Canopy architecture and RUE in sugar beet

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Introduction

There is a linear relationship between intercepted radiation, biomass accumulation and, ultimately, yield of sugar beet (Fig.1). The slope of this line is the radiation use efficiency (RUE).

This project is testing the hypothesis that varieties with more upright canopies have greater RUE.

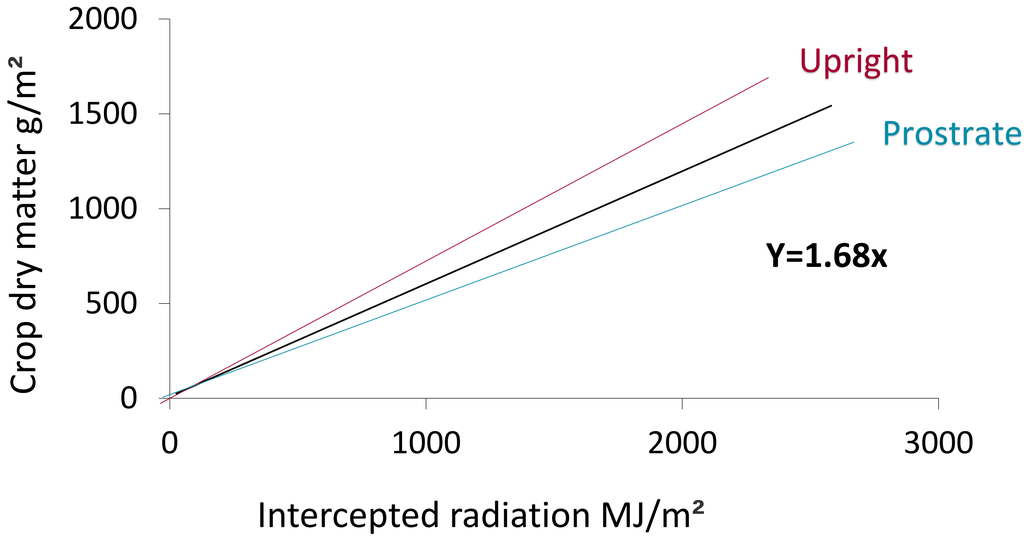

Fig 1. Relationship between intercepted radiation and dry matter accumulation in sugar beet. Black line shows a typical variety with RUE of 1.68g/MJ. Coloured lines indicate our hypothesis for the impact of canopy architecture on RUE: upright variety (pink) prostrate variety (blue). (Adapted from Draycott, 2007).

Canopy architecture

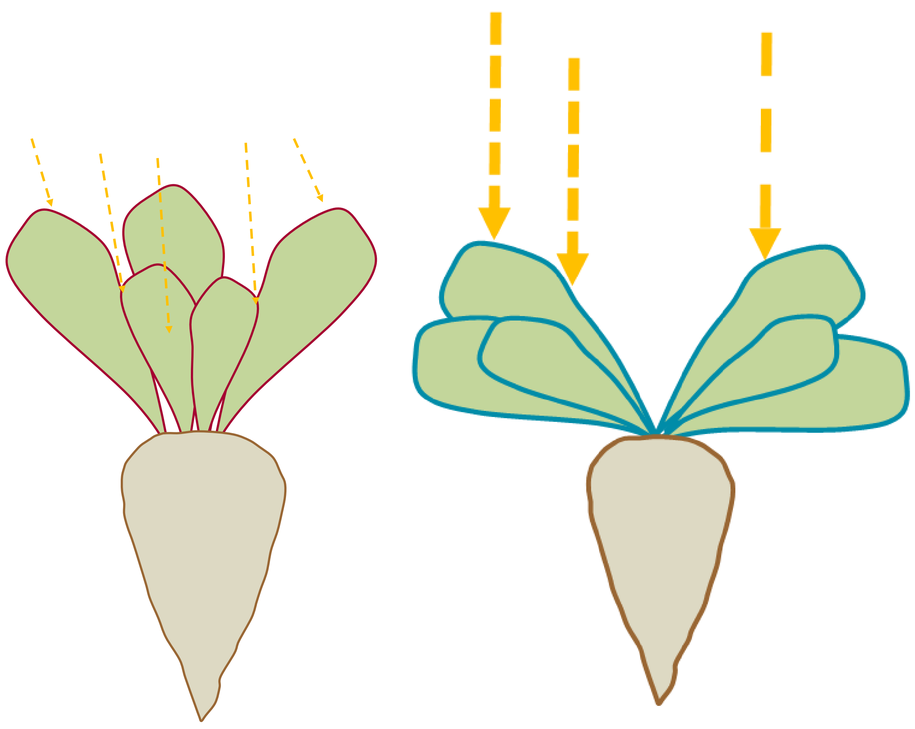

Fig 2. Schematic of light interception in upright (left) and prostrate (right) sugar beet canopies.

- Canopy architecture comprises leaf angle, area, shape and positioning.
- In other crops, it has been shown that upright canopies have more even light distribution: avoiding light saturation, improving RUE and potential yields.
- Theoretically, upright canopies require a greater leaf area to intercept incoming light than prostrate (Fig.2).

Growth room

Research enquiry: How to quantify differences in canopy architecture between contrasting varieties?

Measurements: leaf number, angle and area measured and quantified in upright (left) and a prostrate (right) varieties.

Canopy modelling

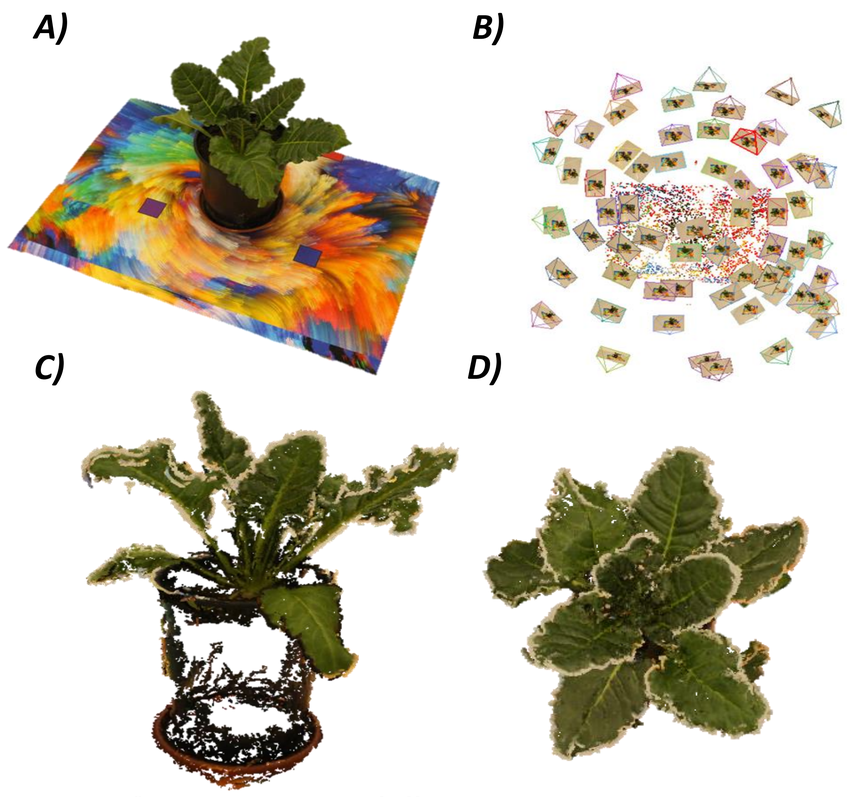

Fig 3. Process of 3D canopy modelling. A) Plant placed on a target. B) Series of images taken around the plant. C+D) Images stitched together to give a 3D plant.

This novel 3D analysis and reconstruction approach is being used to measure canopy traits (angle, area and curvature) without the need for manual measurements; according to the protocol of Pound *et al*. (2014) (Fig.3).

Field trial

Research enquiry: Does the leaf area index and light interception differ across varieties with contrasting canopy architectures? Does this affect RUE?

- RUE can only be measured in canopies and this field experiment tests the hypothesis that upright varieties have greater RUE.
- Methods incl. NDVI will also be evaluated as a proxy for RUE in place of destructive biomass samples.

This project is sponsored by: Chadacre Agricultural Trust; Felix Cobbold Trust; The Morley Agricultural Foundation; British Beet BBRO Research Organisation

References
Pound MP, French AP, Murchie EH, Pridmore TP. (2014) Automated recovery of three-dimensional models of plant shoots from multiple colour images. *Plant Physiology* 166: 1688–1698.
Draycott, A. P. (2006) *Sugar Beet*, *Blackwell Publishing*. doi: 10.1002/9780470751114.