INTRODUCTION

1.) Atmospheric CO2 is rising.

This has consequences for plant physiology and growth – the “CO2 fertilisation effect”.

Physiological responses include:

* Stimulation of CO2 assimilation and photosynthetic rate

Growth responses:

* Depend on availability of water and nutrients, but:
* Biomass allocation (aboveground / belowground)
* Tissue densities and associated position along economic spectra (do these even hold under eCO2?)
  + This may be due to increased storage of carbohydrate reserves (see Piedade 2011)
* Fine root production and turnover

2.) Riparian plants experience frequent waterlogging and inundation. Waterlogging is distinct from complete inundation, affects only the root zone; riparian plants may experience cycles of waterlogging and drying for their entire life cycle.

Waterlogging induces a range of physiological and morphological responses in plants, resulting in different growth responses.

For many plants waterlogging can be highly stressful.

* Anoxia in the root zone and associated production of toxic ions by microbes are the most significant stressors
* Maintaining roots in anoxic conditions bears a high metabolic cost
* Root function is weakened; water and nutrient uptake is impaired
* Root mortality may occur
* Photosynthesis is reduced

Stress is ultimately determined by the degree to which plants are adapted to waterlogged soil conditions.

* Aerenchyma and adventitious roots are common morphological adaptations
* Various physiological strategies also exist (see Voesenek)

3.) Very little literature describes the interactive effects of elevated atmospheric CO2 and waterlogging or flooding on plant growth.

- Megonigal 2005 (baldcypress and aquatic plant)

- Arenque 2014 (Amazonian Senna sp.)

- Shimono 2015 (soybean)

- Sullivan 2010 (typha, wetland plant, but didn’t investigate interaction)

Interaction between CO2 and waterlogging / flooding appears to be variable.

Various hypotheses have been put forward with respect to the potential effect of eCO2 on waterlogged plants:

* Alleviation of anoxic drought via increased water use efficiency
* Increased reserves of non-structural carbohydrates with which to fund morphological adaptation

Recovery following stress events may be more important to fitness than tolerance of the stress, \*especially for the juvenile stage\*. No studies have looked at the influence of eCO2 on recovery following waterlogging.

4.) The objective of this study was to investigate interactive effects between eCO2 and waterlogging on gas exchange, growth, biomass allocation and positioning along economic spectra.

We asked:

* Are eCO2 effects on gas exchange altered by waterlogging, and is this response maintained following recovery from waterlogging?
* Is stimulation of biomass production by eCO2 diminished following recovery from waterlogging?
* Does CO2 mediate biomass allocation or functional traits in response to waterlogging, or following recovery from waterlogging?

We hypothesised:

* That eCO2 stimulation of photosynthesis would be maintained during waterlogging and following a refractory period
* The eCO2 effect on biomass production and allocation would be maintained following recovery from waterlogging
* eCO2 interaction with waterlogging would be evident for root traits but not aboveground traits

METHODS

Species

Seed source

Germination

Pots

Fertiliser

Glasshouses

* swapping
* watering
* light levels

Waterlogging setup

LICOR

Harvesting & trait measurement

Statistical analysis