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The Rpv3-3 locus and stilbenoid induction mediate downy mildew resistance in a grapevine inter-specific population

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The cultivated Eurasian grapevine (*Vitis vinifera* L.) is highly susceptible to downy mildew (DM) – caused by the biotrophic oomycete *Plasmopara viticola* (Berk. & Curt) – the major disease of temperate-humid climates among various pathogen treats. DM control mainly relies on the massive use of fungicides leading to environmental pollution, development of resistance and residual toxicity. The exploitation of DM-resistant wild genetic resources for the development of new resistant varieties represents a promising alternative. Taking advantage of a segregating population derived from Merzling (M, a mid-resistant hybrid) and Teroldego (T, a susceptible landrace), recent studies highlighted the importance of stilbenoids among phenolic compounds in conferring resistance to this oomycete. In order to elucidate the genetic bases of DM resistance and polyphenol biosynthesis upon *P. viticola* infection, 136 M×T F1 individuals were characterized by an integrative approach combining genetic, phenotypic and gene expression data. An improved M×T linkage map was obtained by scoring 192 microsatellite markers. The progeny was further screened for degree of resistance and production of 42 phenolic compounds (including 18 different stilbenoids). QTL mapping showed that DM resistance is associated to a specific haplotype at the Rpv3 locus – herein named Rpv3-3, derived from the French hybrid Seyval – and identified 46 novel metabolic (m)QTLs linked to 30 polyphenol-related parameters. A list of the 76 most relevant candidate genes was generated by specifically exploring the genomic regions underlying the mQTLs associated to the stilbenoids induced by the infection. Finally, the expression analysis of 13 genes in Rpv3-3+/- genotypes, displaying divergent DM resistance and stilbenoid accumulation, revealed significant candidates for the genetic control of stilbenoid biosynthesis and oligomerization. These overall findings emphasized that DM resistance can be mediated by the major Rpv3-3 locus, stilbenoid induction, and their combined protective action.

Keywords: marker-assisted breeding, Merzling, *Plasmopara viticola*, polyphenols, QTL analysis, *Vitis* spp.