
- longer potential growing season
- increase in crop water use efficiency

- shortened growing season for current varieties
- new threats from pests and diseases
- more frequent exposure to extreme conditions

Forecasts of crop productivity for 2050

Map 1 Climate change will depress agricultural yields in most countries in 2050, given current agricultural practices and crop varieties





Confectionary Industry

“Climate change is spooking the world’s chocolate makers”

October 24 2017 – IBM Industries

Cocoa Farmers

- Cocoa farms are mainly low input, rain-fed systems
- The crop is produced by approximately 5-6 million small-scale, low income farmers
- This group is the least able to adapt to the negative influences of climate change

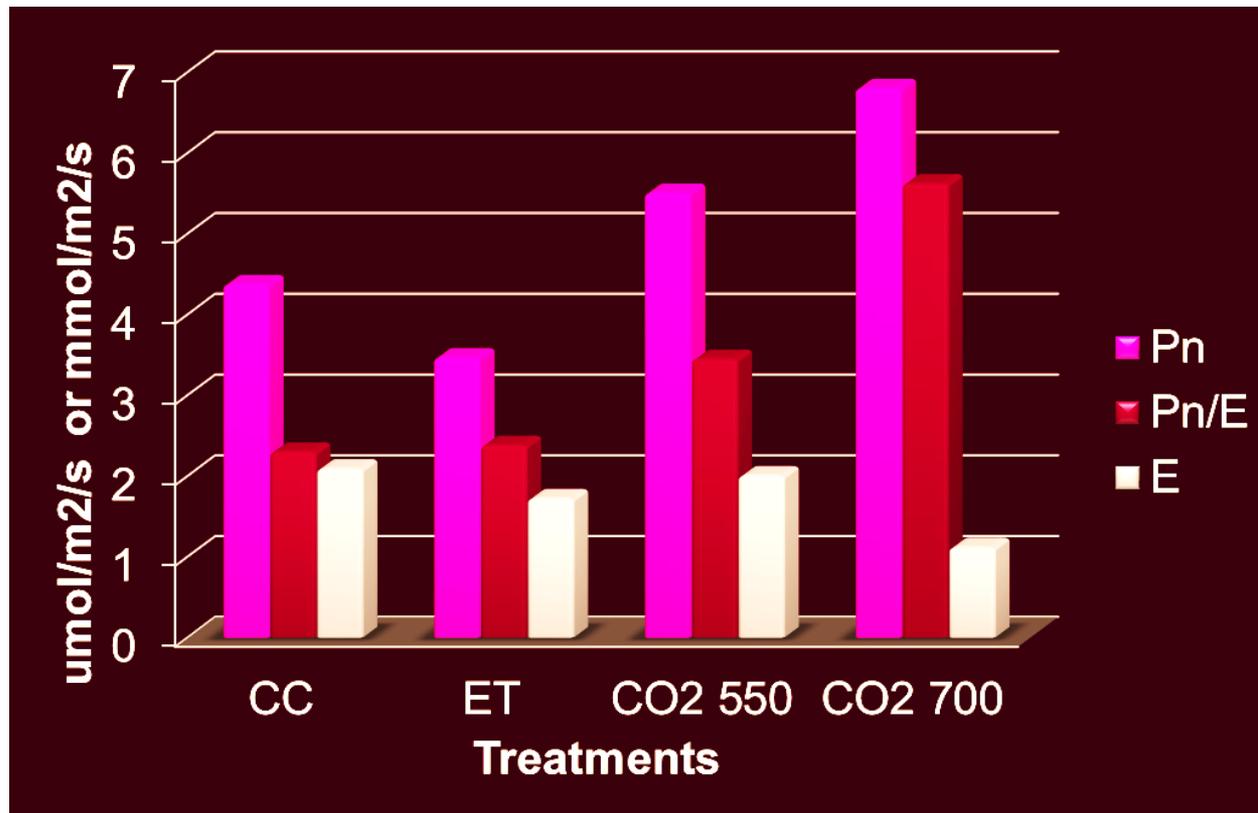


Studies on Climate Change in Cocoa

Open top chambers



Changes in net photosynthetic rate (P_N), instantaneous water use efficiency (P_N/E) and transpiration rate (E)

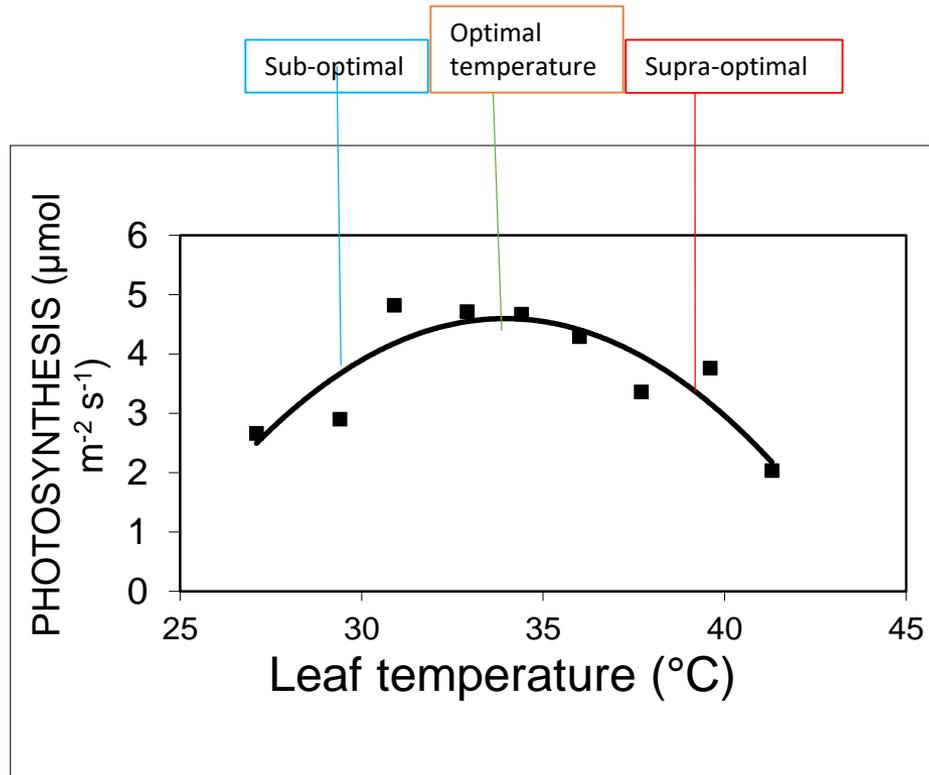


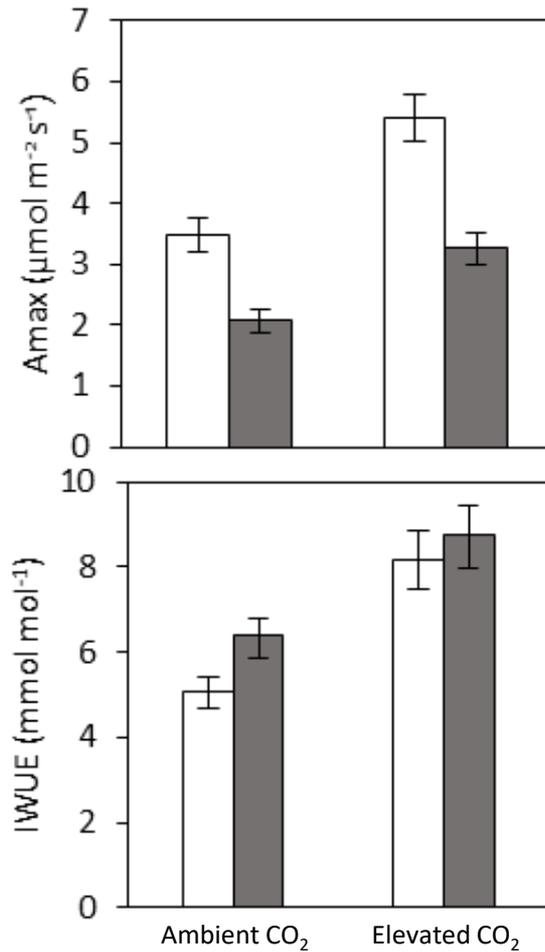
Studies on Climate Change in Cocoa

Greenhouse studies



Temperature response curve of cocoa seedlings



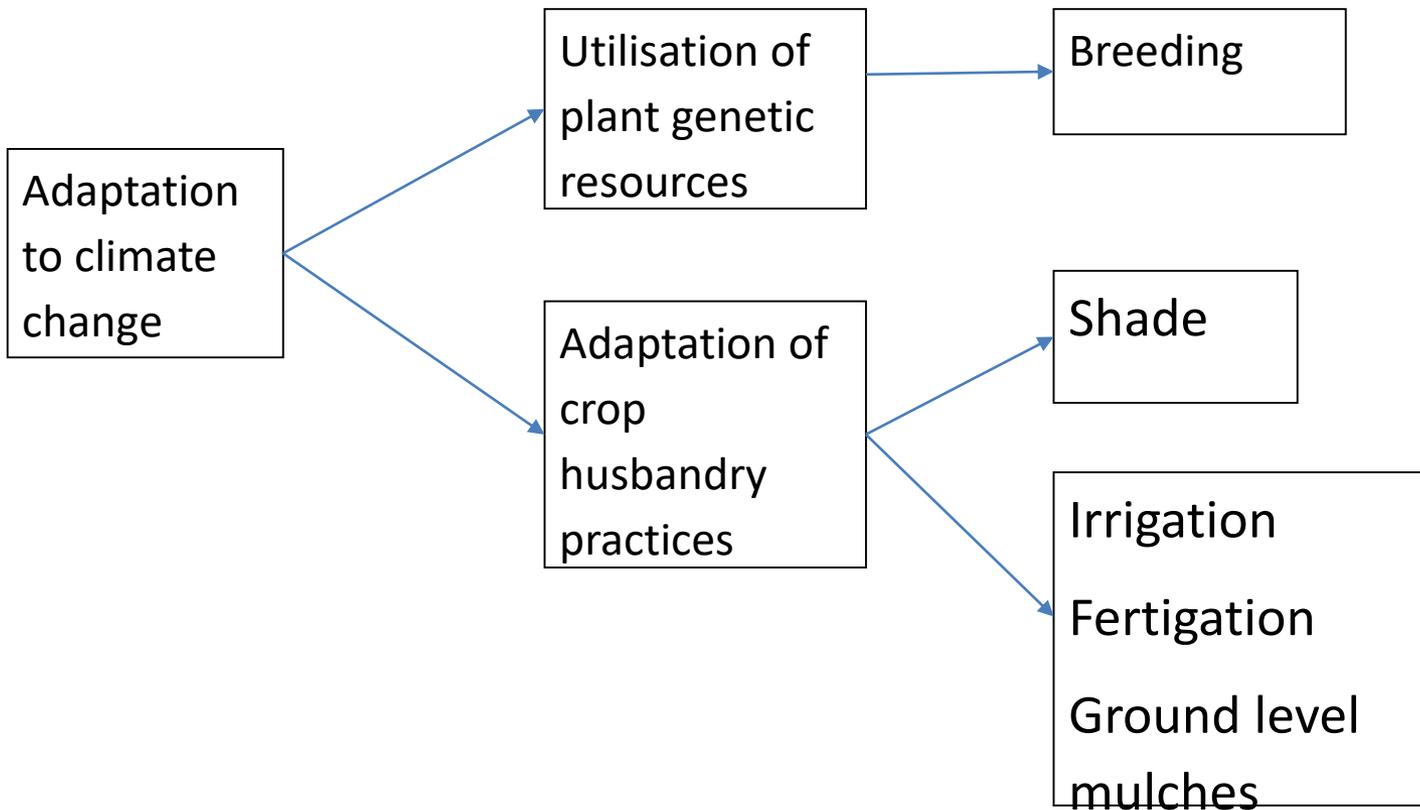


A.

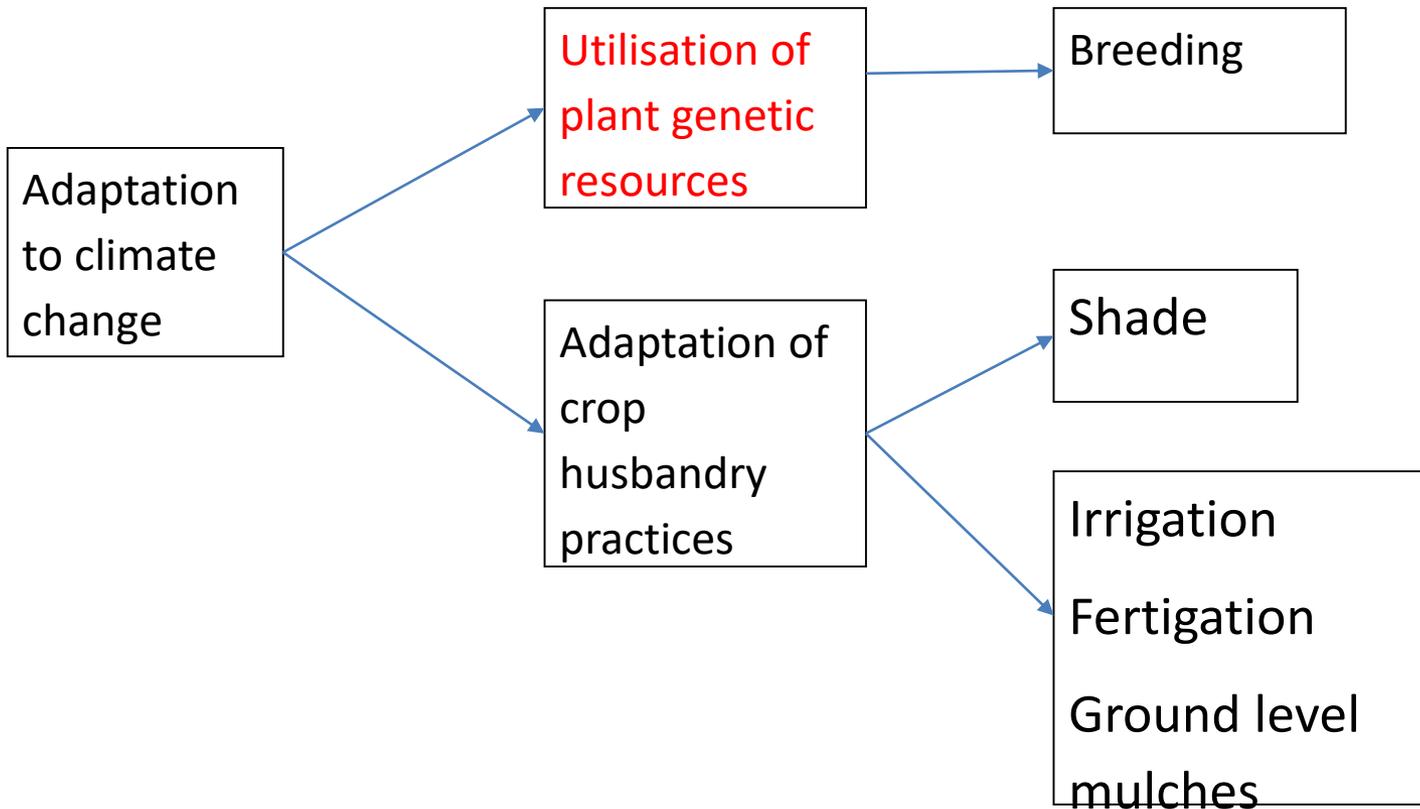
Effects of elevated CO₂
and water stress on:
A. light-saturated
photosynthesis
B. Intrinsic water use
efficiency

B.

Adaptation to climate change



Adaptation to climate change

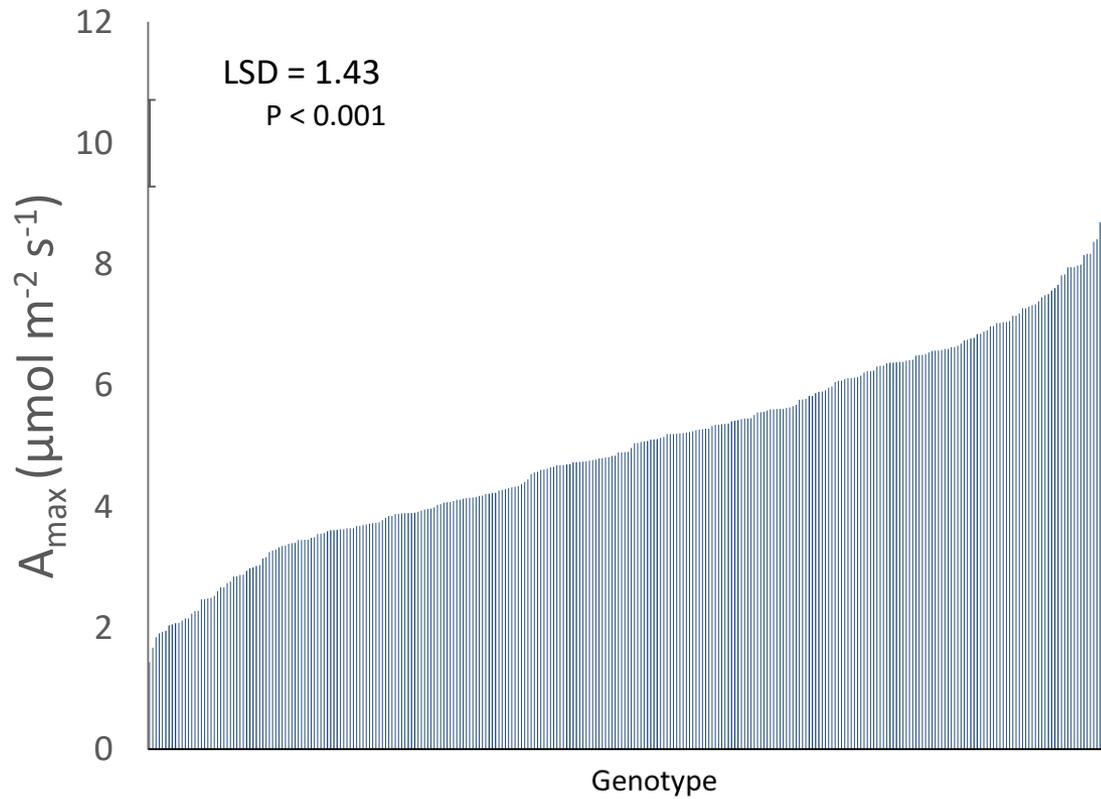


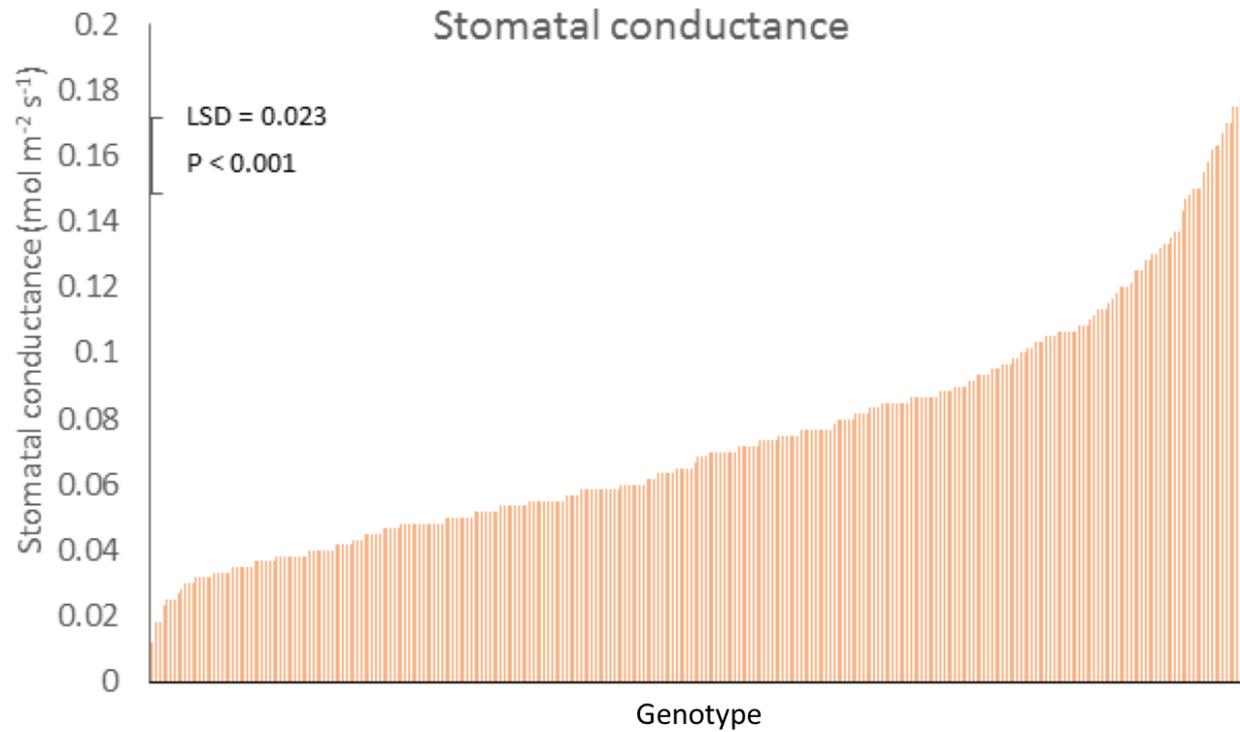
International Cocoa Quarantine Centre

- Currently holds around 400 accessions
- High level of genetic diversity represented with the collection

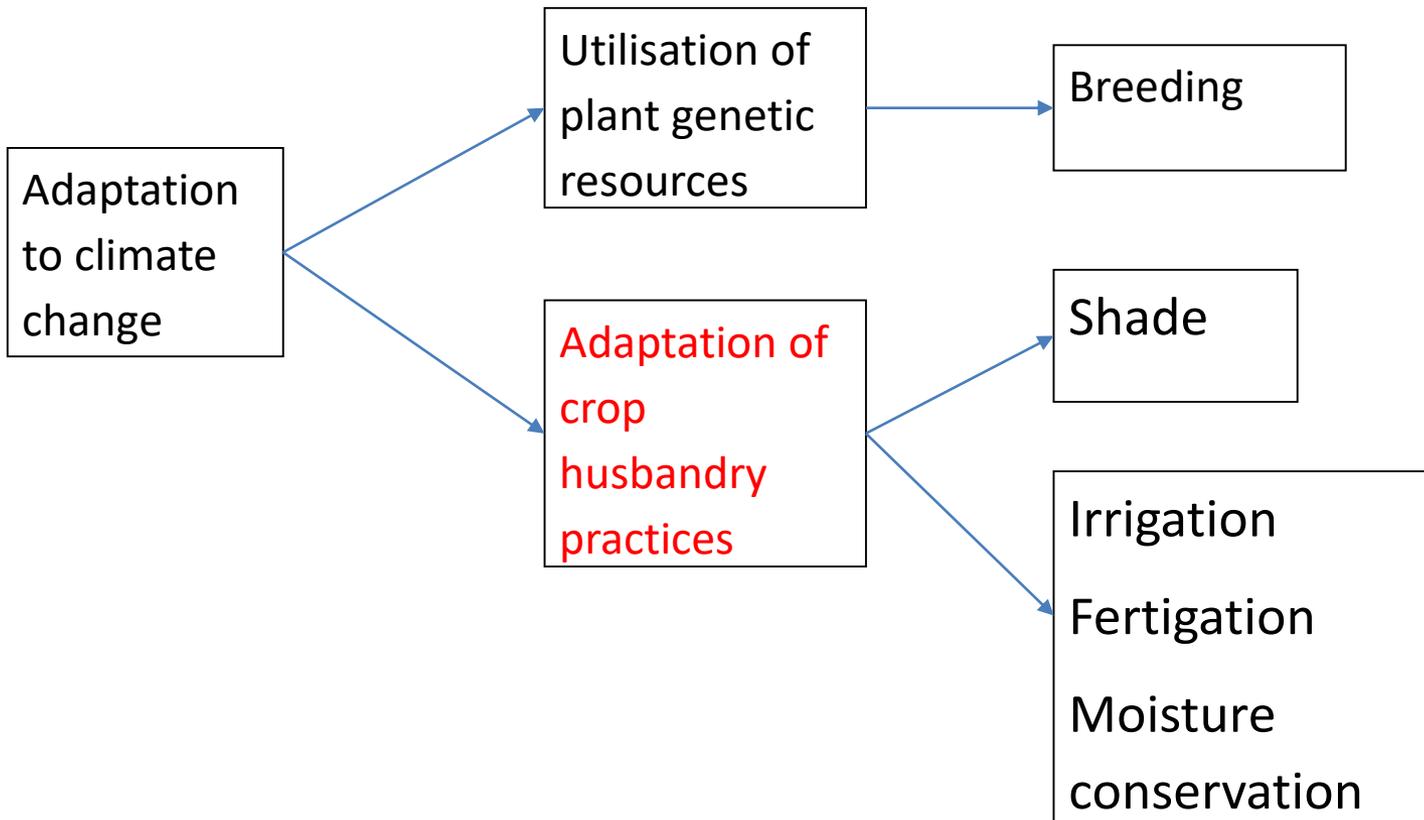


Light saturated photosynthetic rate





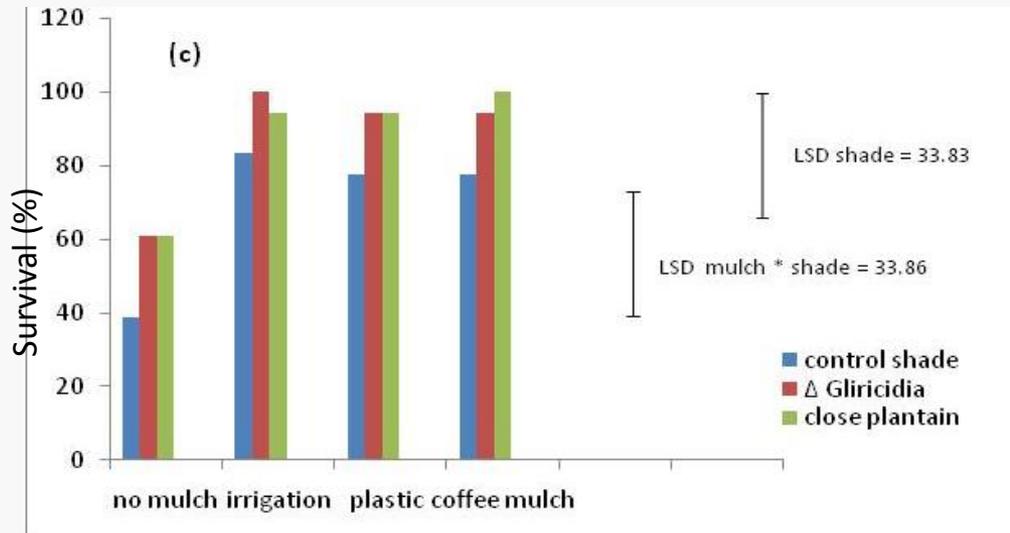
Adaptation to climate change



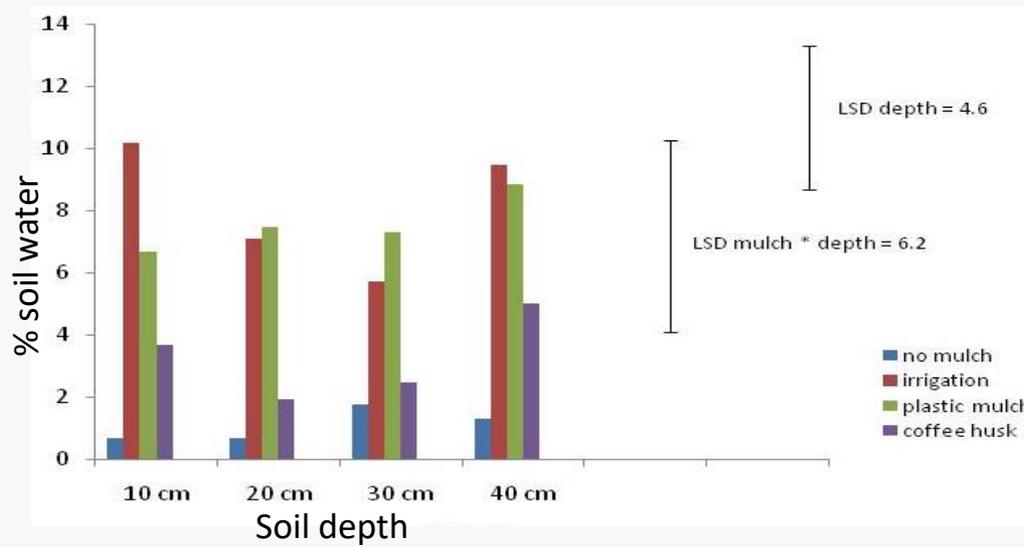
Simple establishment treatments to reduce moisture loss



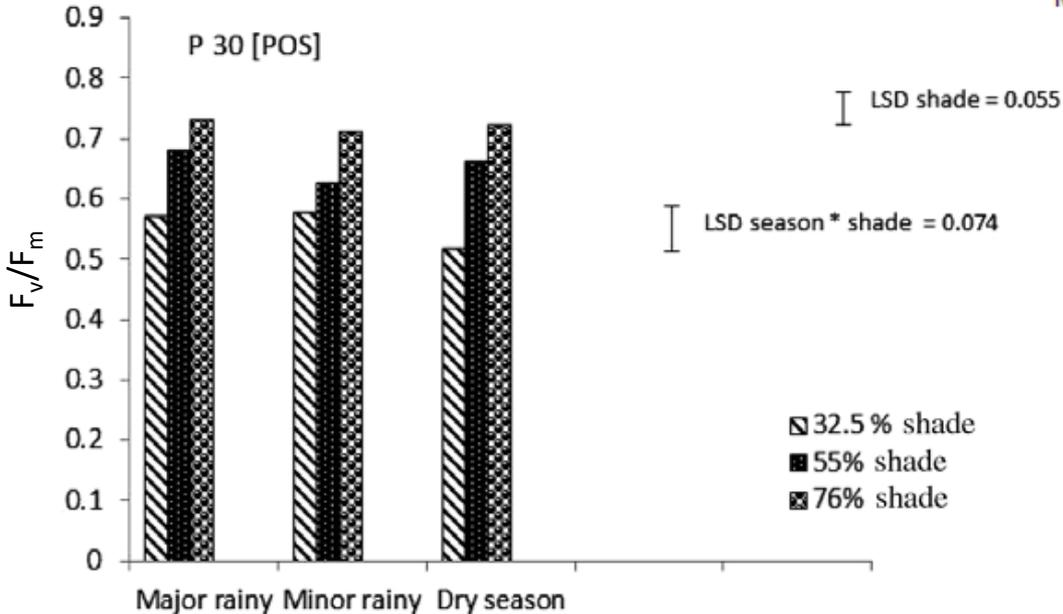
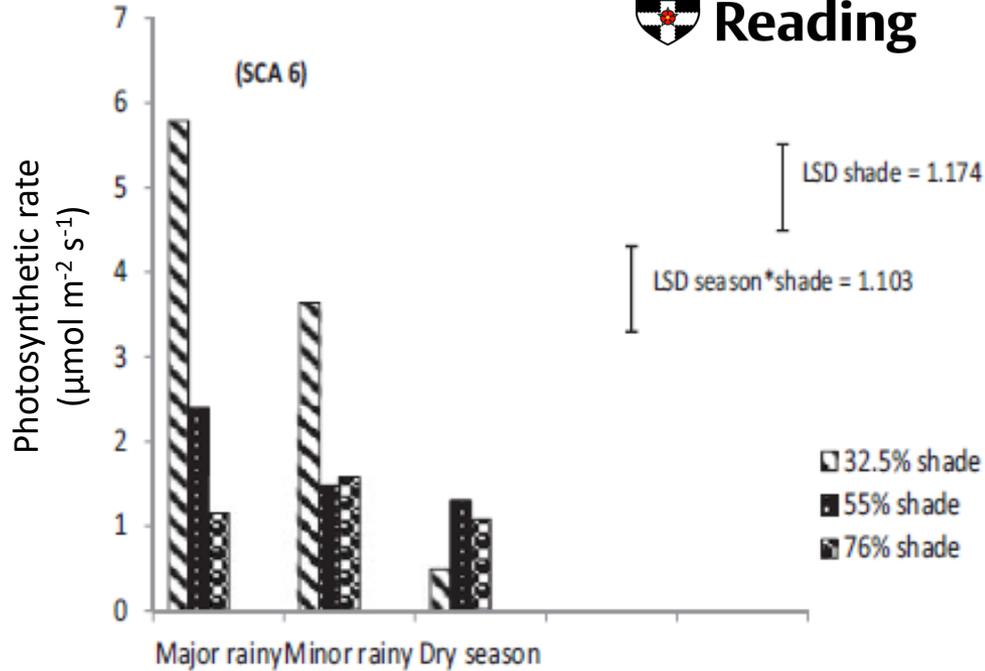
Field survival of young P 30 [POS] cocoa trees under different mulch and shade treatments.



Each bar represents % plants surviving out of 48 (= 100%).



Agronomic Practice - Shade



Acheapong et al. (2015) Exp. Agric 39: 31-42

Climate change: moving forward

- Large five-year project started in 2017, funded by Cocoa Research UK
- Modules on the following areas
 - Screening for water deficit tolerance
 - Screening for high temperature tolerance
 - Examining the interaction between temperature and CO₂
 - Development of a physiological model
- We are exploring ways of collaborating with institutes in the origins to conduct field-based research that will complement the greenhouse/ CE work at Reading
- **An International Doctoral Training Fund to support PhD projects on climate change in cocoa??**



Workshop held at Reading in June 2017





A review of research on the effects of drought and temperature stress and increased CO₂ on *Theobroma cacao* L., and the role of genetic diversity to address climate change

V. Medina and B. Laliberte



Thank you



University of
Reading