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Modelling Agrivoltaics Impact on Fruit Growth

Photosynthesis Calibration and Integrated Physiological Responses

Background & Motivation

Introduction

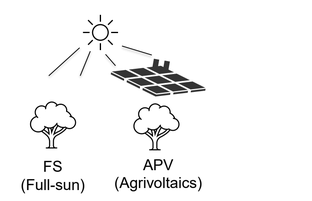
- In a fruit tree, leaves act as source for producing carbohydrates via photosynthesis, while fruits act as the main sinks.
- Understanding the shading impact of agrivoltaics will better facilitate the estimation of fruit yield under source-limiting scenarios.

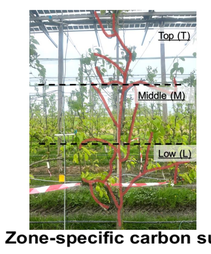
Methods

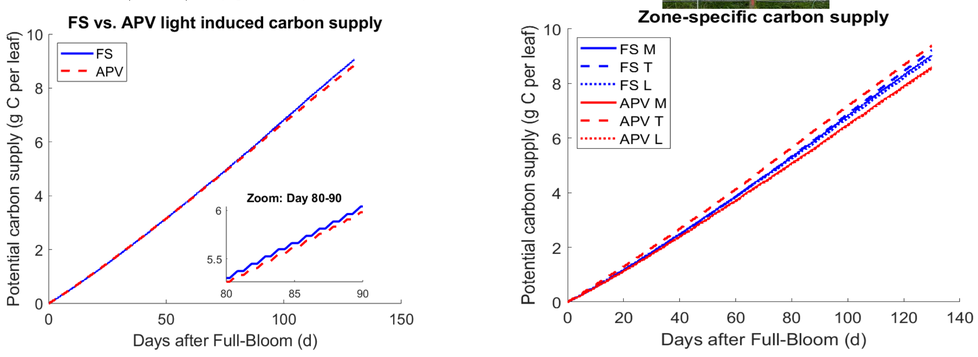
- Measurements were taken in May 2024 with gas exchange analyser LCpro T.
- Parameters were calibrated for the Farquhar, von Caemmerer & Berry model (FvCB).

Results

Instant impact (*Light*)

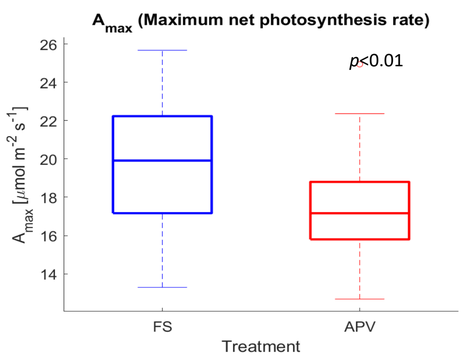


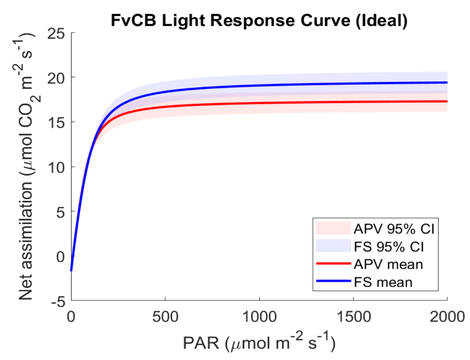




- Agrivoltaics induces **heterogeneous** light environment rather than reducing overall light intensity.

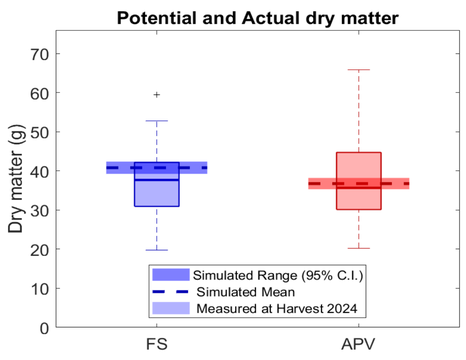
Long-term impact (*Adaptation*)



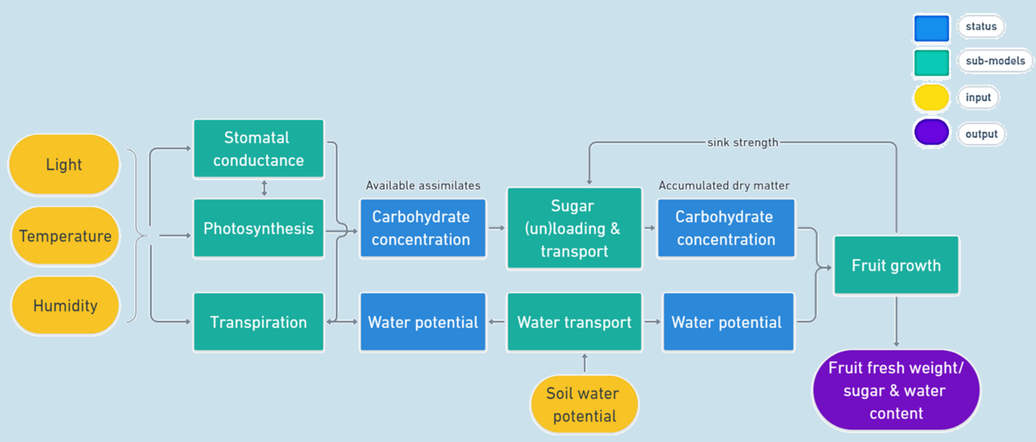


- FvCB model simulated net assimilation rate in response to light intensities.
- *Amax*, as one of the fitted parameters of FvCB model, indicates the existence of leaf adaptation to shading in APV.

Potential carbon gain vs. measured



- The measured fruit dry weight has **larger variation** than simulated potential carbon gain.
- Such variation may relate to *water balance* and *sink-source ratio* of the entire fruit tree.



- The complete model involves **water transport** together with **sugar transport** to provide an integrated view of fruit growth on a tree throughout one year.

Conclusion

- The estimation of potential carbohydrate production in this research emphasizes the importance of both climate (instant) and adaptation (long-term) effect to fruit growth in terms of carbon supply.
- Further modelling work will focus on the transport of water and carbohydrates throughout the branches and to the individual organs.

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