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Two sesquiterpene synthases are responsible for the complex mixture of sesquiterpenes emitted from Arabidopsis flowers

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Summary

Despite the fact that Arabidopsis is largely self-pollinating, its flowers emit a complex mixture of terpene volatiles consisting predominantly of a large group of over 20 sesquiterpenes. Here we report that only two terpene synthases, encoded by the florally expressed genes At5g23960 and At5g44630, are responsible for the formation of virtually all sesquiterpenes found in the Arabidopsis floral volatile blend. Two independent mutant lines with T-DNA insertions in the previously identified At5g23960 gene lacked the emission of three sesquiterpenes, including the main sesquiterpene volatile (*E*)-β-caryophyllene, confirming the previous *in vitro* functional assignment for this gene. Flowers of a mutant line carrying a T-DNA insertion in gene At5g44630 emitted these three sesquiterpenes, but did not emit any of the remaining sesquiterpene volatiles. An At5g44630 cDNA was expressed in *Escherichia coli* and the produced protein catalyzed the conversion of farnesyl diphosphate into over 15 sesquiterpenes in similar proportions to those found in the floral volatile blend. At5g23960 and At5g44630 promoter-β-glucuronidase (GUS) fusion experiments demonstrated that both genes are expressed in several parts of the Arabidopsis flower, with strong At5g23960 promoter-GUS activity in the stigma and strong expression of At5g44630 in intrafloral nectaries. Given the previously reported antimicrobial activity of terpenes, their production in stigmas and nectaries may serve to inhibit microbial infection at these vulnerable sites. A survey of 37 *Arabidopsis thaliana* ecotypes revealed quantitative, but almost no qualitative, variations of floral monoterpene and sesquiterpene emissions suggesting that floral terpene volatiles must play some significant role in the life of the Arabidopsis plant.