Multi-scale high-throughput phenotyping of an apple tree core collection under water stress condition
Benoit Pallas, Magalie Delalande, Aude Coupel-Ledru, Frédéric Boudon, Jérome Ngao, Sébastien Martinez, Sylvie Bluy, Evelyne Costes, Jean-Luc Regnard

To cite this version:
Benoit Pallas, Magalie Delalande, Aude Coupel-Ledru, Frédéric Boudon, Jérome Ngao, et al.. Multi-scale high-throughput phenotyping of an apple tree core collection under water stress condition. 30. International Horticultural Congress IHC2018, Aug 2018, Istanbul, Turkey. hal-02738372

HAL Id: hal-02738372
https://hal.inrae.fr/hal-02738372
Submitted on 2 Jun 2020

HAL is a multi-disciplinary open access archive for the deposit and dissemination of scientific research documents, whether they are published or not. The documents may come from teaching and research institutions in France or abroad, or from public or private research centers.

L’archive ouverte pluridisciplinaire HAL, est destinée au dépôt et à la diffusion de documents scientifiques de niveau recherche, publiés ou non, émanant des établissements d’enseignement et de recherche français ou étrangers, des laboratoires publics ou privés.
Multi-scale high-throughput phenotyping of an apple tree core collection under water stress condition

Benoît Pallas¹, Magalie Delalande¹, Aude Coupel-Ledru¹, Frédéric Boudon¹⁺, Jérôme Ngao³, Sébastien Martinez¹, Sylvie Bluy¹, Evelyne Costes¹, Jean-Luc Regnard¹

¹UMR AGAP, Univ. Montpellier, CIRAD, INRA, Montpellier SupAgro, Montpellier, France
²CIRAD, UMR AGAP, F-34398 Montpellier, France.
³UMR PIAF, Univ. Clermont Auvergne, INRA, 63100 Clermont-Ferrand, France

Large genotypic variation in traits related to plant performance under contrasted environmental conditions has been reported but phenotyping them on large population remains a challenge for trees grown in orchards. We currently investigate or adapt new technologies for phenotyping developmental and adaptive traits in an apple tree core collection composed of more than 1000 individuals and grown under well watered and water stressed conditions. Targeted traits are associated with tree architecture which determines many traits of plant functioning such as light interception efficiency and transpiration, photosynthesis or water use efficiency. At the tree scale, T-LIDAR scans associated with new reconstruction algorithms are used for extracting variables related to the vegetative development (plant leaf area and its spatial distribution; number and length of axes). At the leaf scale, chlorophyll fluorescence has been measured on all the trees of the collection for determining a semi-empirical index (IpL index) previously shown to be a good proxy of photosynthesis activity. Multi-spectral and thermal IR airborne imaging is also carried out in summer in order to compute spectral indices that reveal phenotypic features over the whole field assay. The validity of high-throughput indicators are being assessed at both tree and leaf scales, through in-planta measurements of plant functioning such as architecture digitizing and leaf gas exchanges. Most of the traits collected exhibit a large variability with highly significant effects of water stress and genotype suggesting that methods are relevant for genetic studies. In that context, GWAS analyses are undertaken to identify genomic regions associated to the trait variation. In forthcoming works some of the parameters quantified in this study will be used to complement functional structural plant models for in-silico exploring the interaction between tree architecture and functioning under contrasted environments.

Key words : architecture, photosynthesis, transpiration, T-LIDAR, chlorophyll fluorescence, multi-spectral airborne imaging