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MDPI

Identification and Functional Validation of VvAGL15: A Key Regulator for Shortening the Grape Growth Period

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AIM

we analyzed fruit development and quality in the short growth period cultivar summer black (SB) and its bud-mutation cultivar Early Summer Seedless (ESS), which exhibits an extremely short growth period. Using transcriptomics, we screened the key genes involved in shortening the growth period and determined their functions via gene transfer verification. Our findings provide a theoretical basis for developing high-quality grape cultivars with short growth periods.

RESULTS

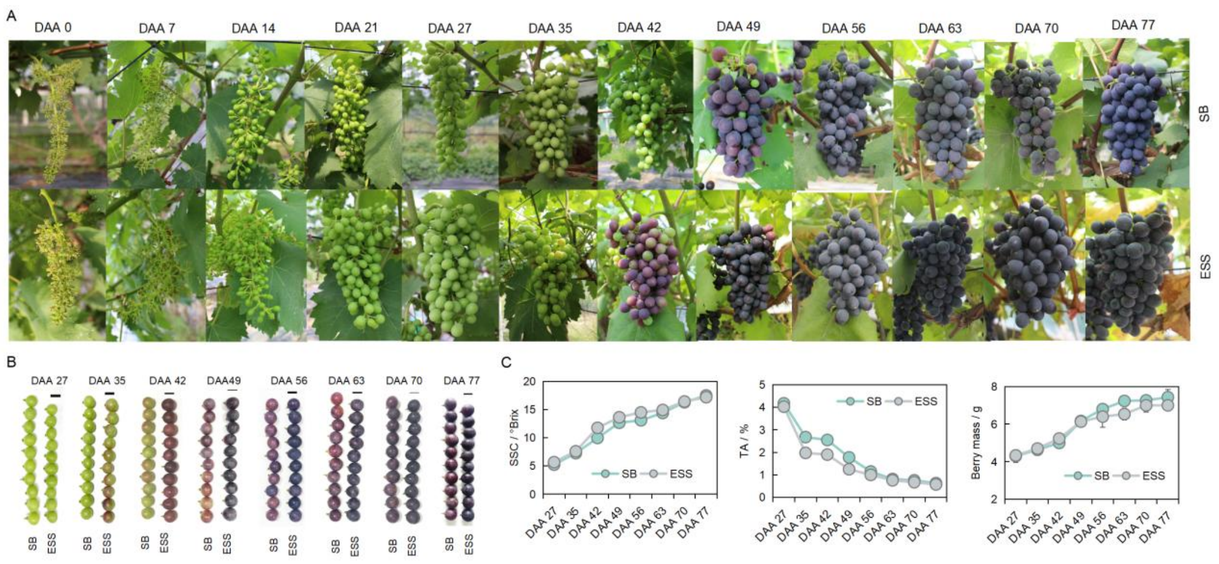

Figure 1. Observations of grape growth and development.
A: Plant phenotypes of Summer Black (SB) and Early Summer Seedless (ESS) at different growth and development stages; B: Berry phenotypes of SB and ESS at different growth and development stages (bar = 1 cm); C: Berry mass, soluble solid content (SSC), and titratable acidity (TA) at different growth and development stages. DAA: Days after anthesis.

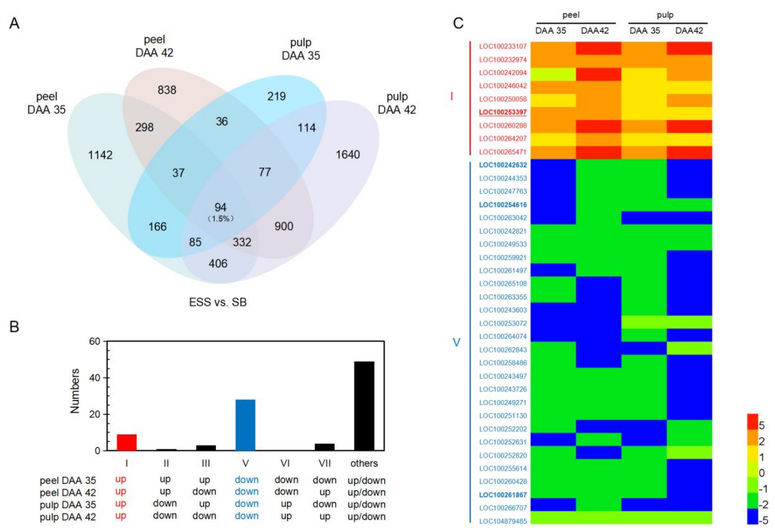

Figure 2. Screening and analysis of differentially expressed genes.
A: Venn diagram; B: Classification C: Gene expression profiles for Classes I and V. “Peel DAA 35” indicates gene expression in the skin of ESS berries 35 DAA, relative to that in SB berries. “Peel DAA 42,” “Pulp DAA 35,” and “Pulp DAA 42” are defined in the same manner.

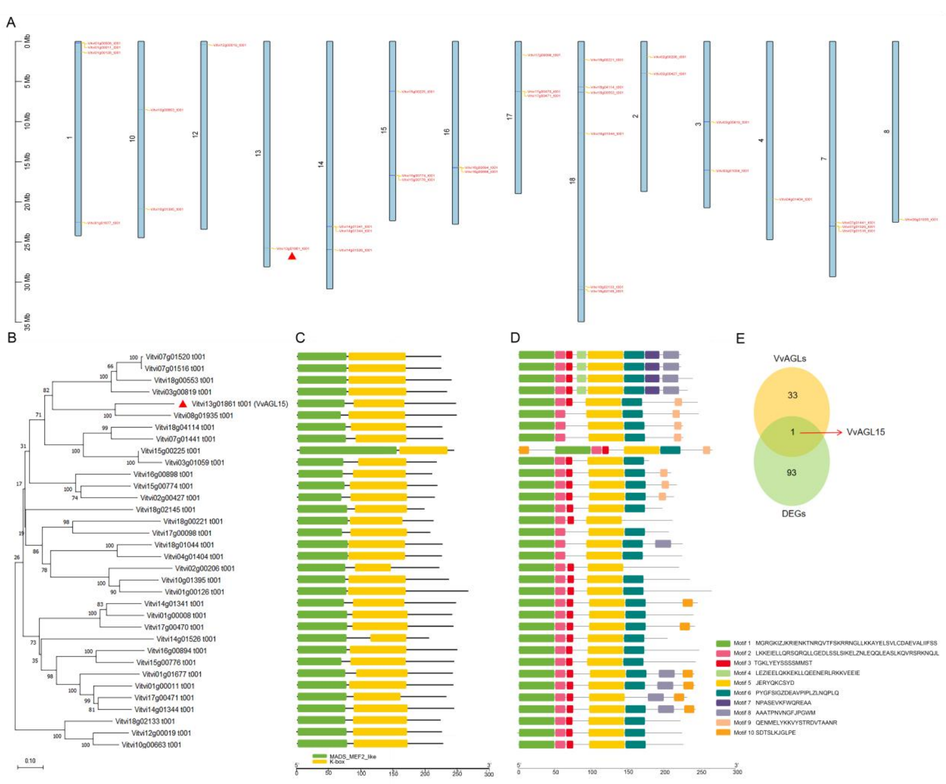

Figure 3. Analysis of VvAGL family members.
A: Chromosomal localization; B: Phylogenetic tree; C: Conserved structural domains; D: Motifs; E: Intersection of common DEGs with VvAGL genes.

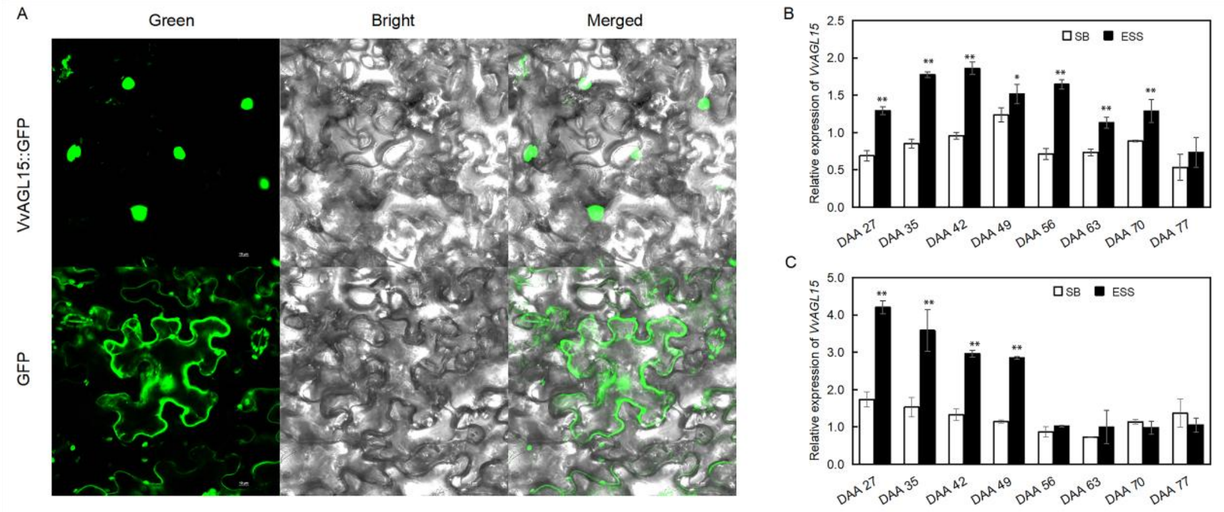

Figure 4. Subcellular localization and expression profile of VvAGL15.
A: Subcellular localization of VvAGL15; B: Relative expression of VvAGL15 in grape pulp at different developmental stages; C: Relative expression of VvAGL15 in grape peel at different developmental stages. SB: Summer Black; ESS: Early Summer Seedless. * or ** indicates a significant difference ($p < 0.05$ or $p < 0.01$, respectively) among the different varieties at the same time point.

Figure 5. Phenotypic analysis of different tomato lines.
A: Growth phenotypes of Micro-Tom (wild type) and VvAGL15-overexpressing tomato lines (OE8, OE11, and OE12) at 30, 60, 90, and 100 days after sowing.

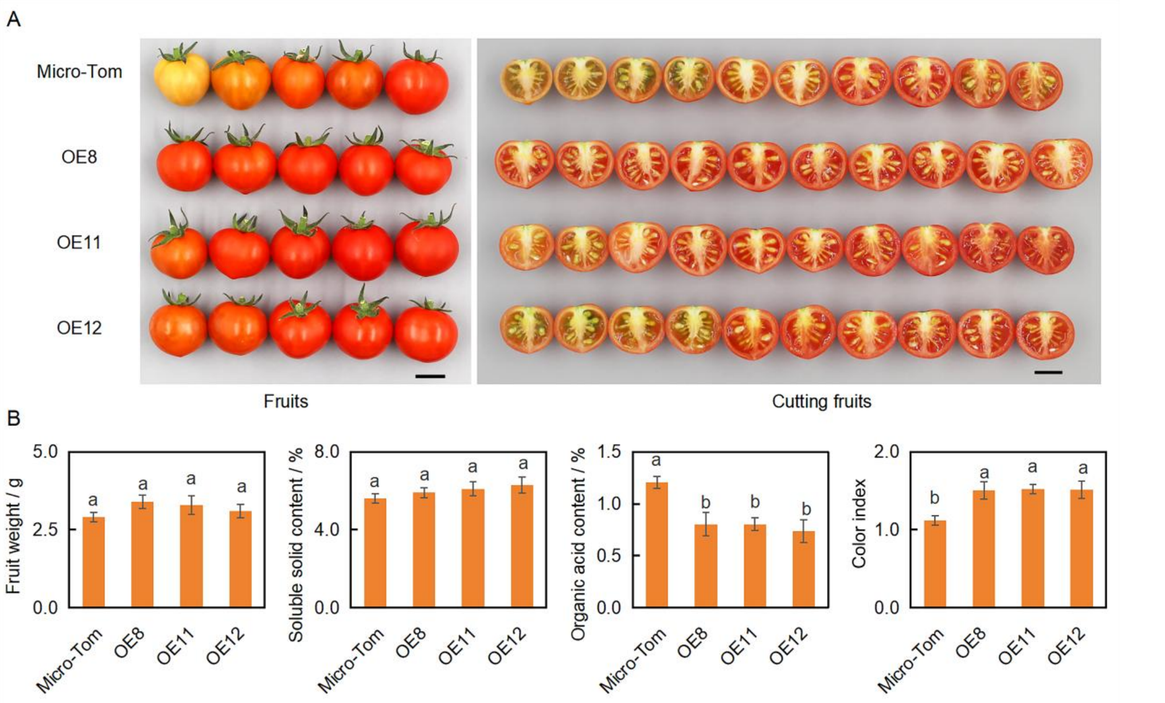

Figure 6. Fruit characteristics of the tomato lines at 120 days after sowing.
A: Fruit and cut fruit phenotypes of tomatoes from different lines; B: Single fruit weight, SSC, organic acid content, and color index of the fruit from various tomato lines (bar = 1 cm). Different lowercase letters indicate significant differences ($p < 0.05$).

CONCLUSION

1. Early grape color change usually leads to an earlier fruit ripening period
2. VvAGL15 overexpression enhances growth, flowering, and color transformation, thus playing an important role in fruit growth and development.