Characteristics of Tomato Plants Expressing Homozygous Mutated Lateral Suppressor Genes (Ls) Generated by CRISPR-Cas9 System

Beemnet Mengesha Kassahun1, Beum-Chang Kang2, So-Jil Bae2, Ye Jin Nam1, and Jeung-Sul Han1*

1Department of Horticulture, Kyungpook National University, Daegu 41566, Korea, 2Center for Genome Engineering, Institute for Basic Science, Daejeon 34047, Korea

Genome editing technology is a powerful tool to make precise change in the genome of organism of interest. Of the technologies, CRISPR-associated RNA-guided endonuclease Cas9 (CRISPR-Cas9) has become widely used for characterizing gene function and improving traits in plants. Tomato is one of the most economically important horticultural crops. Almost tomato genotypes except a natural mutant produce undesirable axillary shoots during cultivation, which let farmers invest additional cost for their management. The results of previous molecular studies revealed that the expression of lateral suppressor gene (Ls) promotes the outgrowth of axillary shoots in tomato. However, the natural Ls mutants have not been used in tomato production due to several undesirable traits. Owing to the multifarious beneficial effects of genome editing technologies, we introduced the CRISPR-Cas9 system to precisely edit the Ls gene using a genetic transformation procedure.

We generated T1 homozygous mutants with different InDel patterns in ‘Heinz 1706’, ‘Rubion’, and ‘Moneymaker’ cultivars. Interestingly, several edited lines revealed not only the formation of new start codon in two base deletion lines but also new start codon accompanying with successive new two codons in one base insertion lines. These lines showed distinguishable phenotypes such as reduced number of axillary shoots and lowered first flower truss compared with wild types. Other edited homozygous lines with large deletions showed expected phenotypes. Given the observed phenotypes in the mutants, the modification of Ls function by CRISPR-Cas9 system in present study departs from the common opinion “Ls gene mutation in tomato does not turn out desirable agronomic traits”. Collectively, we demonstrated the suitability of CRISPR-Cas9 system for targeted Ls gene editing in a variety of tomato cultivars, and the finding of our study provides the tool for regulating tomato plant architecture.

T. 053-950-5729, peterpan@knu.ac.kr