Advances in Crop Science and Technology

Sticklen, Adv Crop Sci Tech 2016, 4:6
DOI: 10.4172/2329-8863.1000246

Short Communication OMICS International

Metabolic Engineering Technology to Increase Corn Seed High Energy-Density Storage Oil by Two-Fold to Benefit the US and Sub-Saharan Africa

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Triacyglycerols (TAGs) are high energy-density oils, stored in the seeds of oil crops such as soybean and canola, and in the fruit of oil fruit crops such as olive and avacado. Presently, the oil crop TAGs generate $ 25 billion per year [1].

Several crop oil biosynthesis expert teams comprehensively reviewed the biochemical pathways that are associated with TAGs biosynthesis [2-5]. Among genes associated with TAGs biosynthesis, is Diacylglycerol O-Acyltransferase 1 (DGAT1), a gene that encodes for the last enzyme in TAGs biosynthesis [6]. There are also several transcription factors that supply substrates needed for synthesis of crop fatty acids. The most studied among these transcription factors is Wrinkled 1 (WRI1), a transcription factor that controls at least 15 associated enzymes [2,6].

After synthesized, TAGs are packaged into spherical oil droplets inside the seeds, where each droplet is protected from lipolysis by the oleosin protein molecules. Oleosin molecules not only protect the oil bodies from lipolysis, they also control the size of the oil bodies from becoming larger and more degradable [7,8].

In its accepted Crop Science article Alameldin [10] the author's research team was able to increase the total oil contents of metabolically engineered corn seeds by 25% or by 9 mg total oil per gram seed dry weight as compared to the seeds of their wild-type control plants. Such increase in oil content translates to 9 kg oil production per a metric ton of dry corn seeds. The team was also able to increase the TAGs in corn seeds by 117%, increasing the high energy density value of the corn seeds.

Corn is the major feed and bioenergy (i.e., corn ethanol) crop of the U.S. Considering that the U.S. corn farmers usually produce 10 tons of seeds per hectare in the field, they should be able to produce 90 kg more oil for biodiesel and other uses, in the seeds of metabolically engineered plants as compared to their wild-type control plants [9].

Corn is also the major staple crop all across the Sub-Saharan Africa. The productivity of maize, however, is very low in Sub-Saharan Africa compared to many regions of the world. It is predicted that by 2050, the world population will increase from 7.3 billion to 9.5 billion, almost all in developing countries especially in countries of Sub-Saharan Africa. Therefore, higher yield and higher calorie (high density energy) crops such as genetically improved corn are needed for their human survival.

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Received October 22, 2016; **Accepted** November 15, 2016; **Published** November 21, 2016

Citation: Sticklen M (2016) Metabolic Engineering Technology to Increase Corn Seed High Energy-Density Storage Oil by Two-Fold to Benefit the US and Sub-Saharan Africa. Adv Crop Sci Tech 4: 246. doi: 10.4172/2329-8863.1000246