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CRISPR/Cas9-mediated targeted mutagenesis of *GmFT2*a delays flowering time in soybean

*Wensheng Hou**, National Center for Transgenic Research in Plants, Institute of Crop Sciences, Chinese Academy of Agricultural Sciences, Beijing, China
Yupeng Cai, National Center for Transgenic Research in Plants, Institute of Crop Sciences, Chinese Academy of Agricultural Sciences, 100081, China
Li Chen, National Center for Transgenic Research in Plants, Institute of Crop Sciences, Chinese Academy of Agricultural Sciences, Beijing, China
Xiujie Liu, National Center for Transgenic Research in Plants, Institute of Crop Sciences, Chinese Academy of Agricultural Sciences, Beijing, China
Chen Guo, National Center for Transgenic Research in Plants, Institute of Crop Sciences, Chinese Academy of Agricultural Sciences, Beijing, China
Shi Sun, Ministry of Agriculture Key Laboratory of Soybean Biology, Institute of Crop Sciences, Chinese Academy of Agricultural Sciences, Beijing, China
Cunxiang Wu, Ministry of Agriculture Key Laboratory of Soybean Biology, Institute of Crop Sciences, Chinese Academy of Agricultural Sciences, Beijing, China
Bingjun Jiang, Ministry of Agriculture Key Laboratory of Soybean Biology, Institute of Crop Sciences, Chinese Academy of Agricultural Sciences, Beijing, China
Tianfu Han, Ministry of Agriculture Key Laboratory of Soybean Biology, Institute of Crop Sciences, Chinese Academy of Agricultural Sciences, Beijing, China

Flowering is an indication of the transition from vegetative growth to reproductive growth and has considerable effects on the life cycle of soybean (*Glycine max*). In this study, we employed the CRISPR/Cas9 system to specifically induce targeted mutagenesis of *GmFT2a*, an integrator in the photoperiod flowering pathway in soybean. The soybean cultivar Jack was transformed with three sgRNA/Cas9 vectors targeting different sites of endogenous *GmFT2a* via *Agrobacterium tumefaciens*-mediated transformation. Site-directed mutations were observed at all targeted sites by DNA sequencing analysis. T1 generation soybean plants homozygous for null alleles of *GmFT2a* frameshift mutated by a 1-bp insertion or short deletion exhibited late flowering under natural conditions (summer) in Beijing, China (N39°58', E116°20'). We also found that the targeted mutagenesis was stably heritable in the following T2 generation, and the homozygous *GmFT2a* mutants exhibited late flowering under both long-day and short-day conditions. We identified some "transgene-clean" soybean plants that were homozygous for null alleles of endogenous *GmFT2a* and without any transgenic element from the T1 and T2 generations. These "transgene-clean" mutants of *GmFT2a* may provide materials for more in-depth research of *GmFT2a*functions and the molecular mechanism of photoperiod responses in soybean. They will also contribute to soybean breeding and regional introduction.