Genetics of root vigour in tomato

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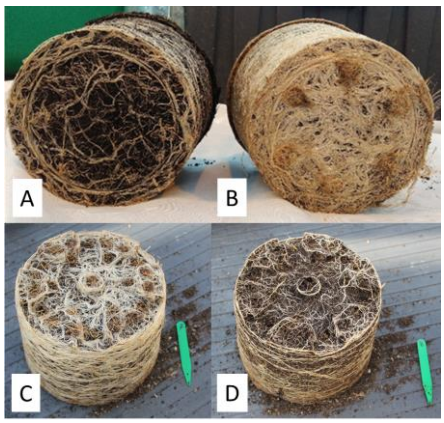
Project Description:

Background. Crop root systems provide a new focus for breeding varieties with greater sustainability and resilience; roots function to capture nutrient and soil resources, and provide anchorage and resistance to multiple soil-borne diseases, they also sequester carbon into the soil profile. The ability to combine the best root traits into elite varieties is the key to reducing water and fertilizer inputs and to eliminating soil fumigation practices; the latter is often used by growers when disease pressure is high, but may have negative consequences for soil health. For fresh-market vegetable crops such as tomato, pepper and melon, breeding for root traits is more specialized because they are produced from plants where different scion and rootstock genotypes are grafted together to surgically combine useful shoot and root traits. Breeders select rootstocks genotypes visually based on high root vigour, and then combine other essential traits like disease resistance by crossing and selecting with DNA-based markers (Thompson et al. 2017). This process would be much easier if the genetic basis for root vigour was understood and markers for root vigour were available.



Root vigour of selected germplasm
A and B and parental lines: A, low vigour parent; B, high vigour parent;
C and D are two individuals from an F2 population showing strong segregation for root vigour. The roots have bene exposed from fruiting plants grown in 30 cm pots.

The aim of this studentship is to identify novel genetic loci and mechanisms for use in breeding enhanced root vigour in tomato. The project is divided into two parts. Firstly, the student will follow-up the recent exciting findings of a novel locus controlling root vigour that is related to carbohydrate partitioning in the roots, here we seek to understand the mechanism. Secondly, we will seek to discover other new genetic loci controlling root vigour with a forward genetic strategy exploiting pre-selected germplasm (see Figure) and the full power of modern sequencing and genotyping technologies coupled with bioinformatics and root phenomics. The supervisory team provides internationally recognized expertise in tomato genetics, genomics and bioinformatics (Cranfield) and in plant phenomics (Aberystwyth).

References:

Thompson, A.J., Pico, B., Yetisir, H., Cohen, R., Bebeli (2017) Rootstock breeding: current practices and future technologies. Chapter 3 in Vegetable Grafting: Principle and Practices (ed G. Colla, F. Perez-Alfocea and D. Schwarz). CABI, Wallingford.