Phenotyping Workshop – Memorandum of understanding (MoU)

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Background

Beside long-lasting resistances of grapevines towards powdery and downy mildew, further important traits for grapevine breeders are resistance towards abiotic stress, optimal yield, improved growth characteristics, and of cause high wine quality as result of healthy and well ripen grapes. Since marker assisted selection (MAS) were introduced into grapevine breeding programs about a decade ago and highly efficient genotyping techniques are available today, the call for comparably efficient, objective high-throughput phenotyping methods is becomes louder. The ongoing continuous development of robust, powerful sensors and computer techniques will facilitate robot- or tractor-based (field) phenotyping approaches in the near future. Automation and the usage of adaptive, intelligent software hereby enable high-throughput phenotyping with only minimal user-interaction.

Recently, there are three main disciplines of scientist working on sensor-assisted plant phenotyping:

1) technique-oriented groups (e.g. engineers/university) investigating high-tech, state-of-the-art sensors under lab, greenhouse or field conditions without a specific crop consideration;
2) trait/application-oriented groups (e.g. breeders) investigating possibly simple-to-handle and (low) cost-efficient sensors in order to phenotype different traits of interest;
3) data analysis-oriented groups (e.g. computer scientists and statistics) developing adaptive, automated and fast algorithms for sensor data analysis and modelling. The type of sensor data, e.g. 2D, 3D or remote sensor data, varied.

The most important challenge and coincidently most promising opportunity will be the fusion and collaboration between all of these disciplines in order to develop high-efficient and objective phenotyping strategies for grapevine breeders and scientists. In a second step, some sensor (-systems) and automated software can be adapted for their transfer into management or precision viticulture applications.

Motivation

Grapevine phenotyping today often means the visual scoring of traits using the established classification systems of e.g. BBCH (phenology) or e.g. OIV descriptors (e.g. morphological traits like berry or cluster traits) executed by skilled employees. The results of classifications hereby strongly depends on the experience and the subjective awareness of an individual operator. The work is very labor-intensive and time-consuming. In order to overcome this – so-called – phenotyping bottleneck the application of efficient sensors (or sensor-systems) and intelligent software will facilitate new opportunities for faster and objective acquisition of phenotypic data that are more precise with reduced error variation. The application e.g. of hyperspectral sensors will enable the detection and eventually characterization of plant stress.

Aiming at the digitalization of time-consuming phenotyping work, the transfer of the breeders eye into sensor-based methods is needed. Sensor-assisted phenotyping will than help saving resources and to deploy valuable employees for other tasks. Finally, automation will notably increase the throughput, and objectivity und precision will enable comparable statistical analysis and modelling.

Aims of the workshop

The major aim of the phenotyping workshop will be the discussion and determination of the most important traits of interest and their priority for individual wine growing regions/countries from a grapevine community point of view.

Prioritized traits for field phenotyping. This table should be updated prior to the workshop and discussed during the workshop. Your response by reply is highly appreciated.

Priority	Trait	Breeding/ Genetic Repositories	Management/ Precision Farming
1	Yield • berry size • no. of berries per cluster • no. of cluster per cane	+/+	+/+
2	Phenology • bud burst • flowering • Veraison • ripening	+/+	+/+
3	Biotic Stress • …	+/+	+/+
4	Abiotic stress • …	+/+	+/+
5	Quality characteristics • …		

The requirements and challenges in viticulture where relevant high-throughput field phenotyping platforms may support quantitative assessment relevant traits over vast area requires interactions within the community. Multi-year phenotyping of selected traits of interest under different growing conditions and their evaluation by statistics and modelling will remain a major challenge. The EU funded project EPPN2020 provides access to some plant phenotyping facilities in Europe (https://EPPN2020.plant-phenotyping.eu/), while the ESFRI listed project EMPHASIS aims at a synergistic development and long-term operation of phenotyping infrastructure in Europe (https://emphasis.plant-phenotyping.eu/) by developing infrastructures and providing access for multi-scale phenotyping to analyze genotype performance in diverse environments and quantify the diversity of traits. One of the key elements of EMPHASIS is the development of well-instrumented field sites with high-resolution recording of the environmental conditions (including abiotic and biotic) and detailed imaging carried by proximal or remote sensing systems on airborne or ground based systems linked to relevant information systems.