Loss-of function of *SPFF*, a novel receptor-like kinase, induces parthenocarpy in tomato

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Abstract

We are facing to the global warming. Fruit yield is deceased under high temperature because of a failure in pollination. To improve fruit yield under harsh environmental conditions, it is needed to understand the mechanism of fruit set. However, its genetic and molecular factors remain poorly understood. Analyzing the mechanism of parthenocarpy, fruit set without pollination, will help to identify the key regulators that control fruit set. A mutant named *small parthenocarpic fruit and flower* (*spff*) was obtained by γ-ray irradiation of Micro-Tom seeds. In this study, we aimed to identify and characterize the responsible gene for parthenocarpy in *spff* mutant. First, we characterized the visible phenotypes, size of cells and ploidy levels. The characterization of *spff* mutant was male sterility, floral organs dwarfism and parthenocarpic fruits with high ploidy levels. Second, in order to identify the responsible gene for these phenotypes, positional cloning by fine mapping and RNAi strategy were performed. They allowed us to identify that a loss of function of a gene coding a receptor like kinase (*SPFF*) triggers parthenocarpy. Third, to analyze the function and characterization of *SPFF* gene, RNA sequence and *in situ* hybridization were performed. *SPFF* expressed higher at receptacle than the other organs including reproductive organs in developing buds. The expression level of cell cycle genes (*CDKB*) and the gene maintaining stem cell (*WUSCHEL*) were affected at developing ovule. According to these results, our research brought a new point of view of the mechanism of fruit set, that they are suppose to be regulated by a receptor like kinase named *SPFF*. Furthermore, we also brought an idea that a responsible gene for parthenocarpy was expressed in receptacle and suppose to be in vascular bundle although the function of receptacle and vascular bundle during fruit set in tomato had not been noticed so far.

Image

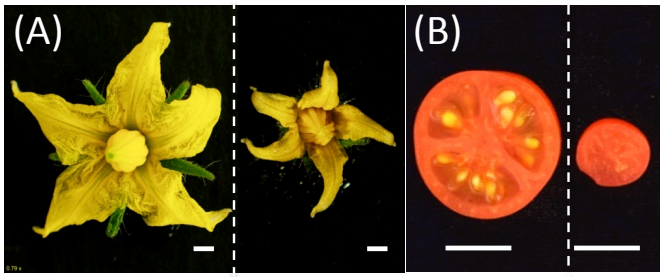


Figure 1. *spff* mutant phenotype
(A) Flower morphology. All flower organs of *spff* were smaller than WT.
(B) Cross section of mature fruits. The *spff* occasionally bore small parthenocarpic fruit. Parthenocarpic fruit doesn't have any seeds.
(A and B) The left is WT, the right is *spff*. Bar; (A) 1 mm, (B) 1 cm

Recent Publications (minimum 5)

1. Ariizumi T, Shinozaki Y, Ezura H (2013) Genes that influence yield in tomato. 63: 3-13.
2. Saito T, Ariizumi T, Okabe Y, Asamizu E, et al. (2011) TOMATOMA: a novel tomato mutant database distributing Micro-Tom mutant collections. Plant Cell Physiol 52: 283-296.
3. Takei H, Ezura K, Ezura H, Ariizumi T (2017) Current understanding of mechanism for parthenocarpy contributed to stable tomato production. Ikusyugaku kenkyu 19: 137-144.
4. Shinozaki Y, Hao S, Kojima M, Sakakibara H, et al. (2015) Ethylene suppresses tomato (*Solanum lycopersicum*) fruit set through modification of gibberellin metabolism. Plant J 83: 237-251.
5. Hao S, Ariizumi T, Ezura H (2017) Sexual sterility is essential for both male and female gametogenesis in tomato. Plant Cell Physiol 58: 22-34.



Biography

Ms. Hitomi TAKEI was received the Bachelor degree of Bioresource Science from The University of Tsukuba in 2016. Now she is a student of international double degree Master's program co-organized by The University of Tsukuba in Japan and University of Bordeaux in France. She has her passion in working toward a solution of food security problems in African countries and other developing regions of the world by improving yields of vegetables and crops.

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Notes/Comments: