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Oral Communication Abstract – 2.03

A PHENOMICS APPROACH TO DROUGHT AND PATHOGEN RESPONSES IN A TOMATO GENOTYPE COLLECTION

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To develop well-performing crops in the face of changing environmental conditions, we proposed the use of high-throughput phenotyping platforms (HTPP) and sensor-based imaging as a technology for quantitative analysis of relevant genetic traits. To date, phenomic analysis has been mainly applied on cereals or model plants.

In this study, an indoor Scanalyzer 3D imaging system (LemnaTec GmbH) was used to quantitatively evaluate morphological and color-related traits of tomato (Solanum lycopersicum) genotypes subjected to: i) abiotic stress (recurrent drought episodes); and ii) biotic stresses induced by virus (Tomato spotted wilt orthotospovirus, TSWV), fungus (Pyrenochaeta lycopersici) or nematode (Meloidogyne incognita) infections. Twenty-two different tomato genotypes showing different levels of susceptibility to the above stresses were analyzed. In addition, the effects of beneficial root-interacting fungi (Trichoderma spp.) on drought stress-induced symptoms were also evaluated. An automatic system for weighing and

irrigating pots allowed the precise imposition of drought stress (20 or 30% field capacity) and recovery cycles. Imaging with RGB sensors at several time points was used to analyze plant growth, biomass, and symmetry, while color-related information revealed that different degrees of leaf ‘greenness’ correlated with chlorophyll biosynthesis and senescence-like symptoms. Near-infrared reflectance (NIR) was assessed as a predictor of water content and the health status of plants.

Using 22 phenotype indices, our results showed that HTTP was effective in detecting the stress status in tomatoes, compared to healthy plants, for all the stresses and genotypes. Furthermore, genotypes with known levels of susceptibility were well discriminated against. Interestingly, a global analysis of the dataset revealed distinct features able to distinguish biotic from abiotic stresses, thus revealing a significant degree of specificity of our phenomics analysis. Values of NIR and senescence index were higher in plants infected by the pathogens, while those of solidity (or shoot compactness), green area, and hue circular mean were higher in drought-stressed plants. Morphometric parameters such as height, width, and area were not useful to discriminate among stress types, but they were non-specific indicators of general distressed conditions of plants. HTPP data supported the development of a ‘digital phenotype’ catalog where morphometric and colorimetric parameters can be employed to characterize tomato genotypes under different adverse environmental conditions. A gene expression analysis of a set of stress-related genes was performed to integrate phenotypic trait analysis with molecular responses.

In conclusion, image-based phenomics provides a solid tool to assess traits of stress tolerance on multiple tomato varieties under complex environmental stimuli, and a set of descriptors able to discriminate biotic vs. abiotic stress conditions in tomato.