Future-proofing sugar-beet

Project Reference: ICS-PLA-JK

Supervisor: Dr Johannes Kromdijk (jk417@cam.ac.uk)

Department/Institute: Plant Sciences

Website: https://www.plantsci.cam.ac.uk/directory/johannes-kromdijk

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BBSRC DTP main strategic theme: Bioscience for sustainable agriculture and food

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Project outline:

Sugar beet (Beta vulgaris) is a major global crop with a global production volume of ~250 million metric tons. Sugar beet is grown across most of the temperate zone, being a common summer crop in most cooler parts as well as a winter crop in the warmer parts. While the increase in average temperatures associated with climate change has been predicted to have limited impact on sugar beet production, climate change is also giving rise to less predictable precipitation patterns and often strongly decreased water availability across many sugar beet production regions. In addition, climate change leads to a significant increase in extreme weather conditions, especially during the growing season, where harsh drought episodes can be interspersed by heavy rain events. To future-proof sugar beet, plants therefore need sufficient basal tolerance as well as an ability to rapidly toggle abiotic stress responses to match the prevailing conditions.

Being a descendant of Beta maritima, a seaside and hence salt-tolerant plant, most sugar beet accessions are sufficiently tolerant to drought stress to avoid complete crop loss, but drought stress nevertheless has a strong negative impact on yield. While most temperate crops are harvested in the generative phase, sugar beet is a perennial, which remains vegetative in farmers' fields meaning that drought avoidance strategies via life-cycle shortening are not applicable. Both the large impact of drought on sugar beet yield and minimal focus on drought tolerance as breeding aim thus far make sugar beet a worth-while and easy-to-handle amenable plant to study and improve drought tolerance.

In this project we aim to define drought tolerance ideotypes. To do so, we will investigate contrasting responses to drought stress across sugar beet genotypes, which may vary from opportunistic water-spending strategies to hypersensitive water-saving responses. The project will initially screen a range of physiological leaf and whole-plant traits linked to drought tolerance, such as stomatal conductance, leaf gas exchange and transpiration efficiency (carbon fixed per water lost), pressure-volume curves and osmotic potential under full hydration, stable carbon isotope discrimination and leaf economics spectrum traits, leaf area development, whole plant water use and growth. Subsequently, genotypes exhibiting interesting trait combinations will be used in experiments applying controlled stress scenarios to find out more about the impact of each trait combination on drought tolerance.