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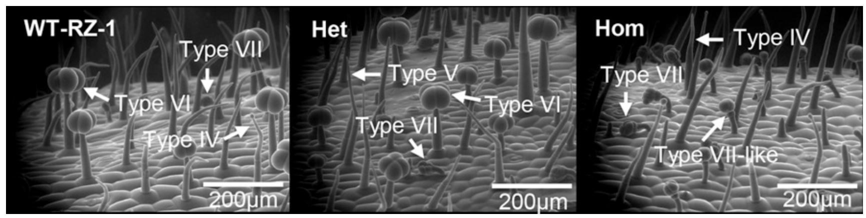
IN BRIEF

The Smell of Transcription: The SlMYC1 Transcription Factor Makes Tomato Plants Smelly[OPEN]

Trichomes are distinctive features of plant stems and leaves. Their primary role is to protect plants—functioning as physical barriers, stinging hairs, or chemical factories that produce a diverse array of compounds. At the extreme, sundews (*Drosera* sp) evolved trichomes that capture and digest invertebrates. Tomatoes (*Solanum lycopersicum*) utilize a diversity of trichome forms represented by eight types, with four glandular and four nonglandular trichome forms. The glandular trichomes are factories that synthesize and store complex cocktails of defense compounds. Of the glandular trichomes, type VI are the most abundant (Bergau et al., 2015) and are largely responsible for the characteristic aroma of tomato plants (Kang et al., 2010). In addition to containing an abundance of aromatic compounds, such as mono- and sesquiterpenes, type VI trichomes contain jasmonic acid, which can be released when disturbed by invertebrates (Peiffer et al., 2009), alerting the plant to the herbivore's presence. Thus, type VI trichomes function both as repellents to, and sensors of, leaf-eating insects.

Arabidopsis (*Arabidopsis thaliana*) trichomes are a key model system for studying cell differentiation. However, Arabidopsis trichomes are unicellular and nonglandular, which has precluded more intensive studies of multicellular glandular trichome development. This contrasts with the importance of glandular trichomes as a rich source of ecologically, agriculturally, and industrially important secondary metabolites. Using tomato as a model system to study glandular trichome development, **Xu et al. (2018)** show that a basic helix–loop–helix transcription factor called "SlMYC1" is necessary for the formation of type VI trichomes in tomato. They show this through the use of two independent knock-out lines, one induced by the mutagen ethyl methane sulfonate, and the other through CRISPR-Cas9 genome editing. Type VI trichomes were absent in all knock-out lines, indicating that SlMYC1 is essential for their formation (see figure). Interestingly, a novel type-VII-like trichome class was present in these knock-out lines. These type-VII-like trichomes may be malformed type VI trichomes, suggesting that although SlMYC1 is necessary for proper type-VI trichome development, the initiation of type VI development likely depends on another factor.



Morphology and Size of Type VI Glandular Trichomes on Stems.

Stem surfaces of wild-type RZ (WT-RZ-1), heterozygous *MYC1/myc1* (Het), and homozygous *myc1* (Hom) plants. Arrows indicate different types of trichomes; note the difference in angle of type-VII and type-VII-like trichomes in the Hom plants. (*Reprinted from Xu et al. [2018], Figure 3B*.)

To gain further insight into type-VI trichome development, the authors constructed a series of RNA_i lines, wherein the expression of *SlMYC1* was reduced by 80% to 95%. Type VI trichomes were still present in these lines, indicating that weak expression of *SlMYC1* is sufficient for type VI trichome formation. Interestingly, in both RNAi lines and knock-out lines, the expression of terpene synthase genes was reduced. When terpene content was measured, monoterpenes showed drastic reductions, even in knockdown lines where type VI trichomes were still present. This indicates that SlMYC1 is necessary not only for type VI trichome formation but also for promoting the synthesis of some mono- and sesquiterpenes. To date, only three transcription factors are known to be involved in regulating volatile terpene biosynthesis in tomato trichomes; this in-depth analysis of SlMYC1 furthers our understanding of both trichome formation and terpene synthesis in tomatoes. The next time you are near a tomato plant, take a sniff and know that SlMYC1 is at work.

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