PROJECT TITLE

In situ phenotyping of root architecture traits of grapevine rootstocks in saline-sodic soil by X-ray microcomputed tomography

CONSORTIUM

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SUMMARY OF THE REPORT

PLEASE NOTE: Due to Covid-19 travel restrictions we experienced logistical issues regarding international mobility from Italy to UK which significantly delayed the start of the project. This delay impacted the analysis of the original proposed biological material – using X-ray CT imaging to phenotype variation in angles of roots of vine (vitis) cuttings – which only form from explants at a specific time of the year. Based on the above issues, and in order to successfully complete the EPPN2020 Transnational Access experiment before the 29th of October, we elected to perform CT-based angle analysis on roots of the cereal crop barley instead of Vitis. The nature and the aim of the research topics remains unaffected.

Two cereal genotypes (Barley wildtype cv. Morex and *Hvegt1* mutant allele TM194) were chosen based on their different root angle phenotypes. The *Hvegt1* mutant allele TM194 exhibits a steeper root growth angle phenotype compared to Morex which shows a shallower architecture (Fusi *et al, invited resubmission to PNAS*). My EPPN X-ray CT imaging studies confirmed the striking difference in root angle between wildtype and *Hvegt1* figure1 and figure2.

Increased steepness of root angle is a trait proposed to improve the ability to penetrate hard (compacted) soil layers (Correa et al., 2019). Researchers have reasoned that if root angle is not steep enough to penetrate a strong soil layer, roots may be horizontally deflected when growth continues. However, when performing experiments on Morex and *Hvegt1* lines in compacted soil (1.5 Bulk Density [BD]) conditions, X-ray µCT revealed that wildtype barley featuring a shallower root angle in compacted soil figure1 grew better than the steeper angled *Hvegt1* line Figure2 based on total root length measurements figure3.

X-ray CT imaging of barley wildtype and Hvegt1 in compacted soil also revealed striking differences in root tortuosity (i.e. the waviness of the root growth pattern; Popova et al., 2016). *Hvegt1* mutant roots appeared to exhibit a much higher level of tortuosity than wildtype roots (Fig. 1). The degree of tortuosity of a root system has been reported to be dependent on both soil bulk density and soil type (Tracy et al., 2012). Increased tortuosity is reasoned to improve the chances to explore a larger volume of soil as roots often grow through cracks, biopores, and holes in the soil (Popova et al., 2016). However, in our case, increased tortuosity in *Hvegt1* was associated with reduced root growth, where mutant roots appeared to buckle more than wildtype as a result of physical impedance imposed by the soil. This distinct root growth behaviour between these lines is likely to arise from differences in root tip mechanical properties recently detected by the host lab using Atomic Force Microscopy (AFM) (Fusi *et al, invited resubmission to PNAS*). These novel results promise to form the basis of a research manuscript.