state of the planet Blogs From the Earth Institute

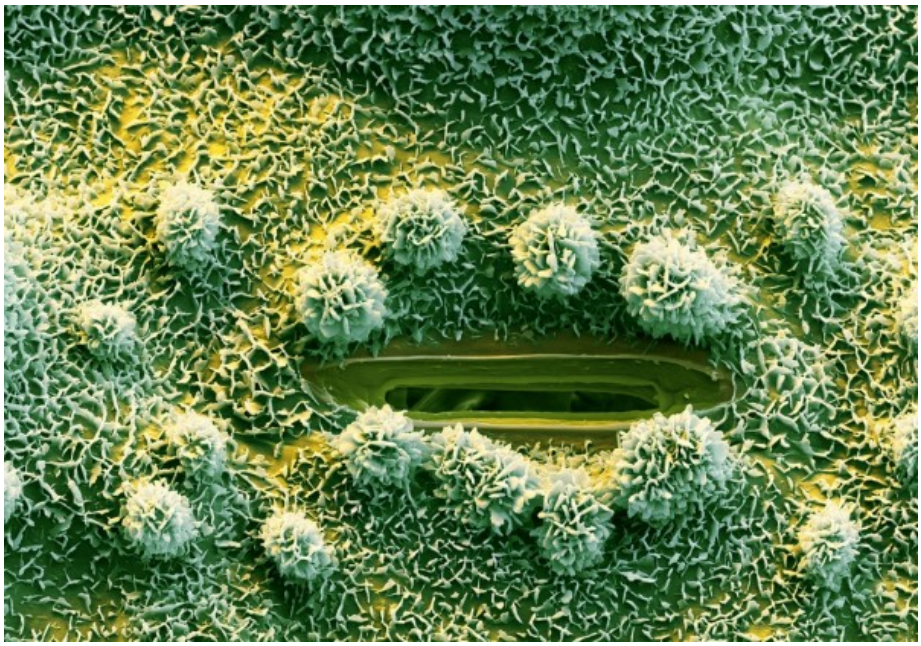
THE EARTH INSTITUTE COLUMBIA UNIVERSITY

ECO MATTERS Center for Environmental Research and Conservation

Climate-Ready Crops: The Pros and Cons

by Renee Cho | 6.23.2011 at 1:16pm | 3 Comments

CATEGORY> AGRICULTURE-FOOD **TAGS>** AGRICULTURE, BIODIVERSITY, CLIMATE AND AGRICULTURE, CROPS, ECO MATTERS, GENETIC ENGINEERING

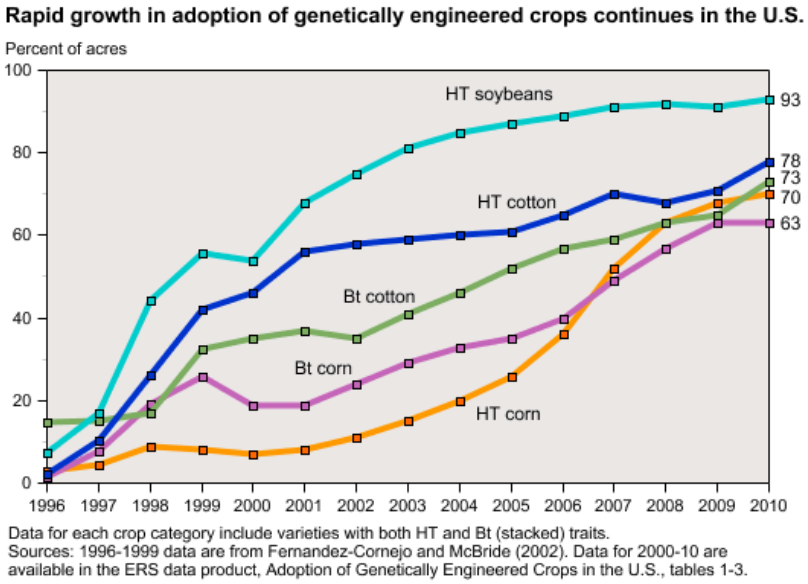


Creating stress tolerant plants with genetic engineering. Photo credit: BASF

"If crops don't adapt to climate change, neither will agriculture, and neither will we," said Cary Fowler of the Global Crop Diversity Trust at the 2009 TED conference. Climate change is already affecting food supplies around the world as heat waves and drought reduce grain harvests and food prices soar. For every 1˚ C rise above optimum growing season temperatures, farmers will likely experience a 10% decline in their yields. And with a growing global population expected to hit 9 billion by 2050, 80 million more people need to be fed each year. Now large agrochemical and seed corporations are developing "climate-ready crops" and have filed 1663 patents for genetically engineered (GE) plants with high tolerance for drought, heat, cold and salinity, according to ETC, a Canada-based organization focused on sustainable and ecological diversity. What are the implications of these climate-ready crops?

Over millennia, agriculture has evolved as farmers identified the most desirable traits in their crops and enhanced crop genetics through selective breeding. Classical breeding involves the exchange of all the tens of thousands of genes in a plant and can only be done with closely related species or genera. In genetic engineering, one or two genes with the desired traits from *any* living organism are transferred directly into the plant's genome, often resulting in novel gene combinations.

The desired gene (called a transgene after it's transferred) is coated onto particles of gold or tungsten and shot into the plant's cells with a gene gun or transferred into the plant's DNA via a bacterium. So far, only two GE applications have been available commercially: one produces herbicide tolerant (HT) crops so that fields can be sprayed with Monsanto's Roundup herbicide (made with the toxin glyphosate) and crops remain unharmed; the second transfers the toxic gene for Bt (*Bacillus thuringiensis)* into the plant to act as a built-in pesticide.



By 2010, almost 366 million acres around the world were planted with GE crops, with the most acreage in the U.S., Brazil, Argentina, India, Canada, and China; developing countries are increasing their GE crops yearly.

In the U.S. GE soybeans make up 93% of the U.S. soybean crop, and GE corn is up to 70% of the corn crop. We don't eat GE crops directly—most of it is used in animal feed—but since there is no requirement that GE products be labeled in the U.S., few Americans realize that as much as 80% of our processed foods contain GE crop ingredients such as corn starch, high fructose corn syrup, canola and cottonseed oil, soy flour, etc. Earlier this year, the Obama administration deregulated Monsanto's GE alfalfa and sugar beets, which will soon make their way into our sugar and dairy products.


Photo credit: TheCleverSheep

Proponents of GE crops claim they reduce the use of herbicides and pesticides, increase crop yields, and are safe, but various reports offer conflicting evidence.

Pesticide use: Research by Peggy Lemaux, a scientist at UC Berkeley, found the overall data confirmed that pesticide use for GE crops is lower than that for conventional crops. The Organic Center reported, however, that while Bt corn and cotton have reduced insecticide use by 64.2 million pounds over the first 13 years commercial GE crops have been in use (1996-2008), HT crops have increased herbicide use by almost 382.6 million pounds in the same period. This is mainly because 15 super weeds resistant to glyphosate have evolved, requiring the use of even more toxic herbicides.

Yield: A Union of Concerned Scientists (UCS) report found that GE soybeans have not increased yields, and GE corn has increased yields only marginally. Other studies have shown a yield reduction of between 5% and 10% in Roundup ready crops when compared to similar non-GE crops.

The effects of GE crops on biodiversity are also of concern. Allergens from GE crops can be transferred across crop species, and transgenes can drift from GE crops to organic and non-GE crops. This gene drift could give some plants a selective advantage, allowing them to drive out other varieties. In addition, the Bt toxin in GE crops may harm species not specifically targeted that ingest pollen or plant debris. And because the giant agrochemical and seed companies can make more money from their GE seeds, they will likely stop selling conventional seeds, eventually limiting the variety of seeds available to farmers.


GE corn. Photo credit: Peter Blanchard

Safety: Lemaux reported that "Although no human activity can be guaranteed 100% safe, the commercial GE crops and products available today are at least as safe as those produced by conventional methods." However, a recent European study (GE crops are banned in the European Union) reviewed research done on mammals fed with GE soybeans and maize and found evidence of liver and kidney problems. The study noted that very few tests have been done on humans to date.

The bottom line is that there is still a lot we don't know about GE crops. It is impossible to verify if they perform as they claim to because so little independent research is being done on them. *Scientific American* reported that to gain access to GE seeds, a buyer must sign an agreement that limits what he/she can do with them. Under the guise of protecting their intellectual property, three agrochemical giants, Monsanto, Pioneer and Syngenta, specifically forbid independent research to be done on their seeds. This means that only studies approved by the controlling companies get published in peer-reviewed journals.

GE crops also have far-reaching socio-economic impacts. Because GE seeds are proprietary, farmers must pay royalties to use them and new seeds must be purchased every season, even as prices rise. Turning their backs on the age-old farming tradition of saving seeds for the next season, farmers must sign contracts agreeing not to reuse and sell GE seeds or risk being sued. As of 2007, Monsanto had filed 112 lawsuits against farmers for patent infringement, including against organic and conventional farmers whose crops were inadvertently contaminated with transgene seeds that blew into their fields.

It is against this backdrop that the agrochemical and seed corporations have filed broad multi-genome patents for climate-ready crops. Six corporations (DuPont, BASF, Monsanto, Syngenta, Bayer and Dow) control 77% of the patents. They maintain that these crops will be able to grow in poor soil, and require less rain and fertilizer. For example, Monsanto and BASF, who are readying the first GE drought tolerant maize for 2012, say field tests have shown 7% to 10% above average yields. Dow Agrosciences is focusing on products that use fertilizer more efficiently and reduce nitrogen pollution. And Arcadia Biosciences is developing GE rice and wheat that can tolerate drought and salinity, and use nitrogen more efficiently.

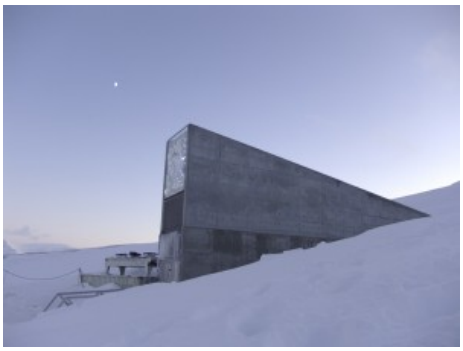
These climate-ready crop claims sound promising, and it's quite possible that some of them may also be able to increase crop yield. But the response of plants to environmental stress from temperature and precipitation involves hundreds of genes and is affected by multiple factors such as the timing, intensity, duration and frequency of stresses. According to the UCS, most of the transgenes being researched for the future will affect many genes and result in much more complex effects, some of which may be harmful to the crop or the environment. Can climate-ready crops safely deliver what they're promising when, in over 20 years of GE research, only single gene GE has been made commercially available?

ETC calls the stockpiling of climate-ready crop patents by the agrochemical giants a "patent grab" in pursuit of an exclusive monopoly and control over the world's plant biomass. The big corporations have donated "royalty-free" genes and technology to poor developing countries in Africa, but are expecting a lenient regulatory environment in return. ETC warns, "The pretext of climate-ready genes will increase farmers' dependence on GM (genetically modified) crops, jeopardize biodiversity, and threaten global food sovereignty."

Bt corn in Kenya.

Is there a better way to produce climate-ready crops? Cary Fowler, Executive Director of the Global Crop Diversity Trust, believes there is, and contends that we will never be able to solve the problems of climate change, energy, water scarcity, or world hunger if we don't have crop diversity. Towards that end, the Trust is leading an initiative with the Royal Botanic Gardens, Kew, and the Consultative Group on International Agricultural Research, to find, catalog, save and use the wild relatives of 23 food crops, including wheat, rice, beans, potato, barley, lentils, alfalfa, banana, and chick peas, to protect the global food supply from the effects of climate change.

The program will identify in the more diverse wild relatives of food crops the traits that allow them to withstand climate stress, especially in developing countries where climate change is expected to reduce yields by 10% to 30%. Using conventional breeding techniques, these traits will then be bred into crops to enable them to adapt to climate change. The 10-year project is a race to collect the biodiversity before it is lost forever and adapt agriculture to climate change before it is too late. The Svalbard Global Seed Vault, owned and funded by Norway, and situated on a remote island near the North Pole, will safeguard 500 seeds of every agricultural crop and share genetic material and information openly.


The Svalbard Global Seed Vault. Photo credit: The Global Crop Diversity Trust

In India, the Navdanya Biodiversity Farm founded by scientist and environmentalist Dr. Vandana Shiva, is also developing climate-ready crops by saving 1500 varieties of seeds and growing them out, allowing the plants to naturally adapt to changing climate conditions. Navdanya practices organic farming methods that achieve soil fertility and pest control through the enhancement of natural processes and cycles. Shiva's research has shown that this type of farming produces 2 to 5 times more food per acre than industrial monoculture farming.

ETC asserts that the keys to climate resilience lie in agricultural biodiversity, local seed systems and agro-ecological processes practiced by farming communities. Even if it's possible to develop GE climate-ready crops, might the public/private money being invested in these proprietary products be better spent developing more affordable, local, and low-input farming strategies to truly help the world's farmers cope with climate change?

To support sustainable food systems to meet the challenges of climate change, visit Food Democracy Now!

Related Stories

- Video: Is Drought In East Africa The New Normal?
- Pedro Sanchez Elected into the National Academy of Sciences
- Why Soil Matters