

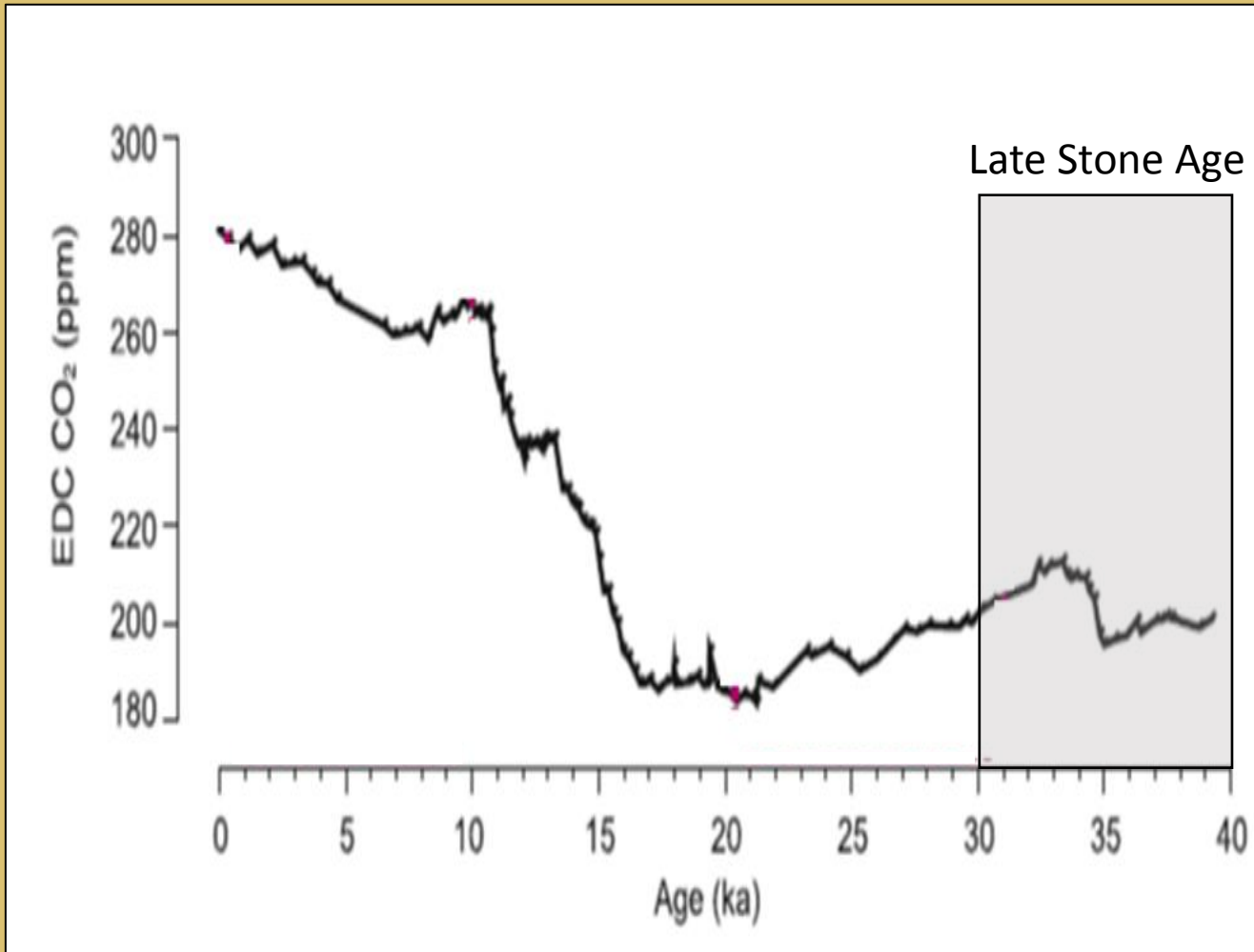
How might CO₂ levels change the resource-scape picture? An assessment of geophyte growth at sub-atmospheric CO₂ concentrations

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Introduction

- Recent attempts to reconstruct living conditions during the Late Stone Age (LSA) have been successful in showing that geophytes were an essential food source for hunter gatherers.
- Various plant parts were harvested:
 - Underground storage organs
 - Flowers
 - Leaves

Introduction



Khon, et al., 2014. *Earth and Planetary Science Letters*.

- Simulations have not taken into account the role of environmental conditions prominent during the LSA:
 - CO₂ concentrations
- Predictions for food availability are highly affected by CO₂ concentrations:
 - How much and how often bulbs can be harvested.
- Current [CO₂] – 400 ppm

[CO₂]

Bulb size

Growth rate

Nutrient content

Sustainability of harvesting

Research aims

- To evaluate the effect of sub-atmospheric CO₂ on the sustainable harvesting of geophytes.
- *Oxalis pes-caprae* L. will be used as a model species.

Oxalis pes-caprae

Table 3

Top ranked edible plant species for different uses (see Appendix A for ranking of all species).

Species by use	Rank	SPI
<i>Vegetable</i>		
1. <i>Oxalis pes-caprae</i>	1	1.00



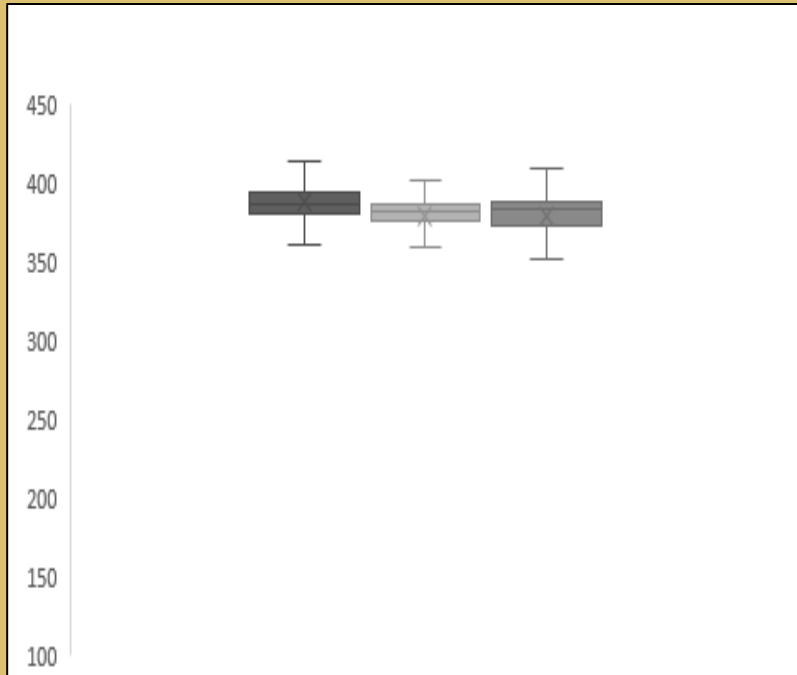
Research aims

- To evaluate the effect of sub-atmospheric CO₂ on the sustainable harvesting of geophytes.
- *Oxalis pes-caprae* L. will be used as a model species.
- Questions to be considered:
 1. How is growth affected by CO₂ concentrations?
 2. How does nutrient content change with changing CO₂ concentrations?
 3. Is flowering favoured over vegetative reproduction under low CO₂ concentrations?

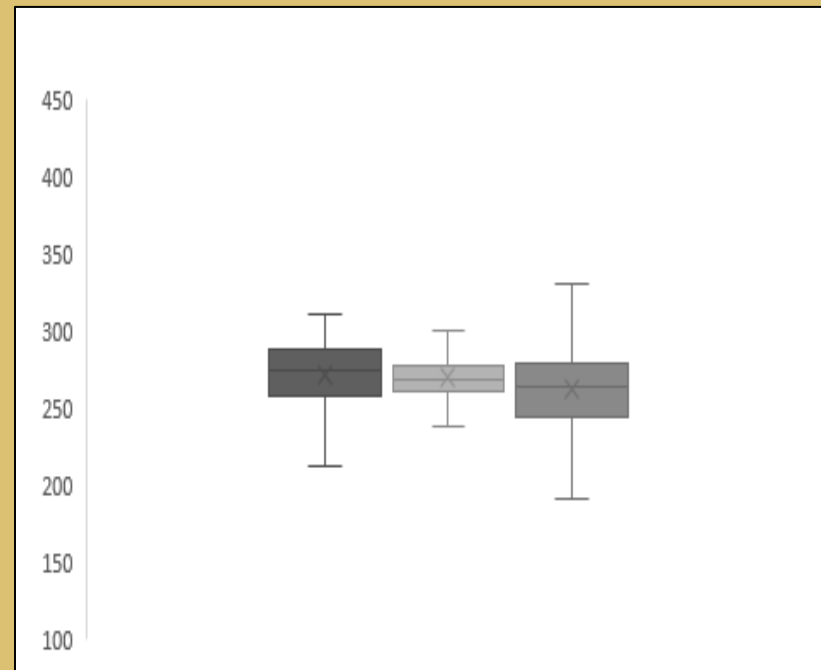
How is growth affected by CO₂ concentrations?

Growth at sub-ambient CO₂

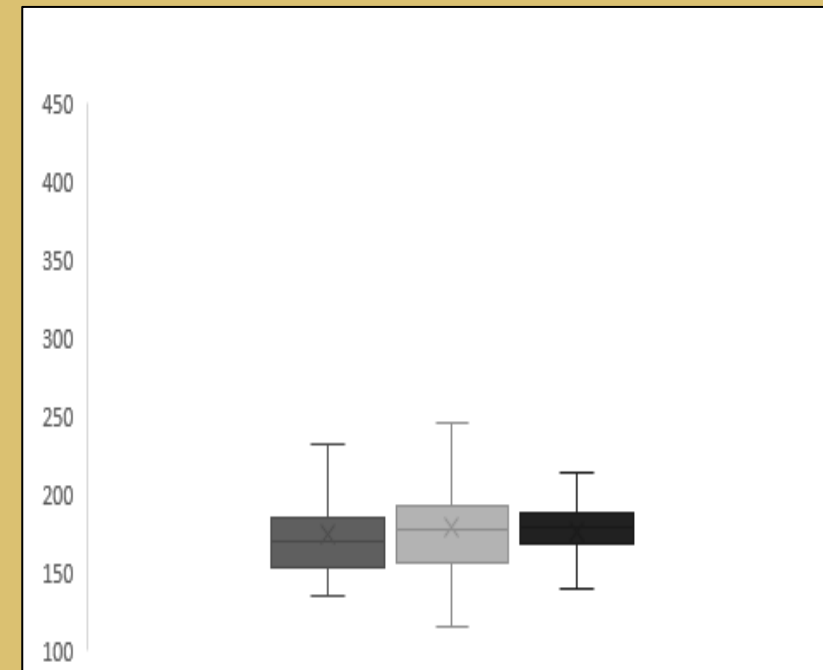
400 ppm



280 ppm



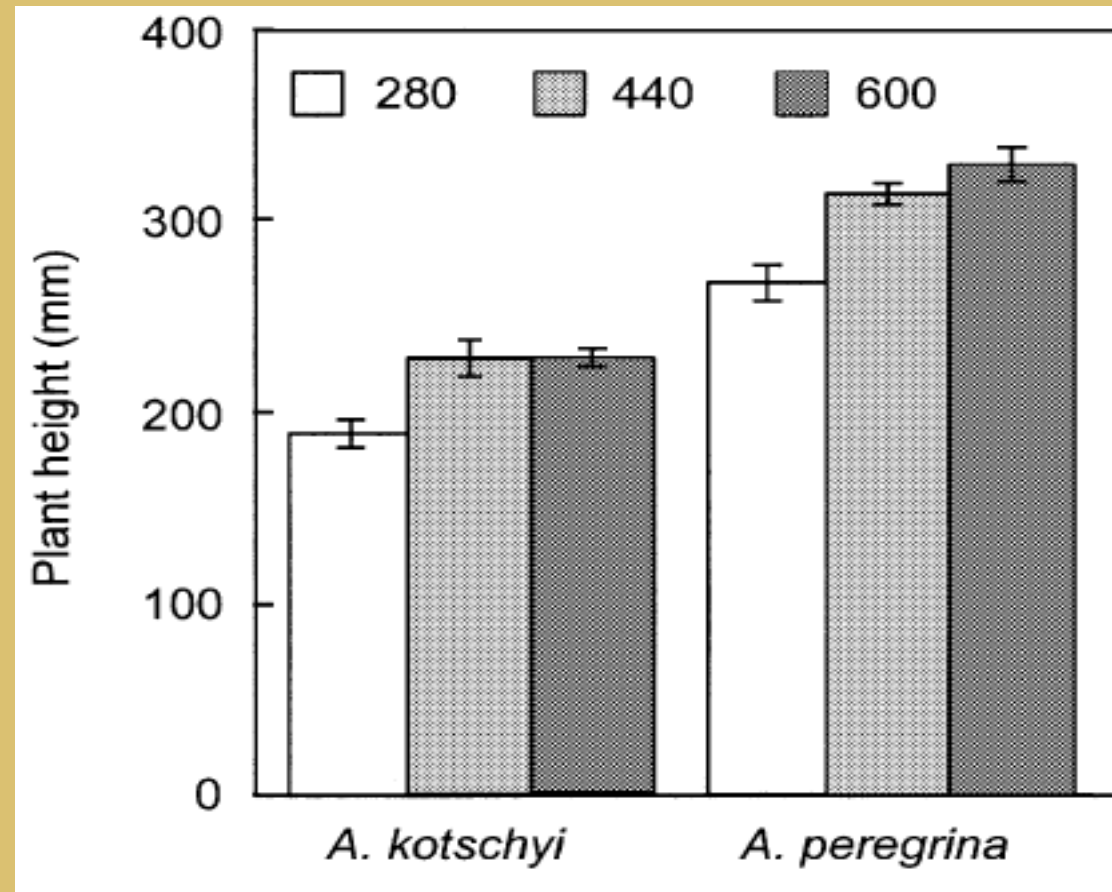
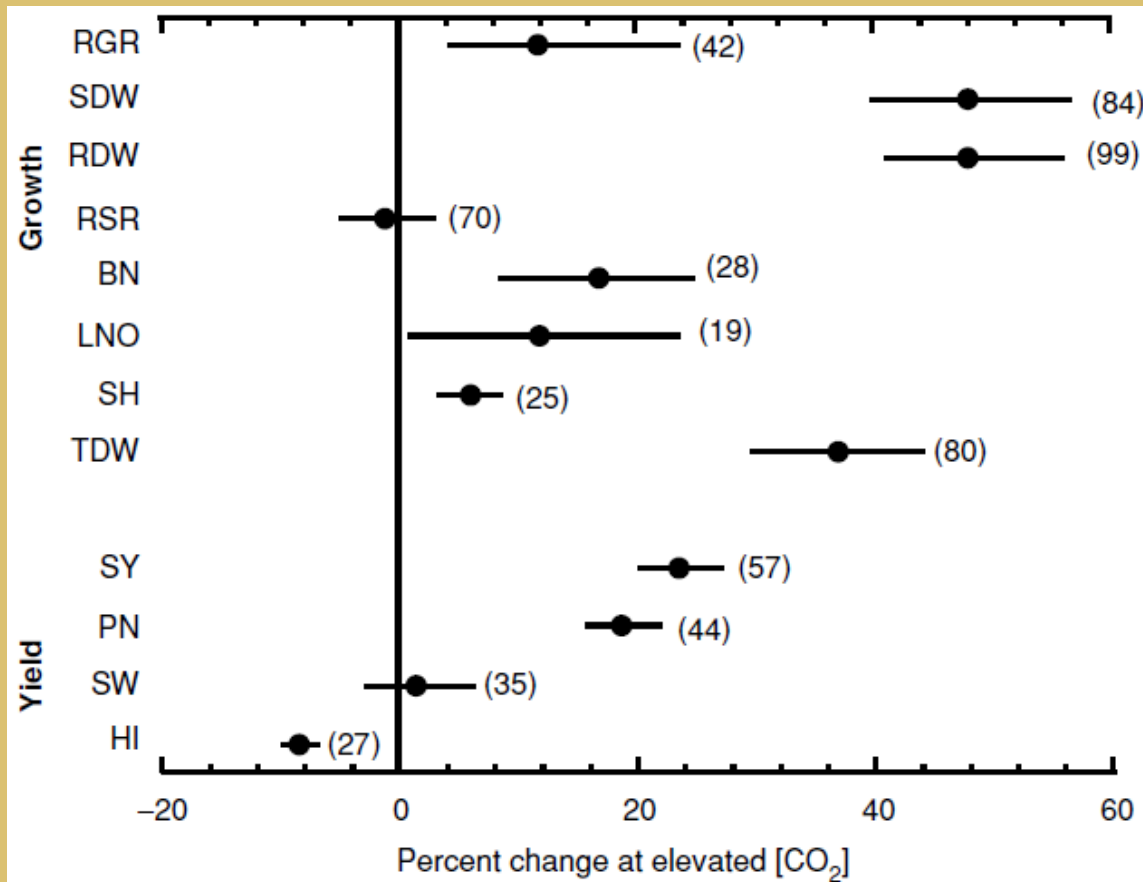
180 ppm



- Estimate growth rate
 - Photosynthetic rate
 - Yield at the end of the growing season



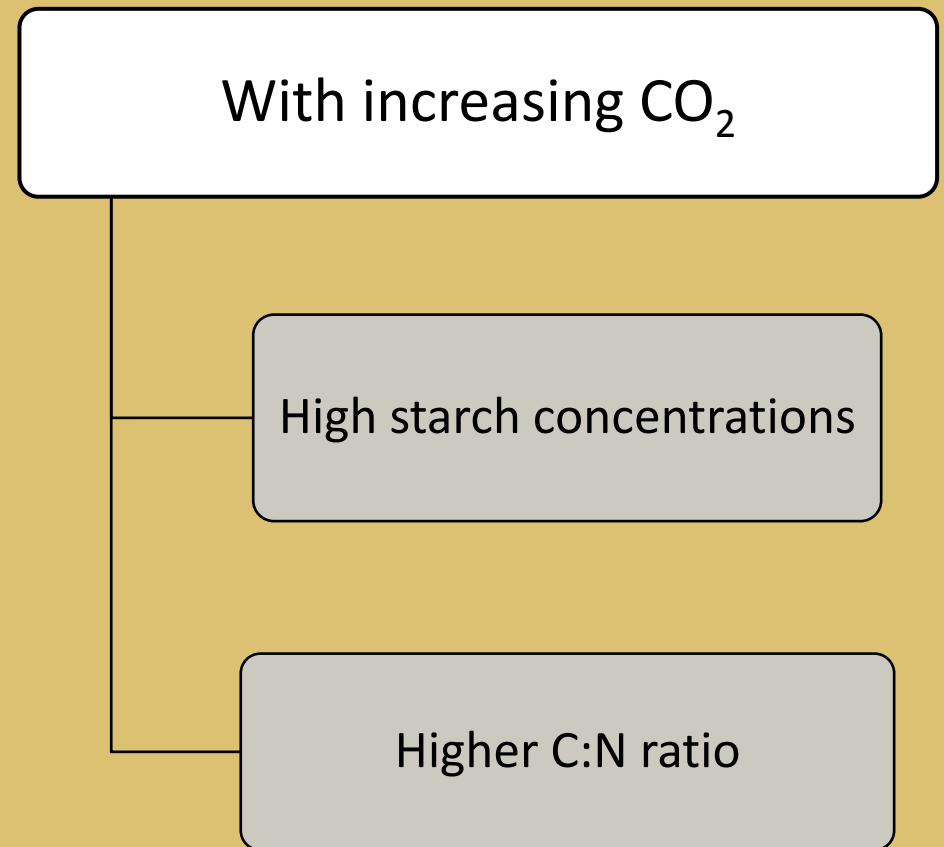
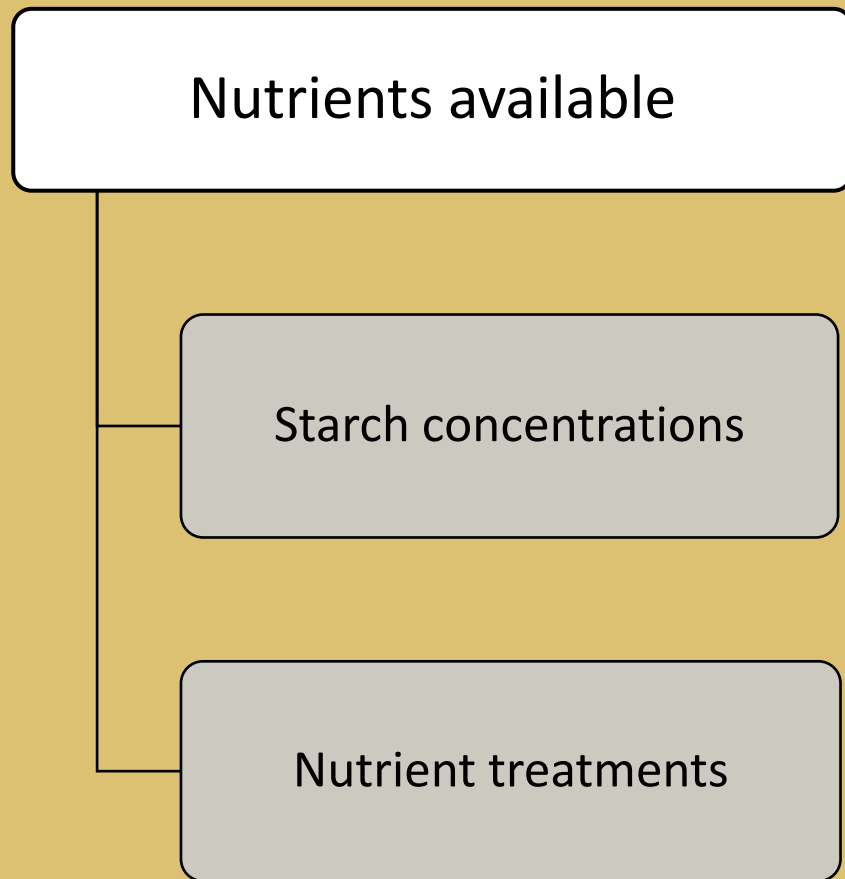
Expected results



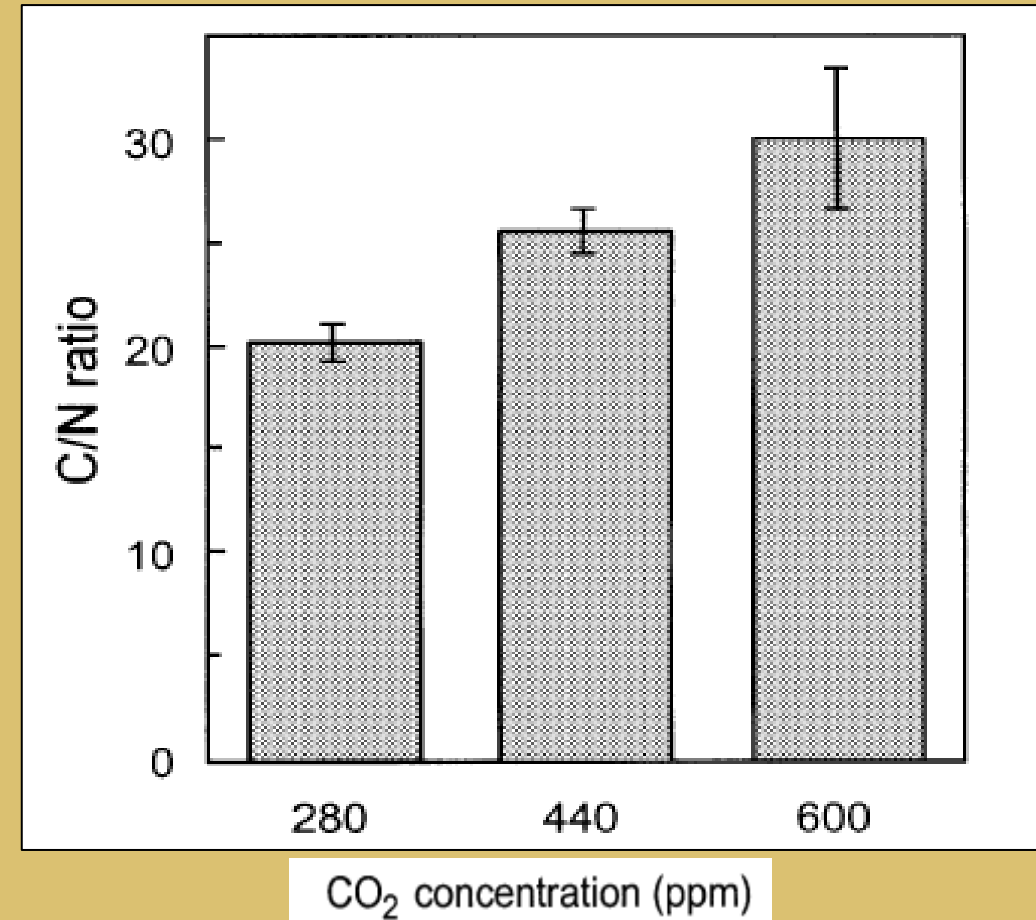
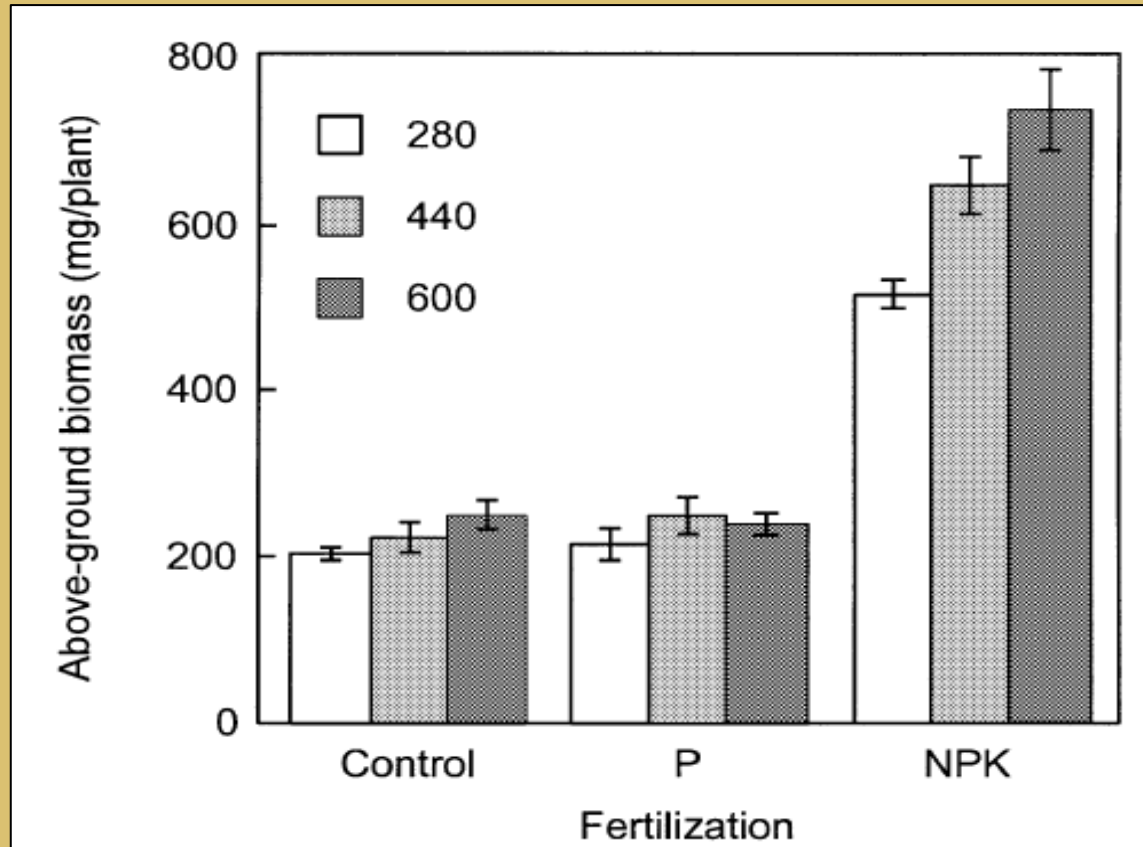
Ainsworth, E. et al., 2002. *Glob. Chang. Biol.* 695–709.

Grunzweig, J.M., & Korner, C., 2000. *Glob. Chang. Biol.* 6, 631–638.

How does nutrient content change with changing CO₂ concentrations?



Expected results



Is flowering favoured over vegetative reproduction under low CO₂ concentrations?

Bulbs and flowers

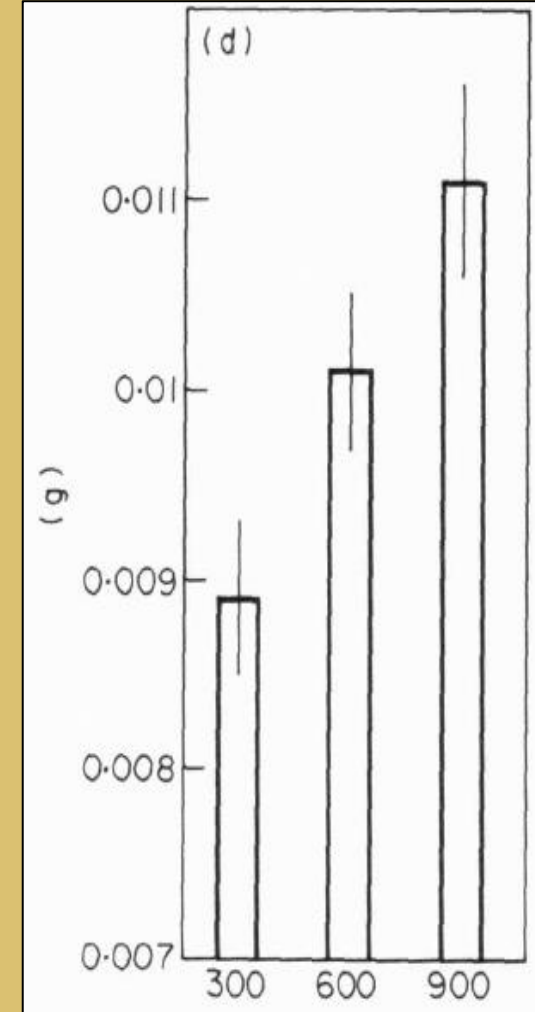
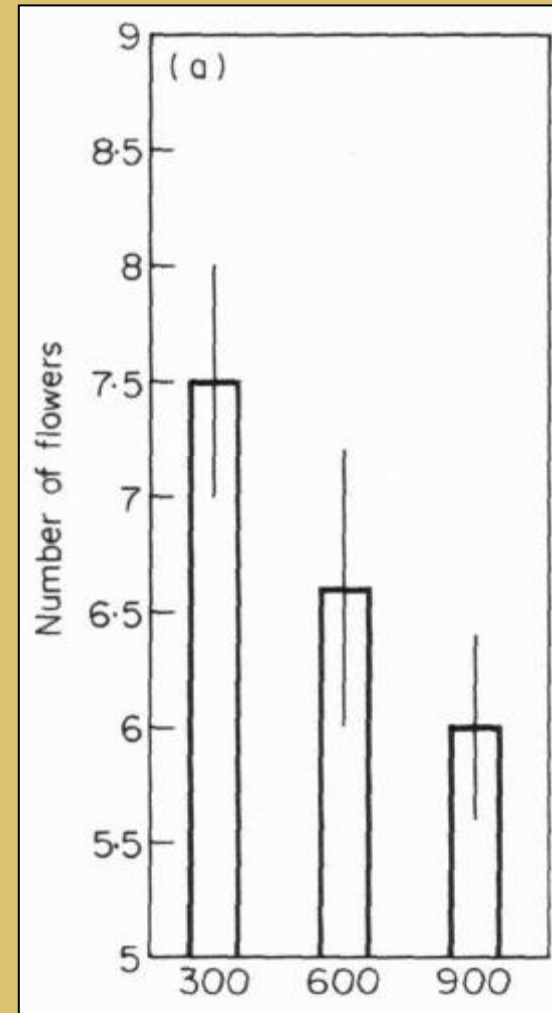
Number of flowers

Quantity of bulbs

If flowering increases

Vegetative reproduction decreases

Expected decrease in bulb size



Implications

Decreased growth
under low CO₂

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graph LR; A[Decreased growth under low CO2] --> B["• Not enough food available in one growth season<br/>• Fewer events of harvesting under low CO2<br/>• Alternative food sources would have been required"]; C[Increased flowering] --> D["• Reallocation of resources from vegetative reproduction to flowering<br/>• Smaller bulbs produced will not be sufficient for food"];
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- Not enough food available in one growth season
- Fewer events of harvesting under low CO₂
- Alternative food sources would have been required

Increased flowering

- Reallocation of resources from vegetative reproduction to flowering
- Smaller bulbs produced will not be sufficient for food