Risk prediction of *Botrytis* bunch rot based on physical characteristics of grapes

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Abstract

Botrytis bunch rot is the third economically most important disease in cool climates as most of the domesticated wine grape varieties are highly susceptible. In order to avoid or delay spreading of *Botrytis* infections until the grapes reach physiological ripeness, different management strategies as early defoliation or fungicide applications were developed.

The major task within the scope of the German grapevine breeding program is the selection of fungus-resistant, climatic adapted vines with balanced, healthy yield and outstanding wine quality. Facing the long-term procedure of breeding, marker-assisted selection (MAS) is the most efficient method for an early selection of grapevine seedlings. MAS and marker development work effective for qualitative single locus traits as *R*-gene mediated downy and powdery mildew resistance. Corresponding resistance genes are not described for *Botrytis* for neither grapevines nor any other affected crop. However, new grapevine selections can be equipped with natural infection barriers protecting against *Botrytis* bunch rot represented by physical and mechanical characteristics: loose grape bunch architecture, and thick, impermeable berry cuticles. At the same time, such quantitative traits are difficult to trace for the development of molecular markers and require objective phenotyping.

The present study aims at a new type of risk prediction for *Botrytis* bunch rot based on physical fruit traits (bunch architecture, berry impedance and berry texture) assessed with objective, high-throughput sensors. The preliminary predictive model is trained and tested on one-year data determined in 2021 including a mixture of 14 *Botrytis*-susceptible and –resilient varieties as well as elite breeding lines. Berry impedance and berry texture were identified as most effective traits enabling the forecast of *Botrytis* bunch rot infection with high accuracy. In addition, new QTLs were detected facilitating the development of molecular markers selecting for an increased resilience to *Botrytis* bunch rot. Furthermore, the physical barriers showed to be additional indicators for sunburn resilience and thus, are probably protecting berries against abiotic damages, too.

Keywords: grapevine phenomics, Botrytis bunch rot, predictive model, grape berry cuticle, berry impedance, berry texture, 3D grape bunch architecture, QTL analysis, sensor-based phenotyping