

Anti-herbivore silicon defences in a model grass are greatest under Miocene levels of atmospheric CO₂



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Background

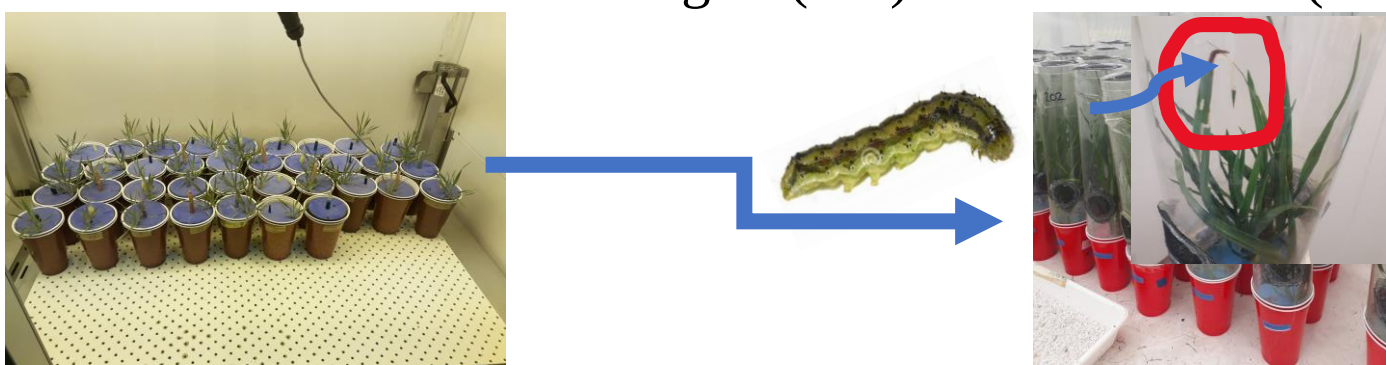
- ❖ Plants and insects have engaged in an evolutionary arms race. In this competition, insect herbivores can be able to remove 5-20% of grain crops around every year.
- ❖ Paradoxically, plants evolve defence mechanisms to minimize consumption by insects. Silicon (Si) is one off the many defences used by the plants to counter-attack insect herbivore.
- ❖ Si is a beneficial soil element for plants. It is taken up by roots, translocated and deposited in plant tissues as phytoliths. Si deposition in the leaf surface may protect plants against a myriad of abiotic and biotic stresses.
- ❖ Si may be deposited in discrete physical structures at the leaf surface including macrohairs, prickle cells and silica cells, which potentially create tougher and abrasive leaves that reduce herbivore feeding.
- ❖ Studies involving the effect of CO₂ concentration on Si accumulation showed that Ambient and elevated reduces Si accumulation, which causes reduced Si-based grass defences. Contrasting, pre-industrial atmospheric CO₂ was linked to increased grass Si accumulation. However, it is unknown whether higher levels of Si accumulation under pre-industrial CO₂ can impact insect herbivore performance.

Objective: To determine how three CO₂ concentrations (200, 410 and 640 ppm) and Si supplementation (Si+ or Si-) affect Si accumulation in a model grass *Brachypodium distachyon*, and the subsequent impacts on feeding and performance of chewing insect herbivore, *Helicoverpa armigera*.

Materials and Methods

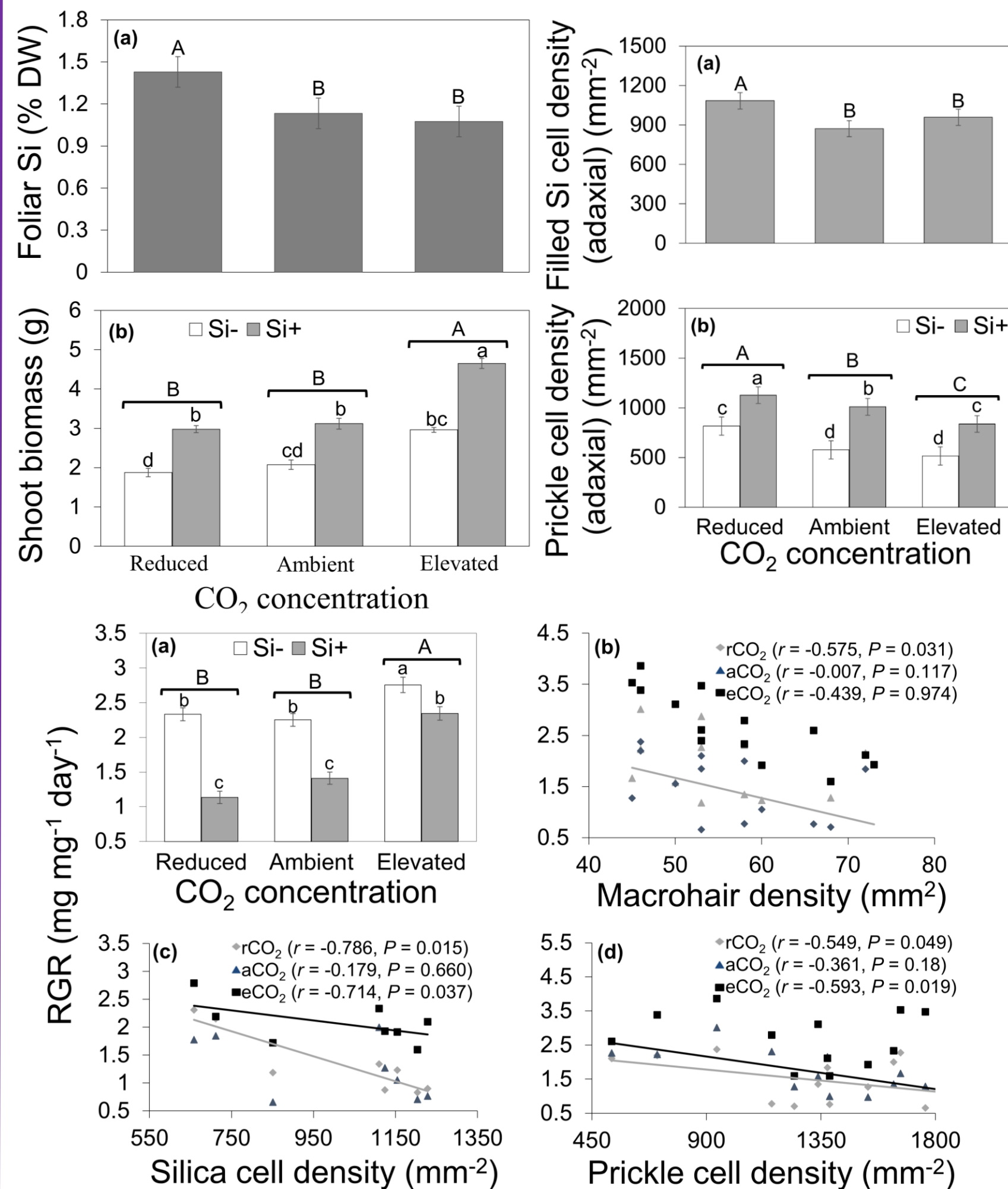
Experimental plants and growth conditions:

Brachypodium distachyon was grown in three growth chambers maintained at CO₂ concentration of 200, 410 and 640 ppm. And plants were grown with or without Si (Si- or Si+). *Helicoverpa armigera* larvae were fed leaves either containing Si (Si+) or devoid of Si (Si-).

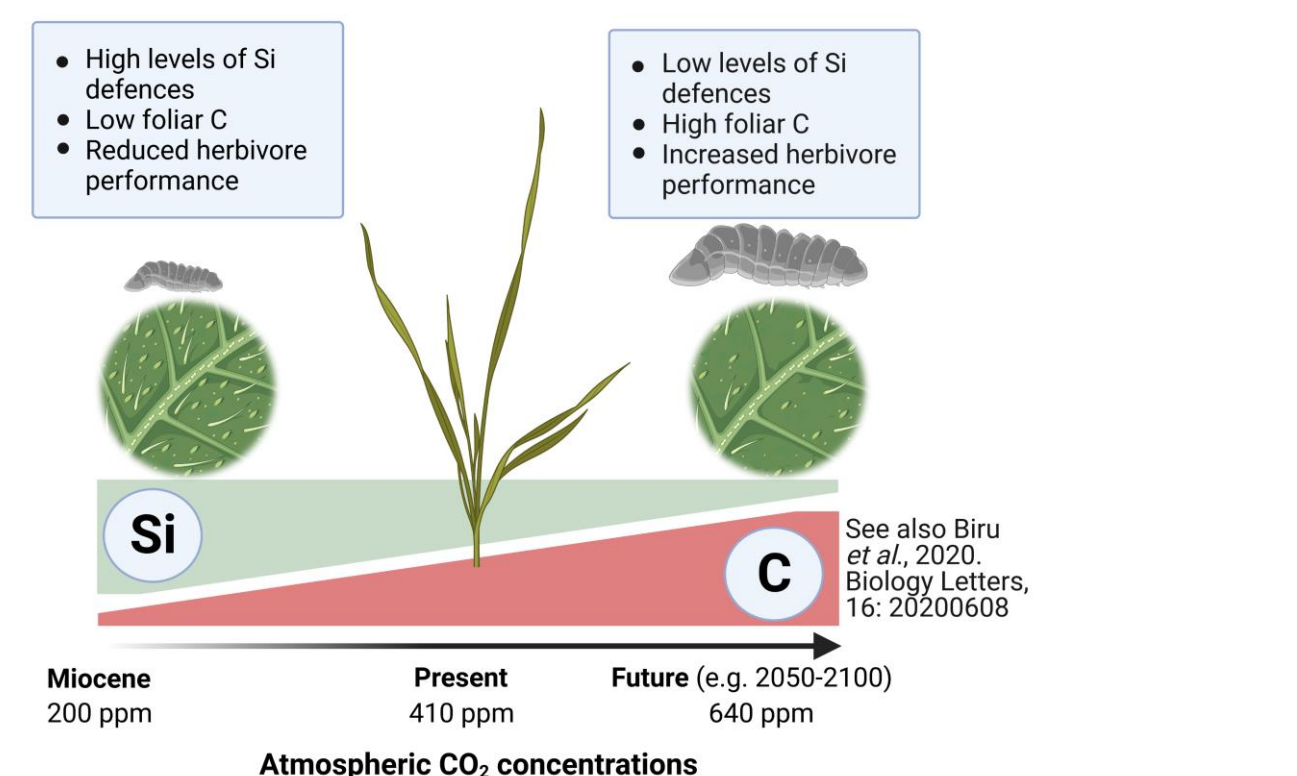


Parameters collected: Plant biomass, Leaf surface morphology (Macrohairs, silica cell and prickler cells densities), herbivore RGR and plant Si concentration.

Results



Summary



Selected citations

1. Biru, F. N., Cazzonelli, C. I., Elbaum, R., & Johnson, S. N. (2020). Contrasting effects of Miocene and Anthropocene levels of atmospheric CO₂ on silicon accumulation in a model grass. *Biology Letters*, 16, 20200608. <https://doi.org/10.1098/rsbl.2020.0608>
2. Johnson, S. N., & Hartley, S. E. (2018). Elevated carbon dioxide and warming impact silicon and phenolic- based defences differently in native and exotic grasses. *Global Change Biology*, 24, 3886– 3896. <https://doi.org/10.1111/gcb.1397>

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