Soybean Breeding in the U.S.
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Soybean provides approximately 71% of the world’s protein meal and about 29% of the world’s vegetable oil. The U.S., Brazil, and Argentina supply approximately 80% of the world’s soybean production, accounting for approximately 88% of world soybean exports. In the U.S., approximately 30 million metric tons of meal are used by livestock; with poultry (54%), swine (23%), and beef (12%) having the largest share. Whole soybeans account for 80% of U.S. exports, mostly to China, Mexico, and Japan.

U.S. soybean breeders develop varieties with high yield, desired composition, and defensive traits that can endure suboptimal production environments. Defensive traits fall into three categories 1) resistance to weeds (through the use of biotech-enhanced herbicide-resistant varieties, 2) resistance to biotic stresses such as nematodes (soybean cyst, root-knot, reniform, etc.), fungal diseases (soybean rust, Phytophthora root rot, charcoal rot, etc.), as well as bacterial and viral diseases (bacterial leaf blight, bacterial pustule, etc.), and 3) resistance to abiotic stresses (heat, cold, drought, flooding, and mineral toxicity/deficiency, etc.).

Commercial companies are now moving into an age of “designer-gene” varieties. With the rapid advance of genomic analysis and molecular tools, we are approaching the time when varieties will be custom designed for specific market areas and potentially even for specific producers. Genomics allows for breeding in reverse, wherein a variety is conceived and designed, and then the necessary compliment of genes are thought-assembled by molecularly selecting the appropriate parents. Proprietary computer algorithms can now reliably predict the number of progeny needed to arrive at the desired genotype with its full complement of “designer genes.” A full array of molecular markers can then be used to select the specified “designer” variety prior to any phenotypic selection. Testing of phenotypes will be done more to confirm prior molecular selections than to actually make selections. Single genes will be added or deleted to accommodate changing needs and markets.

In 2017, biotech-enhanced stacked combinations of herbicide-resistant products will be commercially available in the U.S. In many states, producers will be allowed for the first time to spray tank mixes of Roundup and Dicamba on varieties engineered to be resistant to both herbicides. Other varieties have been engineered to resist Roundup, 2-4 D, and Liberty, allowing the use of multiple herbicides on a single crop. These varieties will not be marketed in 2017, but may be in 2018, depending upon existing U.S. and international laws. Also, laws in individual U.S. states may govern which herbicide combinations can be used together.

In the USDA-ARS and other public research institutions, we try to compliment and assist industry by working on traits that need attention, but that are not the highest priorities for industry. In my soybean breeding program, we have focused on tolerance to specific abiotic (heat and drought) and biotic stresses (multiple diseases and nematodes) as well as on increasing the diversity of yield genes. Working together, U.S. public and private soybean breeders continue to contribute to supplying the world’s demand for soybean and soy products.