Metabolite profiling and feeding bioassays suggest a major role for a dicaffeoylquinic acid in induced resistance of peach to Myzus persicae aphid

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The green peach aphid (GPA, *Myzus persicae* Sulzer) is a generalist insect pest infesting agricultural and horticultural crops worldwide. GPA causes significant direct damages to peach, its primary host, and may transmit viruses that cause serious diseases such as Sharka conferred by the *Plum Pox Potyvirus*. Resistant genotypes have been identified among the peach germplasm and are used in breeding programs to create peach cultivars showing a durable resistance to GPA. Among these genetic resources, Rubira, a red-leaf cultivar used as rootstock and carrying the dominant resistance gene *Rm2*, shows a strong and induced antixenosis-type resistance associated with hypersensitive-like necrotic lesions on developing leaves.

To study the mechanisms involved in induced resistance of Rubira to GPA, we used a metabolomics approach and investigated metabolite changes occurring in shoot apices of Rubira and a susceptible cultivar after a 48-hours infestation with GPA. Untargeted ^{1}H NMR and targeted LC (sugars, organic acids, amino acids), LC-MS (secondary metabolites including phenolic and cyanogenic compounds) and GC-MS (Volatile Organic Compounds, VOCs) were applied. While no significant modifications occurred in the susceptible cultivar, dramatic changes in primary and secondary metabolites were observed in Rubira following infestation. Carbohydrates and most organic acids showed a marked decrease. Several amino acids, including lysine and branched-chain and aromatic amino acids, showed a large accumulation whereas levels of glutamine, proline and threonine were greatly reduced. Infestation of Rubira by GPA also triggered the release of VOCs, mainly methyl-salicylate and (E,E)-α-farnesene, and the accumulation of secondary metabolites. Chlorogenic acid (5-caffeoylquinic acid, 5-CQ) and 3,5-dicaffeoylquinic acid (3,5-diCQ) were the main phenolics of shoot apices. Strikingly, these closely related compounds showed differential responses to infestation: while 5-CQ level did not change, 3,5-diCQ showed a significant accumulation and therefore could be involved in resistance. The effect of 5-CQ and 3,5-diCQ on GPA was further studied in bioassays with artificial diets. Whereas 5-CQ did not show any effect on larval development, 3,5-diCQ was highly toxic and larvae did not survive at the concentration as low as 1mM (516 mg.L^{-1}). These results suggest that 3,5-diCQ could play a major role in antixenosis resistance of Rubira to green peach aphid.