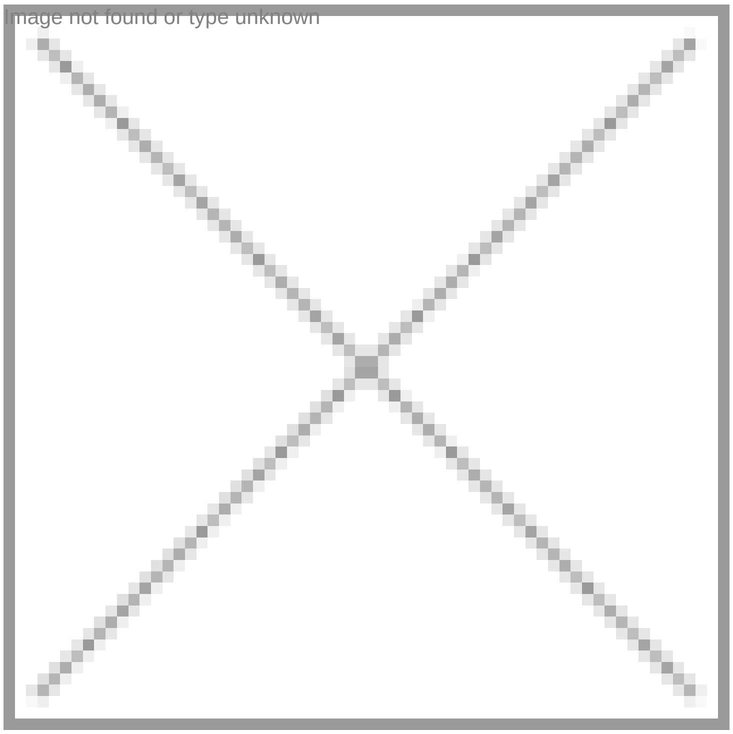
BioSpectrum the business of Bio & Health Sciences

Genuity SmartStax corn: An amazing advancement in GE crop

05 May 2010 | News



Using GS corn as a platform would be a quicker way of enhancing the number of transgenes in a single crop variety

The trademarked Genuity-SmartStax corn (GS corn) containing eight transgenes-six for pest control and two for weedcontrol-developed through collaboration between Monsanto and Dow AgroSciences, introduced few months ago, is an amazing development in crop genetic engineering (GE). Incorporated into the best of corn varieties, this event is expected to provide the most comprehensive pest and weed control system available, leading to an impressive crop health and increase of whole farm crop yields. The development of Genuity SmartStax corn from the shaky origins of genetic engineering is a fascinating reading.

Genuity SmartStax corn
GS corn takes care of the major pests, such as the European and southwestern corn borer, northern and western corn rootworm, western bean cutworm, black cutworm, corn earworm, and fall armyworm and also imparts tolerance to both glyphosate and glufosinate herbicides. In addition, the coming together of two giants in the seed industry will encourage other private-private partnerships to further this initiative.

Eight transgenes in GS corn

- Tolerance to aerial pests (three Bt genes): Cry 1A.105 (Monsanto), Cry 2Ab2 (Monsanto) and Cry 1F (Dow).
- Tolerance to subsoil pests (three Bt genes): Cry 3Bb1 (Monsanto), Cry 34Ab1 (Dow) and Cry 35Ab1 (Dow).
- Tolerance to herbicides (two genes): Glyphosate (Roundup Ready, Monsanto) and Glufosinate (LibertyLink, Dow, under license from Bayer).

Biosecurity evaluation

Transgenic crops are evaluated for product efficacy and biosecurity in the laboratory, green house and in the field for over 10 years before commercialization. The GS corn is in phase-IV of regulatory evaluation, the final step prior to the product's planned commercial release in 2010. This phase includes development and testing of best trait and germplasm combinations for commercial launch.

All the genes involved in the GS corn were approved in the US in single gene transgenic varieties and are being commercialized in different countries. Each of these eight traits has also been individually approved by the Canadian Food Inspection Agency (CFIA).

A refugium is a non-Bt buffer zone in a transgenic crop field to retard the development of pest resistance to the Bt proteins. Earlier a 20 percent refugium was mandatory. In June 2008, Monsanto requested the US Environment Protection Agency (EPA) for a reduction of refugium requirement to five percent for GS corn in the northern corn belt and 20 percent in southern states where cotton is planted. The EPA has now approved a five percent refugium for the product's aerial pest protection. The CFIA has evaluated the potential impact and risk to the environment, by using a five percent non-Bt refugium strategy for the GS corn, and has concluded that 'a conditional authorization until December 31, 2012, for the use of this reduced volume of refugium poses minimal risk to the environment'. Thus both the US and Canada have given short-term approvals for GS corn.

Anti-tech activism

There has been a protracted and persistent activism against GE crops stemming mostly from Europe for over 15 years. It is not surprising that the activist groups were disappointed when an eight gene product is approved by both the US and Canadian regulatory authorities. Some Canadian farmer and environmental groups said that Canada rushed the approval process ignoring environmental risks and even without making public the basis of their decision. They charged that the CFIA has substantially weakened a critical environmental stewardship rule just for the introduction of SmartStax.

Committee for Independent

Research and Information on Genetic Engineering (CRIIGEN) alleged that humans are used as guinea pigs for the 'second generation' of genetically modified (GM) crops. The Canadian Biotechnology Action Network, chose the World Food Day (October 16, 2009) as the first 'International Day of Action Against Multinational Corporations'. Some activist groups argue that there might be unintended consequences when so many traits are combined. It should not surprise any one if the opposition to GS corn gains momentum in the coming months.

Commercialization process

Notwithstanding activist noises, GS corn is being planned to be grown on 30 to 40 lakh acres in the US and Canada in 2010, both for internal consumption and export. With regulatory approvals for import, GS corn will now be exported to Japan, Korea, Taiwan, Mexico, Australia and New Zealand, under the trade names such as Mycogen, Dairyland, Renze, Brodbeck, Triumph, Pfister and Hyland.

Certainly there would be several other products similar to GS corn, but using GS corn as a platform would be a quicker way of enhancing the number of transgenes in a single crop variety, not as a gene game but to compound several benefits into a single product.

How GE crops evolved?

Genetic engineering

The concepts of 'biotechnology' (Karl Erkey1919) and 'genetic engineering' (Justin, 1941) came into use long before Watson and Crick (1953) proposed their model of the structure of DNA, the genetic material. It took 20 years of basic research before Stanley Cohen and Herbert Boyer (1973) perfected the recombinant DNA (rDNA) technology. They cut genes of the African clawed toad using restriction enzymes and incorporated them in the genome (total genetic complement) of the experimental bacterium Escherichia coli (E. coli) using the enzyme DNA ligase and demonstrated the expression of the transferred genes in the new environment, a major breakthrough in GE.

Genesis of GE crops

In 1982, the first transgenic plant, an antibiotic resistant tobacco, was developed. In January 1983, three different teams reported success in using the bacterium, Agrobacterium tumefaciens, a natural genetic engineer, to produce transgenic plants. Soon, using Agrobacterium tumefaciens to carry new genes into plant cells became the most common means of producing transgenic plants. Field tests for GE crops resistant to pests and pathogens were first conducted in the US in 1985 and the first GE tobacco was approved for commercial release in 1986. After getting the approval from the Food and Drug Administration, Flavor Saver, the first GE tomato, with a longer shelf life, reached the US markets in 1994. Between 1995 and

1996, GE soybean, corn and cotton were approved for commercialization in the US.

GE crops with several different beneficial traits are now commercially cultivated in 25 countries and imported into five others. Global transgenic acreage has increased from 17 lakh hectares in 1996 to 12.5 crore hectares in 2008. This impressive growth indicates farmer and consumer acceptance of GE crops and products for their benefits. Over 35 crore Americans have consumed GE foods for over 13 years without any discernible untoward health effects showing that GE food crops and their products are safe for human consumption.

The most widely used trait in the commercialized GE crops is tolerance to the most important pest in each of such crops as cotton, potato, tomato, and corn, with genes from the universally occurring soil bacterium, bacillus thuringinesis. The other important trait is tolerance to herbicides, to achieve an easier and efficient weed control that facilitates no-tillage farming. There is also a GE papaya with tolerance to the ring spot virus disease in commercial cultivation.

An array of GE crops
A number of grain, oil seed and vegetable crops with diverse traits for pest, disease (bacterial and viral) and herbicide tolerance have joined the array of GE crops, many of them in very advanced stages of development. Produced through gene silencing, a protocol different from rDNA technology, a variety of coffee without caffeine and a variety of tearless onion are interesting products.

GE crops with a number of traits for nutritional enhancement and production of pharmaceuticals are also in advanced stages of development. Golden Rice, rice with genes for Ã¢-carotene, the precursor of vitamin A, is a very promising means to alleviate vitamin A deficiency in the developing countries. GE rice with human milk proteins is designed to provide an efficient infant feed. Rice with higher iron content, a carrot variety with very high levels of calcium and a purple tomato with high levels of anthocyanins that function as antioxidants to prevent several diseases, are fascinating developments in the year 2008.

Among the non-food GE crops, genes for number of pharmaceutically active chemicals, vaccines and antibodies have been introduced into crop plants for an inexpensive and large scale production of these therapeutic aids, an area called biopharming. A GE tobacco plant that synthesizes human haemoglobin and another that detoxifies soils contaminated by explosive residues have been demonstrated. A GE blue rose is now available in the Japanese market.

GE food grains that withstand drought, flood and salinity are high priority research, and so are those for high yield. Due tothe complexity of inheritance of these traits a successful development of these crops would take some years to become a reality.

Genes of transgenic crop
In all these products only a single gene is involved. For quite long it was an open question as to how many different genes can be genetically engineered into a single crop variety, a process called gene stacking or gene pyramiding, to derive their cumulative benefits.

A significant development was Monsanto's Bollgard II, a GE cotton with two stacked Bt genes, Cry 1 Ac and Cry 2 Ab, which provides a better pest control, than with a single gene. In several other crop varieties two genes for pest or viral or herbicide tolerance were stacked. Monsanto announced a triple-stack corn for release in the US in 2009. DuPont stacked five genes in corn to make it both pest and herbicide tolerance.

The April 2009 announcement of a transgenic corn with five different genes to synthesize very high quantities of vitamin A, vitamin C and vitamin B9 precursors, was a welcome news, from the points of view of both scientific accomplishment and

Image not found or type unknown

fits. But the GS corn announced in July 2009, caps it all.

- C Kameswara Rao, Foundation for Biotechnology, Awareness and Education, Bangalore