MES7 Modulates Seed Germination Via Regulating Salicylic Acid Content in Arabidopsis

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Research Article

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Abstract

Seed germination is an important phase transitional period of angiosperm plants and sensitive to environment condition. Although seed germination is under the regulation of salicylic acid (SA) and other hormones, the molecular mechanism underlying these regulations remains mysterious. In this study, we determined the expression of SA methyl esterase (MES) family genes during seed germination. We found that MES7 expression decreases significantly in imbibed seeds, and the dysfunction of MES7 decreases SA content. Furthermore, MES7 reduces and promotes seed germination under normal and salt stress conditions, respectively. The application of SA restores the seed germination deficiencies of mes7 mutants under different conditions. Taking together, our observations uncover a MeSA hydrolyzation enzyme, MES7, regulates seed germination via altering SA titer under normal and abiotic stress conditions.

Full Text

Due to technical limitations, full-text HTML conversion of this manuscript could not be completed. However, the latest manuscript can be downloaded and accessed as a PDF.

Figures

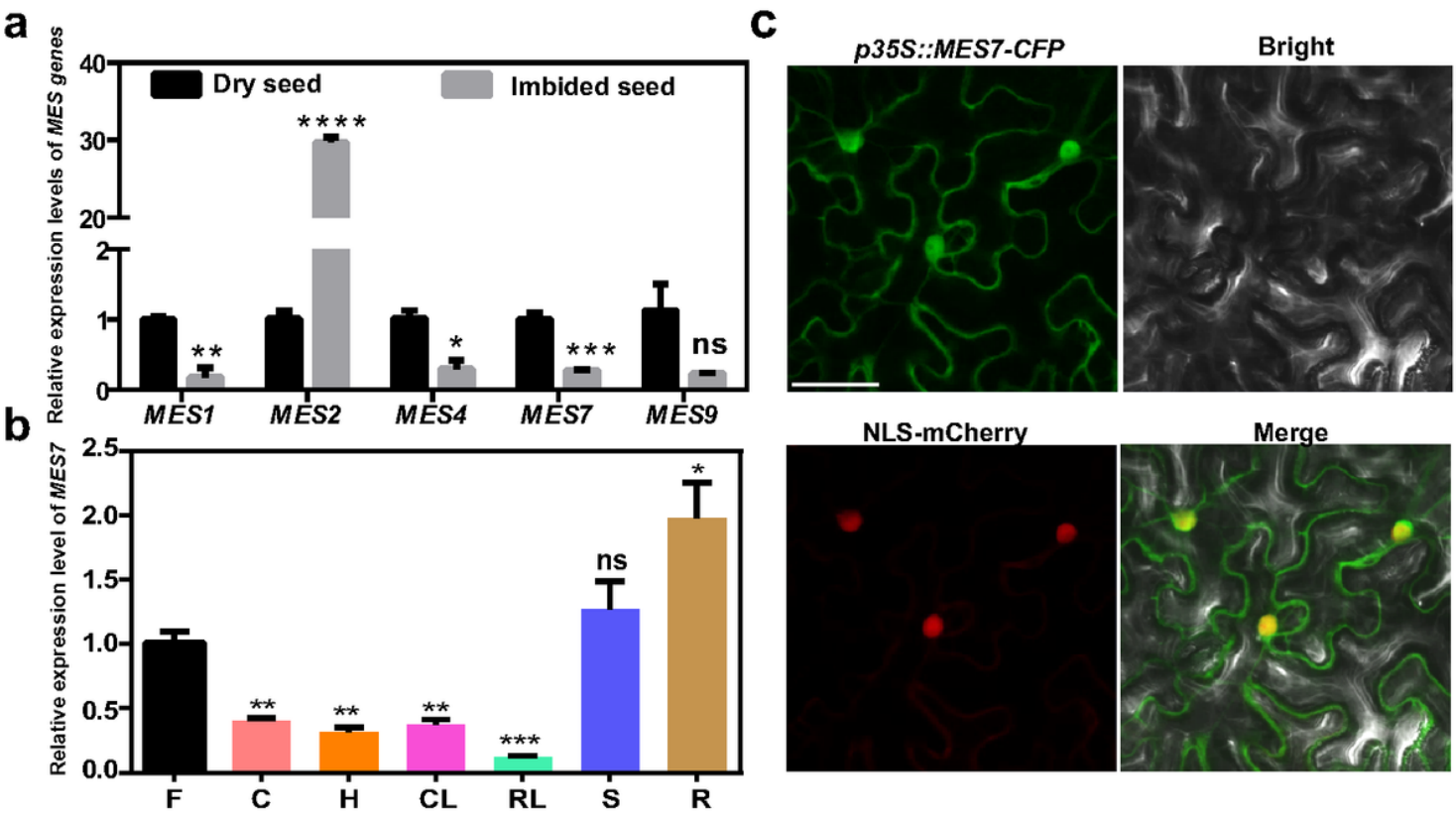

Figure 1

Expression and subcellular localization analysis of MESs. a Relative expression of MES1, MES2, MES4, MES7, and MES9 in seeds. To determine the MES1, MES2, MES4, MES7, and MES9 transcript levels in seeds, Col-0 WT seeds were imbibed on moistened filter paper for 24 h, whereas dry seeds were maintained on dry filter paper for 24 h. Total RNA was extracted from the seeds, and GAPDH was used as an internal control. b Relative expression of MES7 in different tissues of A. thaliana. R: Root, S: Stem, F: Flower, CL: Cauline leaf, RL: Root leaf, C: cotyledon, H: hypocotyl. Cotyledons and hypocotyls were taken from one-week-old seedlings, and other tissues were taken from eight-week-old flowering A. thaliana. ACTIN2 was used as an internal control. The expression of MES7 in flower was set as 1. Error bars represent standard deviation of three replicates. Asterisks mark significant differences according to Student's t-test, *P value < 0.1, **P value < 0.01, ***P value < 0.001, ****P value < 0.0001. Primers are listed in Supplemental Table 1. c Microscopy analysis of the subcellular localization of MES7 in epidermal cells of N. benthamiana. Green indicates CFP. Red indicates NLS-mCherry. Scale bar, 50 μm.

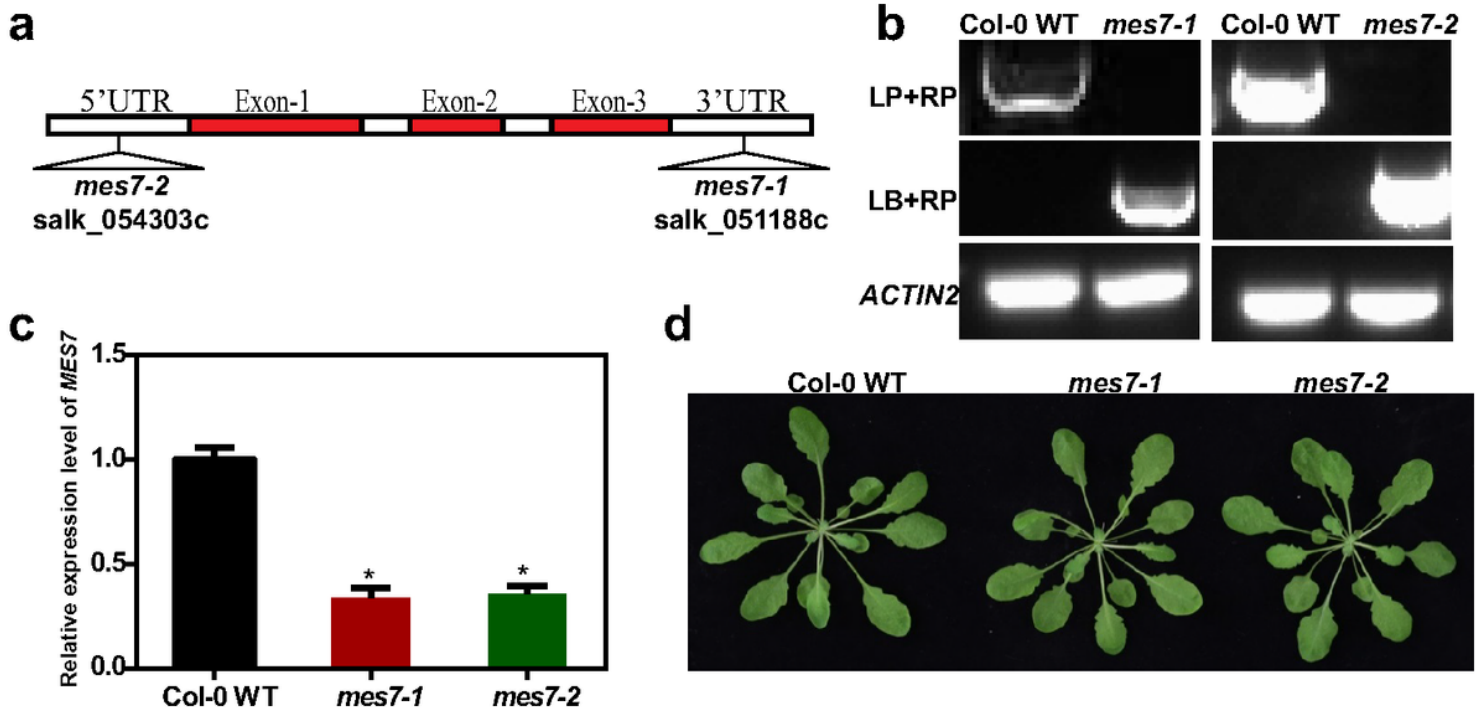

Figure 2

Identification of mes7 mutants. a Scheme of MES7 T-DNA insertion 2osition of the two mutants: mes7-1 (Salk_051188c), mes7-2 (Salk_054303c). b Genotyping on mes7-1 and mes7-2 mutants. ACTIN2 was used as an internal reference gene. c Relative expression level of MES7 in mutants was analyzed by qRT-PCR. Error bars represent standard error of mean of three replicates. Asterisks mark significant differences according to Student's t-test, *P value < 0.05. d Phenotype of five-week-old Col-0 WT and mes7 mutant plants.

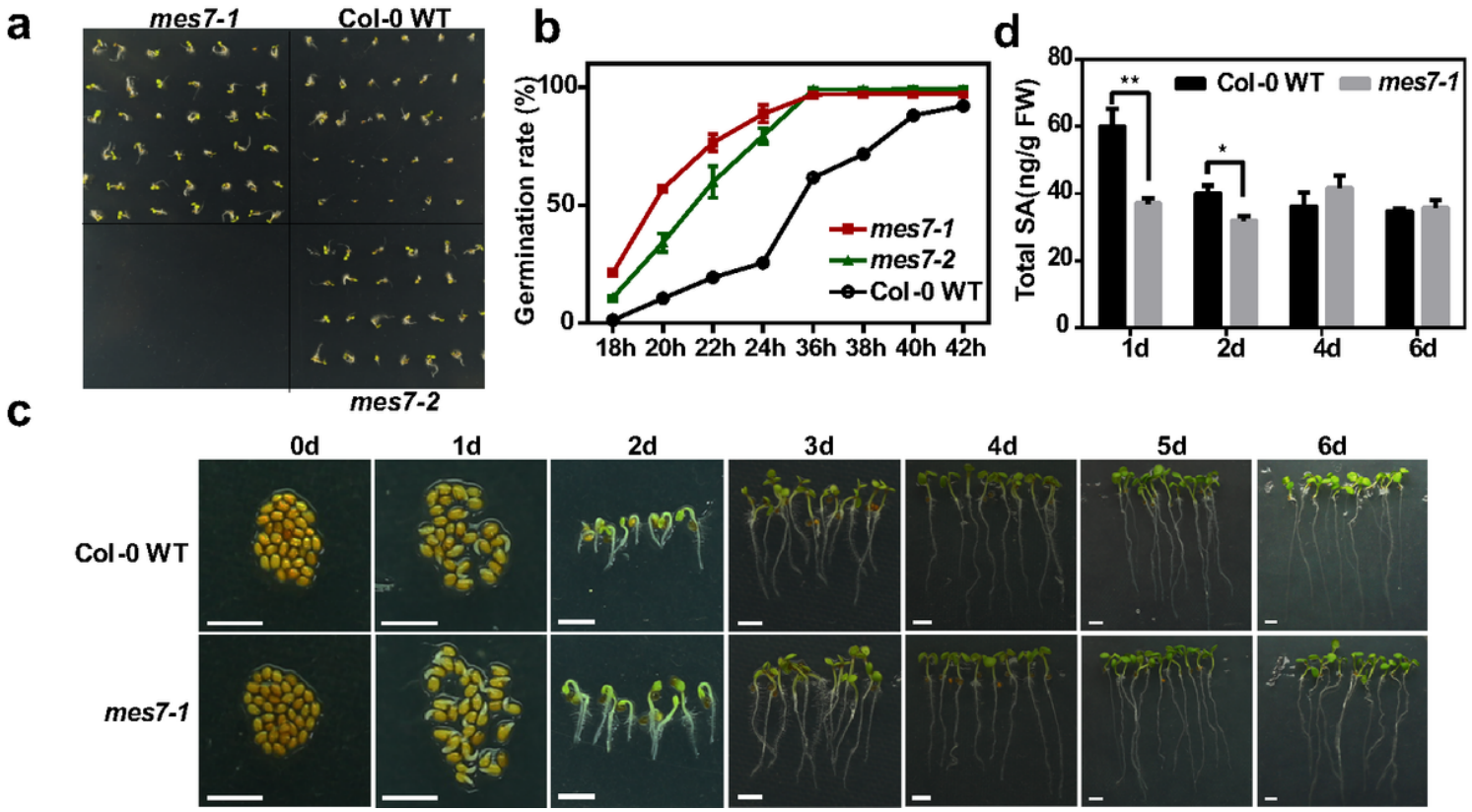

Figure 3

MES7 modulates seed germination under normal condition. a Germination phenotype of Col-0 WT, mes7-1 and mes7-2 seeds on 1/2 MS medium. Representative images were photographed at 3 days after incubation under normal germination condition. b Time course quantification of germination on 1/2 MS medium. c Phenotype of seeds and seedlings at different germination time. Scale bar, 0.2 cm. d SA content in the seedling of Col-0 WT and mes7-1 plants corresponding to c. Error bars indicate the standard error of the mean. Similar results were obtained for more than three biological replicates. Asterisks indicate significant differences according to Student's t-test, *P < 0.05, **P < 0.01, for the others, P ≥0.05.

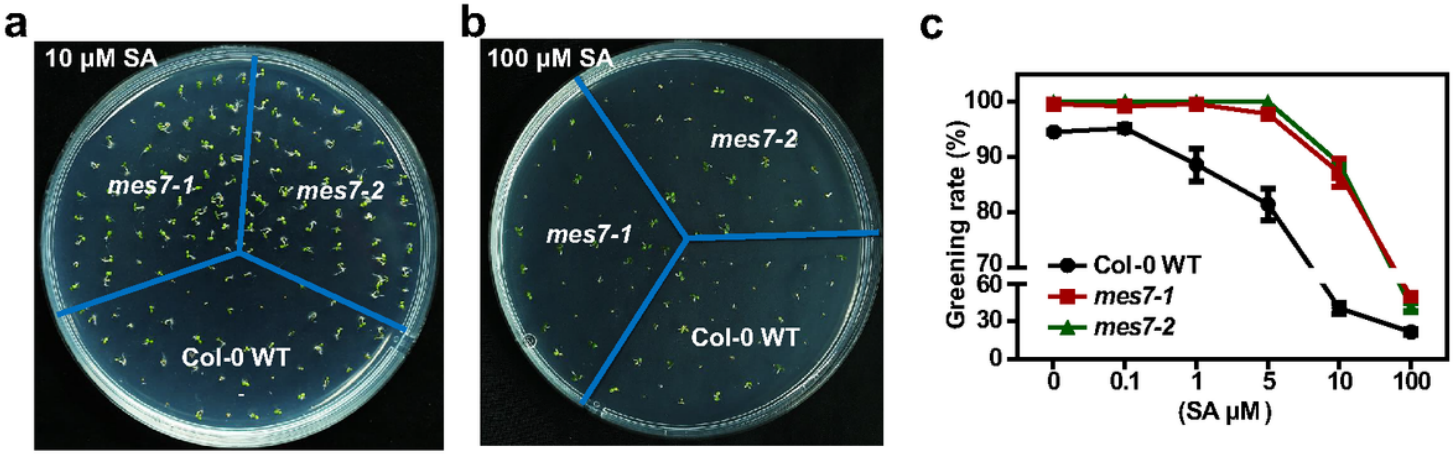

Figure 4

MES7 modulates seed germination in a SA-dependent manner under normal conditions. Representative image of Col-0 WT and mes7 mutants under 10 μM SA (a) and 100 μM SA (b) treatments. c Greening index (two cotyledons exposed) of Col-0 WT and mes7 mutant seeds under different concentrations of SA. Data collected after 3 days grow at 22 °C in the incubator. Data are mean ± SEM of three replicates.

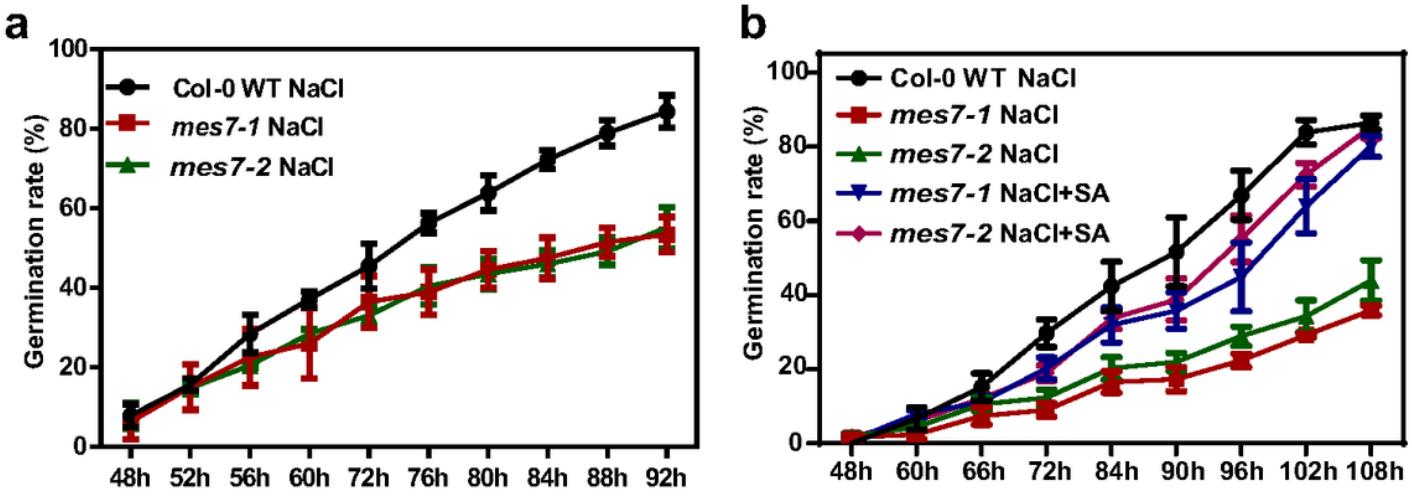

Figure 5

Application of exogenous SA rescues the germination deficiency of the mes7 mutants under saline conditions. a Time course quantification of germination on 1/2 MS medium containing 150 mM NaCl. b Effects of low concentrations (10 μM) of SA on germination of mes7 mutant seeds in the presence of 150 mM NaCl. Data from three independent replicates are shown; error bars indicate ± SEM of the mean.

Supplementary Files

This is a list of supplementary files associated with this preprint. Click to download.

- SupplementalTable1.pdf