P30 – Characterization of grapevine resistance to downy mildew using hyperspectral imaging in SWIR spectral range

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Abstract

Downy mildew (DM) caused by the oomycete Plasmopara viticola is a serious disease in viticulture, which causes high economical losses. Currently repeated applications of fungicides and copper are used to avoid massive damages or total losses. Beside the environmental pollution, fungicide resistances are frequently found in P. viticola populations. Therefore, the introgression of resistances is a major task for grapevine breeding programs.

While molecular genotyping methods are well established, the methods for the characterization of phenotypic expression are still labour- and time - consuming. *Rpv3* and *Rpv10* carrying varieties are known to differentiate in the accumulation of stilbenes. These differences contribute to the described differing level of resistance, while stilbenes like resveratrol, pterostilbene and viniferins play a crucial role in the defense reaction of grapevine to downy mildew. While proceeded DM infections can be detected, using a simple RGB-imaging workflow, hyperspectral imaging in the short-wave infrared (SWIR) range is a promising tool to detect and possibly quantifiy biochemical components, like e.g. stilbenes. These non-destructive and fast insights in plant's changed metabolism due to an infection with P. viticola allows on one hand a high throughput and can help on the other hand, gaining a better understanding of resistance mechanisms by enabling the measurement of resistance kinetics in time series. Both aspects are highly demanded in grapevine breeding and research.

The objective of the present study was to develop a SWIR-imaging based method for the differentiation of varieties with (I) no resistance locus, (II) *Rpv3*, (III) *Rpv10* and (IV) *Rpv3* and *Rpv10* loci. Our assumption is a stilbene-associated resistance reaction due to *Rpv10*. To test the performance of the hyperspectral sensor, resistance response of leaf discs was induced by UV-C radition on one hand and artificial inoculations on the other hand. HPLC-MS based reference data were used to model stilbene concentrations in leaf discs, using artificial intelligence based algorithms. These neural networks allow to group the tested varieties into different resistance levels and due to their intelligent and learning ability nature are promising tools for studies on an extended set of varieties in further research.

Keywords: Hyperspectral imaging, resistance, downy mildew, grapevine