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PERSONAL VIEW JEREMY RIFKIN

## Perils of unnatural science

Critics have every justification in being concerned about the damage transgenic crops could have on the environment

**W**hile the 20th century was shaped largely by breakthroughs in physics and chemistry, the 21st century will belong to biology.

Scientists are deciphering the genetic code of life. Global life science companies are beginning to exploit the discoveries in myriad ways. Genes are already being used in fields including energy, bioremediation (bugs that eat pollution), building and packaging materials, and pharmaceuticals and medicine. Nowhere is the new genetic commerce likely to have a bigger impact than in agriculture.

Life science companies such as Monsanto promise a biological renaissance. Critics worry that the seeding of farmland with transgenic food crops could spread genetic pollution and damage the biosphere. The critics are right.

It is true, as supporters of genetic engineering say, that human beings have been re-making the earth for as long as we have had a history. Until recently, however, our ability to manipulate the environment has been tempered by the restraints of species boundaries. We have been forced to work narrowly, crossing only close relatives in the plant or animal kingdoms.

But scientists can now manipulate the natural world at the most fundamental level – the genetic one. They can take genes from unrelated species and create life forms that have never before existed. Scientists have taken the gene that emits light in a firefly and inserted it into the genetic code of a tobacco plant; the mature plant glows 24 hours a day. Other researchers have introduced an anti-freeze gene from the flounder fish into the genetic code of a tomato plant to protect it from cold spells.

Over the next 10 years, life science companies plan to introduce hundreds of laboratory-conceived transgenic plants over millions of acres of farmland around the world. The risks in releasing these genetically engineered crops are similar to those in introducing exotic organisms. While many have adapted to new ecosystems without severe dislocations, a small percentage of them have wreaked havoc. Gypsy moth, Dutch elm disease, starlings and Mediterranean fruit flies come to mind.

Whenever a genetically engineered organism is released, there is always a small chance that it will run amok. Like exotic species, it has been artificially introduced into local ecosystems that have developed a complex web of relationships over evolutionary history.

Much of the effort in agricultural biotechnology centres on creation of herbicide-tolerant plants. To increase their share of the growing global market for herbicides, companies such as Monsanto and Novartis have created transgenic crops that tolerate their own herbicides. For example, Monsanto's herbicide-resistant patented seeds are resistant to its best-selling chemical herbicide, Roundup.

The life science companies hope to convince farmers that the new herbicide-tolerant crops will allow for a more efficient eradication of weeds. Farmers will be able to kill weeds without

be tempted to use more herbicides as a result. The increased use of herbicides, in turn, raises the possibility of weeds developing resistance, which will force an even greater use of herbicides.

New pest-resistant transgenic crops are also being introduced. Several plants, including Ciba Geigy's pest-resistant "maximiser corn" and Rohm and Haas's pest-resistant tobacco, are already available. New evidence points to the likelihood of creating "super bugs" resistant to pesticide-producing genetic crops.

The new generation of virus-resistant transgenic crops poses the equally dangerous possibility of creating new viruses. Some ecologists also warn of the danger of "gene flow" – the transfer of transgenic genes from crops to weedy relatives by way of cross-pollination. Transgenic genes for herbicide tolerance, and pest and viral resistance, for example, might escape and insert themselves into the genomes of weedy relatives, creating weeds resistant to herbicides, pests and viruses.

Such fears were heightened in 1996 when a Danish research team observed the transfer of a transgene from a transgenic crop to the genome of a wild weed – something biotech companies have ignored as a remote or non-existent possibility.

The insurance industry is not so blasé. Several years ago it made clear it would not insure the release of genetically engineered organisms into the environment against the possibility of "long-term" catastrophic environmental damage.

Who, then, will be held liable for losses if a transgenic plant introduction were to trigger genetic pollution for an indefinite period? The life science companies? The government?

The debate could affect humans even more directly. Most new genetically engineered crops contain genes from non-food organisms including a wide range of viruses, bacteria, insects

and exotic animals. With 2 per cent of adults and 8 per cent of children allergic even to common foods, consumer advocates argue gene-spliced foods need proper labelling. The Food and Drug Administration has fallen well short of requiring across-the-board labelling; no less than The New England Journal of Medicine concluded FDA policy "would appear to favour industry over consumer protection".

The industry has all but dismissed such criticisms. The biotech companies may be right. But what if they are wrong?

A worldwide moratorium should be declared on releasing genetically engineered food crops and other gene-spliced organisms into the environment pending further study. It would be irresponsible and foolish to begin seeding farmland with such crops when we have yet to develop a rudimentary risk-assessment science by which to regulate these new agricultural products.

*The author has recently published The Biotech Century: Harnessing the Gene and Remaking the World, Tarcher/Putnam*

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