Tackling the 3D root system architecture of grapevines: a new phenotyping pipeline based on photogrammetry

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Plant roots fulfil important functions as they are responsible for the acquisition of water and nutrients, for anchorage and stability, for interaction with symbionts and, in some cases, for the storage of carbohydrates. These functions are associated with the Root System Architecture (RSA, i.e. the form and the spatial arrangement of the roots in the soil). The RSA results from several biological processes (elongation, ramification, mortality…) genetically determined but with high structural plasticity. In grapevine, several factors can influence the RSA development (e.g. rootstock and scion genotypes, soil and plant management…). However, the effects of all these factors on the establishment of the RSA and associated functions (e.g. drought tolerance) have hardly ever been assessed. Such an assessment could help to improve the management of vineyards in our changing world. This lack of knowledge is mainly associated to methodological difficulties to characterize the RSA during grapevine development in the vineyard. To take up this challenge, we developed a new phenotyping pipeline, connecting photogrammetric data (produced using Archeo*vision* Production) with plant structures reconstruction software (PlantScan3D) and two packages dedicated to plant architecture analysis and visualisation (MTG and PlantGL from the OpenAlea platform). This new approach was developed on the uprooted root systems of two perennial species: grapevine and maritime pine. Their robustness was evaluated by comparing root traits estimated by this pipeline to root traits measured manually or estimated by a reference technique (semi-automated 3D digitizing, used on maritime pine root systems [1]). With this pipeline, we have planned to characterize the RSA of different rootstock genotypes, from different plantation types, soil management or water treatments, and at several developmental stages. All these data will be used to calibrate a functional-structural root model to facilitate the selection of plant material aimed to overcome the negative effects of climate change.

Keywords: Root system architecture, 3D Phenotyping, *Vitis* sp., *Pinus pinaster*, Photogrammetry, Architectural analysis

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References:

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