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Using Cell Culture Systems and CRISPR-Cas9 Genome-Editing Technology to Increase Seed Production and Sustainable Vegetable Oil Yields in Soybean

Abstract

An increasing population has led to a high and consistent food demand which has reinvigorated worldwide interests to create high-yielding varieties of legumes. Soybean *Glycine max* (L.), native to eastern Asia, member of the legume family has become one of the most important and essential food crops due to its oil and protein contents and demand. Major consumers of soybean products are the food, nutritional, pharmaceutical, cosmetic, and bioenergy industries. Nowadays, soybean provides 22% of the worldwide vegetable oil, and its seeds contain 20% and 40% of the oil and protein, respectively. These percentages can be increased since soybean have the potential to feed the world and improve agricultural economics. To improve this, high-throughput efficient cell culture systems capable of genetic transformation and regeneration are necessary for studying protein disulfide isomerase (PDI) gene functions and germplasm improvement. We will employ ortholog PDIs reported in Arabidopsis to improve seed development/size and subsequently increase oil yields. For that reason, we rationalize that *Glycine max* PDI genes are valuable target genes to improve seed properties and to enhance edible oil traits in soybean. Thus, our study focuses on developing reliable transformation and regeneration methods for soybean to enable cloning of PDI genes with CRISPR/Cas9 technology. This will lead us to a better understanding of PDIs gene role in the seed development and oil production in soybean and provide fast and reliable methods to alter the genes of this crop. Thus, using a multi-disciplinary approach including cell and tissue culture, genetics and genomics, biochemistry, biotechnology, and bioinformatics, three objectives to investigate are i) Transformation of established soybean cell culture systems with CRISPR/Cas9 genome-editing technology. ii) Regeneration of CRISPR/Cas9 cell lines to obtain soybean plantlets. iii) Genetic characterization of CRISPR lines. Currently, we established cell lines that are being employed for transformation and regeneration.

Keywords: Cell culture system, CRISPR-Cas9 genome editing technology, Protein disulfide isomerases, Regeneration, Seed, Transformation, Vegetable oils.