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Profiling the Volatile Metabolome in Pear Leaves with Different Resistance to the Pear Psylla Cacopsylla bidens (Sulc) and Characterization of Phenolic Acid Decarboxylase

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Abstract : Pear Psylla is the most important pest of pear in all pear-growing regions, in Asian, European, and the USA. Pear psylla damages pears in several ways: high-density populations of these insects can cause premature leaf and fruit drop, diminish plant growth, and reduce fruit size. In addition, their honeydew promotes sooty mold on leaves and russeting on fruit. Pear psyllas are also considered vectors of pear pathogens such as Candidatus Phytoplasma pyri causing pear decline that can lead to loss of crop and tree vigor, and sometimes loss of trees. Psylla control is a major obstacle to efficient integrated pest management. Recently we have identified two naturally resistance pear accessions (Py.760-261 and Py.701-202) in the Newe Ya'ar live collection. GC-MS volatile metabolic profiling identified several volatile compounds common in these accessions but lacking, or much less common, in a sensitive accession, the commercial Spadona variety. Among these volatiles were styrene and its derivatives. When the resistant accessions were used as inter-stock, the volatile compounds appear in commercial Spadona scion leaves, and it showed reduced susceptibility to pear psylla. Laboratory experiments and applications of some of these volatile compounds were very effective against psylla eggs, nymphs, and adults. The genes and enzymes involved in the specific reactions that lead to the biosynthesis of styrene in plant are unknown. We have identified a phenolic acid decarboxylase that catalyzes the formation of p-hydroxystyrene, which occurs as a styrene analog in resistant pear genotypes. The His-tagged and affinity chromatography purified E. coli-expressed pear PyPAD1 protein could decarboxylate p-coumaric acid and ferulic acid to p-hydroxystyrene and 3-methoxy-4-hydroxystyrene. In addition, PyPAD1 had the highest activity toward p-coumaric acid. Expression analysis of the PyPAD gene revealed that its expressed as expected, i.e., high when styrene levels and psylla resistance were high.

Keywords : pear Psylla, volatile, GC-MS, resistance
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