Framework

Elevated atmospheric partial pressure of CO2 causes a fertilisation effect. Unless water and nutrients are lacking, this effect is typically associated with increased photosynthesis and biomass accumulation. Production and turnover of fine roots may be especially stimulated by eCO2 (especially in low nutrient conditions?).

Waterlogging of roots is an environmental stress commonly experienced by riparian plants. The effect of waterlogging is species specific and depends on a multitude of adaptations to waterlogging and flooding (webb et al 2012). Waterlogging may be associated with reduced photosynthesis (??), reduced nutrient uptake and reduced growth. “The physiological and growth responses of tree species to flooding and reduced soil Eh conditions vary depending on the species’ ability to adapt either morphologically or physiologically (Kozlowski 1984, 1997, Pezeshki 1994)” – Anderson et al. J. Plant Physiol. 158. 227–233 (2001).

Aerenchyma and adventitious roots may be induced in response to waterlogging, mitigating the effects of anoxia on the root system and allowing plants to continue photosynthesising and accumulating biomass.

eCO2 increases leaf tissue density, which may reflect changes in ecological strategy across the leaf economics spectrum. Root tissue density can be looked at analogously (Reich 2014). Since eCO2 affects fine root production and turnover, we were interested in whether waterlogging affects how biomass is invested in fine root tissue under eCO2. When plants increase root biomass, to what extent are they making more roots (acquisitive) or are they investing in the roots they already have (conservative)? Can use this to look at aerenchyma, right?

Only a few studies have investigated the interaction between waterlogging or flooding and elevated CO2, and none have looked at plants following recovery from waterlogging. We had no idea what would happen, really, but were interested in how waterlogging might alter the eCO2 effect.

Hypotheses:

1. eCO2 stimulation of photosynthesis and growth will be suppressed by waterlogging
2. eCO2 stimulation effect on photosynth / growth will return following a recovery period
3. eCO2 will increase root tissue density per unit root biomass in control treatment, but not for waterlogged treatments.