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Transcription factors regulating terpene synthases in tomato trichomes

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Summary

Tomatoes, like many other plants, produce and store secondary metabolites in glandular trichomes. Glandular trichomes are protrusions of epidermal origin, found on the vegetative tissue of plants. Among the metabolites that are produced in these specialized cells are volatile terpenes, which are emitted by plants under attack by herbivores. Such volatile cues are perceived by herbivore enemies (predators and parasitoids) that indirectly benefit the plant by feeding from or laying their eggs into herbivores. All terpenes are synthesized from the same building blocks (the five carbon-unit isopentenyl diphosphate and its isomere dimethallyl diphosphate) through the action of prenyl diphosphates and the downstream enzymes Terpene Synthases. Production of terpenes is tightly regulated in a temporal (and spatial) manner and such regulation involves Transcription Factors that bind to the promoters of terpene synthases, thus exerting an effect on their expression. The aim of this project was to identify transcription factors that regulate terpene synthases in tomato trichomes. For this, two approaches were taken. First, the promoter of a monoterpene synthase (SlMTS1) was used in a yeast-one-hybrid screen with a trichome cDNA library, in order to identify proteins that can bind to it. One transcription factor was identified and designated Emission of Terpenes 1 (SlEOT1). Second, a sequencing database obtained from tomato trichome cDNA pyrosequencing (GS FLX, 454 Life Sciences) and a transcript-profiling database (originating from trichomes of Control and Jasmonic acid-treated plants; Genome Analyzer II, Illumina) were mined, in order to discover transcription factors potentially involved in terpene biosynthesis. Two transcription factors were selected (SlMYC1 and SlWRKY4) and shown to interact with terpene synthase promoters. Interestingly, SlEOT1 and SlMYC1 have an additive effect in the regulation of SlMTS1.