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Altering concentration of omega-6 and omega-3 by improving fatty acid bio-synthesis system in soybean

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Soybean seed has about 20% oil content at maturity with the oil being the world's most widely used vegetable oil. Soybeans contain five predominant fatty acids, 12% palmitic acid, 4% stearic acid, 23% oleic acid (ω -9), 54% linoleic acid (ω -6, LA) and 8% α - acid (ω -3, ALA). Linolenic acid or ω -3 was reported to have anticancer and anti-inflammatory effects and a role in preventing cardiovascular diseases. In contrast, oils high in ω -6 were reported to have negative effects on health in humans. Studies have shown that minimizing the ω -6/ ω -3 ratio in edible oils could have human health benefits. Therefore, reducing the ω -6/ ω -3 ratio of soybean fatty acids has become a goal in breeding programs. Normal soybeans have a ω -6/ ω -3 ratio of 6 to 7. Wild soybeans contain ~15% ω -3 in seed oil whereas cultivated soybeans have ~8%. Therefore, progeny having different ω -6/ ω -3 ratios can be derived from interspecific crosses between a wild and cultivated soybeans. A cross between S08-14717 with high oleic genes *FAD2-1A* and *FAD2-1B* having ~80% oleic acid and ~5% ω -6 and ω -3 each was made with wild soybean, PI 483463, with ~14% oleic acid and 55% ω -6 and 15% ω -3. There was large variation in fatty acid composition in $F_{2:3}$ seed oil from each of 1500 F_2 plants from the population. Lines having *FAD2-1A* or *FAD2-1B* mutations had 33.5 – 47.1 % oleic acid, 26.5 – 37.8 % ω -6, and 13.9 – 15.7 % ω -3. Therefore, several lines were identified with ω -6/ ω -3 ratios as low as 2-3:1. Lines with low ω -6/ ω -3 ratios have been advanced to the F_5 generation with the ω -6/ ω -3 ratios stable in every generation. The ratio between ω -6 and ω -3 is reduced by using *FAD2-1A* or *B* mutations to increase oleic acid and reduce ω -6 while increasing the ω -3 from wild soybean. This system will be useful to improve fatty acid composition in soybean.