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SACPD-C mutations uncover an impact of stearic acid in leaf and nodule structure and morphology

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Soybean [*Glycine max* (L.) Merr.] is the most widely consumed legume crop in the world, providing 56% of the world's oilseed production. Soybean cultivars contain between 3-4% seed stearic acid. Increasing stearic acid confers a higher melting temperature and oxidative stability necessary for solid fat application. Highly-saturated soybean seed oil would be suitable for this end use. Stearoyl-acyl carrier protein desaturase (*SACPD-C*) has been reported to control the accumulation of seed stearic acid; however, no study has previously reported its involvement in leaf stearic acid content and impact on leaf structure and morphology. A subset of an EMS mutagenized population of soybean c.v. 'Forrest' was screened to identify mutants within *GmSACPD-C* gene. Using a forward genetics approach, nonsense and four missense *Gmsacpd-c* mutants were identified to contain not only high levels of seed, but also high nodule number, in addition to increased leaf and nodule stearic acid content. The EMS nonsense F605 mutant presented the highest seed stearic acid content even reported. Homology modeling and *in silico* analysis of the GmSACPD-C enzyme reveals that most of these mutations were localized near or at conserved residues essential for di-iron ion coordination. Furthermore, mutations at conserved residues cause the highest stearic acid content and correlate with the presence of cell senescence and a necrotic cavity in the nitrogen fixing nodules. Interestingly, soybean plants with GmSACPD-C mutations in non-conserved residues show an increase in stearic acid content and conserving healthy nodules. Thus, random mutagenesis and mutational analysis allows the development of high seed stearic acid content soybeans with no associated negative agronomic characteristics. Finally, results obtained from the current study uncover the impact of *GmSACPD-C* mutations in leaf and nodule structure and morphology.