TERPENOID VOLATILES

Inter-organ aerial transport

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Plant-synthesized volatile organic compounds (VOCs) play important roles in the interactions between plants and other organisms. However, their involvement in inter-organ communications remains unexplored. By studying the biosynthesis and function of terpenoid volatiles in petunia flowers, Benoît Boachon, from Purdue University, and colleagues revealed natural fumigation as a new mechanism for VOC transport between flower organs that affects floral organ development and seed yield.

Using targeted metabolite profiling and RNA-seq data, the researchers identified terpenoid VOCs and four terpene synthases (TPSs) responsible for terpenoid production in petunia flowers. The specific products synthesized by each TPS were determined using a yeast expression system. The tissue specificity of TPSs is mostly consistent with the tissue specificity of their products. However, an exception is that the sesquiterpenes specifically produced by the tube-expressing terpene synthase *Petunia hybrida* TPS1 (PhTPS1) mainly accumulated in the pistils but not tubes, suggesting that VOCs produced by PhTPS1 might have been emitted from the tubes and transported to the stigmas through the air.

This hypothesis received support from multiple lines of evidences. The PhTPS1-produced VOCs were shown to mainly emit from the inner side of the tube. Removing tubes before flowering led to the deprivation of these VOCs but not other terpenoid VOCs produced in pistils. Also, feeding the tubes with stable isotope-labelled precursor of sesquiterpenes showed direct gas phase transmission of PhTPS1-produced VOCs from tubes to pistils. Moreover, transgenic petunia with reduced *PhTPS1* expression by RNA interference (RNAi) showed dramatically reduced PhTPS1 products in pistils, which can be restored by growing these pistils within wild-type tubes.

Compared to the wild type, the impaired sesquiterpene fumigation in the *PhTPS1* RNAi flowers led to a significant increase of *Pseudomonas* bacteria on stigmas as well as altered pistil growth and seed yield, suggesting the aerial-transported VOCs shape bacterial communities in floral organs and organ development.

Finally, the researchers showed that the higher cuticular wax content of pistils compared to tubes might drive the preferential adsorption of VOCs.

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