Non-invasive phenotyping methods for abiotic and biotic stress in grapevine breeding

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Climate change impacts greatly upon agricultural ecosystems and also viticulture is directly affected by the effects of global warming. As a consequence, changes in frequency and severity of extreme climatic events are projected. Increasing occurrence of heat waves and droughts and following heavy rain events will lead to higher susceptibility of vines to pathogens. Due to their considerably shorter generation time pathogens show usually better adaptability to climatic conditions than plants. This leads to more problems with diseases like powdery mildew and downy mildew in the field. The interactions between plant resistance and the expected simultaneously increasing aggressiveness of the pathogens are a major biotic impact of climate change for European viticulture.

The project Vitismart aims at establishing a resilient and flexible viticulture system, which is able to recover itself quickly from abiotic and biotic stresses. To achieve this, more resilient cultivars should be identified and genetic resources for resistances should be found. In collaboration with project partners, the beneficial use of microorganisms to improve the plant resistance are examined.

As an example of abiotic stress heat stress will be examined. With regard to biotic stress, on the one hand breeding material will be screened for powdery and downy mildew resistance. On the other hand berry bloom, being one of the parameters of Botrytis resilience, will be evaluated.

To validate the resilience of cultivars and breeding material towards abiotic and biotic stress, an objective and time saving phenotyping method will be developed using hyperspectral imaging to screen leaf disc assays, bunches and single berries in the laboratory. The collected sensor data will be correlated with visual inspections using the International Organisation of Vine and Wine (OIV) descriptors for (1) Downy mildew (2) Powdery mildew and (3) Berry bloom, microscopic studies and chemical analysis to establish a phenotyping pipeline.

After establishing the hyperspectral measurements in the laboratory and for a small set of plants, it will be tested if the method is transferable to field conditions. The method finally could update the existing field phenotyping techniques and improve grapevine breeding programs.