

Abstract in Peer-Reviewed Conference/Symposium Proceedings

Caldera, H.I.U., De Costa, W.A.J.M., Woodward, F.I., Lake, J.A., Ranwala, S.M.W.(2012). Stomatal response of *Camellia sinensis* (L.) O. Kuntze to elevated carbon dioxide. Proceedings of the 29th New Phytologist Symposium – Stomata 2012, 2-4 July, 2012, Manchester, United Kingdom. pp. 38.

Caldera, H.I.U. (November 2012). Plant responses to environmental change with special emphasis on anatomical and physiological adaptations of stomata across an altitudinal gradient. PhD dissertation, University of Colombo

Section 2

Executive summary of the project

The sessile nature of plants requires them to continually adapt to variations in their environment and stomata play a pivotal role in supporting this function. The present work focused on the response of stomata to environmental gradients. The objectives included identifying and determining a cultivar based variation in *Camellia sinensis* across an altitudinal range; determining the impact of soil water stress on *C. sinensis*; determining the stomatal, anatomical and physiological responses of *C. sinensis* and *Arabidopsis thaliana* ecotypes to elevated atmospheric [CO₂] and elevated temperature under controlled environmental conditions. The *C. sinensis* cultivars in the field study showed a cultivar based response to altitude in their stomatal numbers and dimensions, though stomatal size was a more conserved trait. While leaf thickness increased with altitude, cultivars sampled at the lowest altitude showed the highest palisade:spongy parenchyma ratio (PSR) while estate cultivars showed the lowest PSR at each altitude. Stomatal characters showed a significant relationship with leaf anatomical characters. In the water stress experiment a significant cultivar x treatment effect was seen for weight and relative water content. The popular TRI 2025 cultivar showed a related drought response irrespective of altitudinal origin. The two estate cultivars used in the study (CY9 and DT-1) also showed a similar drought response.

Many *A. thaliana* ecotypes increased their stomatal density in response to elevated CO₂, but stomatal size was not as plastic in response to both elevated CO₂ and temperature. The stomatal dimensions of *C. sinensis* were responsive to CO₂ but stomatal numbers did not vary with

increasing [CO₂]. However, stomatal conductance decreased by 25%, suggesting an aperture level control. Elevated CO₂ increased the net photosynthetic rate and leaf thickness in *C. sinensis*.

Section 3 -Report in detail

1. Introduction/background

The atmospheric carbon dioxide concentration ([CO₂]) is predicted to double from 379ppm within the next 100 years. An average warming of about 0.2⁰C per decade is projected in terms of global mean surface temperature. Other climatic changes such as droughts and extreme precipitation events due to changes in atmospheric water vapour levels are also envisaged. [CO₂] and ambient temperatures are key abiotic requirements necessary for plant growth. Plants would respond to these environmental changes by possibly species specific anatomical and physiological alterations which may include reduction in number of stomata, reduction in stomatal conductance, increased leaf thickness and alternations in sink status.

Stomata are small pores present on the aerial parts of plants, predominantly on the abaxial surface (under surface) of leaves. They play a key role in regulating carbon dioxide and water vapour exchanges between plants and their surrounding environment. As such, stomatal physiology influences both the carbon and water balances of vegetation, influencing plant growth and water use. Therefore, elucidation of the short- and long-term modifications/adaptations of stomatal anatomy and physiology in response to increasing atmospheric carbon dioxide is imperative for understanding the response of plants to climate change.

The present study focuses on investigating the fundamental aspects of the response of stomatal physiology to increasing atmospheric [CO₂] and its interaction with other key environmental factors such as soil water deficit and atmospheric vapour pressure deficit. The investigations used two plant species, namely, *Arabidopsis thaliana* (a model plant species with a fully-sequenced genome, with which in-depth investigations on the fundamental aspects can be carried out) and Tea, *Camellia sinensis*, (an economically-important agricultural crop grown across the whole range of altitudes in Sri Lanka).