Say No to GMOs! (Genetically Modified Organisms)

Written by Chris Picone, Darcy Andresen, Gene Thomas, Dan Griffith, and other members of the UM Chapter of the New World Agriculture and Ecology Group

Time was when you could bite a tomato and not ingest fish genes. Time was when you could eat french fries and just worry about the fat and salt, not the bacterial genes that produce insecticides in the potato. Those times are over, thanks to corporate control over both genetic engineering and the lack of food-labeling. Unless you are a "hard core" consumer of organic foods, you eat genetically engineered foods everyday. While 80-90% of US consumers believe genetically engineered foods should be labeled, only 3% know they already on the market.[1] Today 60-70% of the food in a grocery store contains components from genetically modified crops. Moreover, this technology was unleashed on over 45 million acres of US farmland last year alone, after having been commercially introduced only four years ago.[2] Here we will provide a brief background on the types of genetically engineered crops that are being surreptitiously forced upon consumers, then argue against their current widespread use.

Background on GMOs

Genetically engineered crops, or transgenic crops, are often popularly referred to as Genetically Modified Organisms (GMOs). They are created whenever genes from one species are spliced into the genome of another species. In order to control the market on this form of biotechnology, chemical companies like Dupont and Monsanto have bought up seed companies, including Pioneer Hi-Bred and Delta and Pine Land, respectively. These chemical giants are now the two largest seed sources in the world. Here is a partial list of the types of GMOs they produce:

Pest-resistance genes: Perhaps the most widespread way of genetically modifying crops is to make them produce insecticides from other species. For example, the soil bacterium *Bacillus thuringiensis* (Bt) has genes for toxins that kill insect pests. Agro-chemical companies like Monsanto have inserted Bt toxin genes into many crops, especially corn, soy, cotton and potatoes.

Herbicide resistance genes: Roundup™ is the largest selling herbicide in the world, and is also produced by Monsanto (who formerly brought us Agent Orange). Monsanto has engineered crops that are genetically resistant to Roundup, thus ensuring that farmers who buy Monsanto's seeds will also use more of Monsanto's chemicals. Already widely used in corn, soy, cotton and canola, it will soon be available in sugar beets, wheat, and potatoes.

rBGH. Bovine Growth Hormone (BGH) is a natural hormone in cows. Monsanto produces the hormone artificially in bacteria (the engineered form is thus "recombinant BGH", or rBGH) and supplies it to farmers to increase milk production. Ironically, even before widespread use of rBGH, milk has been overproduced in the US, such that the federal government buys the surplus. So who really benefits from rBGH?

Sterility genes. One headache the agro-chemical companies have faced is how to control ownership of "their" genetically modified organisms. One initial solution was found in the form of US patent law: When a company inserts a gene from one species into another species, it can now file for a patent on that life form. If farmers replant seeds they have produced from transgenic crops, they violate patent laws. In fact, farmers are now sued for replanting saved seeds, which is a practice they have followed since the beginning of agriculture, and a requirement to adapt a crop to local conditions. The latest stage in this process of controlling agriculture (and undermining farmers) is "Terminator technology," where genes are inserted to make a crop sterile.[3] Seeds produced from such transgenic plants will not germinate, which prevents farmers from replanting them.

Many people insist that GMOs are important to feed a hungry world -but one must ask how a hungry world benefits from sterile crops. Only in a society where corporate rights are sacrosanct would science become so absurd that it designs sterile crops that prevent farmers from producing food.

Many people also insist that GMOs do not represent anything new - we have been changing the genomes of crops for millennia by selective breeding. For example, the ancestor of modern corn was genetically very different from what we eat today. Humans have manipulated the genomes of such crops by crossing different varieties, and sometimes closely related species, to make hybrids. From those hybrids we have selected the traits we desire. So why is modern genetic engineering any different? We argue that there are several fundamental differences between GMOs and traditionally bred crops.

Arguments against GMOs

1. The cheerleaders of GMOs ignore basic taxonomy when they argue that there is no difference between transgenic crops and traditionally bred crops. Taxonomically, there is a fundamental difference between mating two species in the corn genus, versus crossing corn with petunias, fish, or bacteria.

2. As stated by plant geneticist Wes Jackson on a visit to the U of M last year, traditional breeding selects phenotypes (traits) and "drags along" genotypes (DNA), whereas genetic engineering inserts the genotypes (DNA) directly. The phenotype is the trait we can see, like greater productivity, resistance to a particular disease, fruit color, etc. The genotype is the genetic DNA blueprint for that trait. Traditional breeding cannot manipulate the gene of interest directly. Instead, traits to breed are selected, indirectly causing the selection of the genes responsible. Traditional breeding thus selects genes in a whole context, within the "genetic architecture" that the gene originally evolved, functioned, and related to other genes. In contrast, genetic engineering ignores the surrounding genetic architecture when inserting new genes.

To understand the relation between a gene's expression (traits) and its surrounding DNA (genetic architecture), consider an analogy provided by Harvard's Stephen J. Gould and Richard Lewontin[4]. They describe paintings on unusual spaces between arches at St. Mark's Cathedral in Venice. The structure and form (traits) of the painting are largely constrained by the shape of the spandrel (the genetic architecture). Now consider what happens when a chemical company like Monsanto isolates the painting and inserts it into another church: The painting is now out of its context, out of the environment in which it evolved. Will it continue to express the same picture that it did in its former church? [5] Why do we assume a gene will express an identical trait in any organism we insert it into?

As the geneticist Richard Lewontin argues, we can no longer naively perceive genes as some kind of computer software, that can be inserted into any organism and expected to function consistently. We must abandon the traditional view of genetics that isolate a gene's function from it's surrounding environment. Rather, we must acknowledge advances in genetics and think of each genome [one organism's entire set of DNA] as a small ecosystem.[2] As such, there are constant positive and negative feedbacks among genes, their products, the products of other genes, and the gene's environment. Because of this myriad of known and unknown INTERACTIONS, "tweaking" any component in that small ecosystem can generate unpredictable consequences. This uncertainty is exacerbated by the fact that engineered genes are typically inserted into random positions in the receiving organism's genome.[6, 7] We don't know exactly where they are in the genome, but only that they are producing traits we want (and perhaps some unknown traits we don't want). Therefore, we should approach genetic engineering with the same intellectual humility that we hold (or should hold) for manipulating ecosystems. Inserting genes is similar to ecological practices that we thought we understood well, but which held unexpected consequences, such as introducing industrial chemicals to the environment (consider DDT, PCBs), or such as introducing alien species (consider Purple Loosestrife, Kudzu, Starlings).

3. Regardless of our fundamental ignorance of the genetic mechanisms mentioned above, no one has properly studied the ecological and health ramifications of releasing so many GMOs into farms and grocery stores. Even the New York Times admits that GMOs are being released to farmers "with less evaluation than they had in the past with traditional varieties."[8] This coming summer, almost 35% (27 million acres) of the US corn crop will be transgenic, as will half (40 million acres) of the oilseed crop, half (7 million acres) of US cotton, and over half of all soy.

But rather than speculate about ecological risks, allow us to present real data:

Unexpected effects on natural enemies of pests

- Snowdrop genes were inserted into Scottish potatoes to combat the greenfly. After greenflies fed on the potatoes, 50% of the ladybugs that fed on those greenflies were killed
- Bt toxins (from bacterial genes) are supposed to be harmful only to specific insect groups, depending on the variety of Bt genes inserted into the crop plant. Unexpectedly, a variety "specific" for caterpillars also killed lacewings that fed on caterpillars with a Bt diet.[9] Our ignorance is truly humbling.

Increased rates of resistance in pests

- To reduce insect pests, organic farmers use Bt as a bacterial spray. Small-scale use of this "bio-pesticide" is unlikely to lead to resistance in the insect pests, because they are rarely exposed to it. In contrast, when Bt toxin genes are inserted into crops, the plants constantly express the toxins over widespread areas. Bt crops exude 10-20 times the amount of toxin as in organic sprays. Such overuse of the pesticide allows resistance to develop very rapidly in the pests. By 1997, the cotton bollworm developed resistance on 40% of the farms using Bt cotton. In addition to increasing farmers' costs, such resistance takes away a public good - the use of an organic pesticide. Does Monsanto have that right?

Genetic Pollution

- Herbicide resistance genes have spread via pollination to wild relatives in oilseed rape and sugar beet[10, 11], as well as unmodified rape growing 400 meters away.[12]
- Inserted genes are 30 times more likely to spread via pollination than the plants' own genes.[13]
- Genes in engineered bacteria were passed to indigenous bacteria in an artificial gut.[14]
- Plasmids can transfer genes from yeasts to plant mitochondria, increasing the likelihood of spreading modified genes from crops into other plant and fungus species.[15]

Consider - how do you clean up genetic pollution? Unlike an oil spill, this form of pollution reproduces itself while it spreads, and cannot be contained once released. In addition, the companies that are releasing these products are in no way legally responsible for any genetic pollution they generate.

Health Risks

- Potatoes inserted with snowdrop lectin genes reduced the weight of many organs in rats, including the brain, and impaired their immune response.[16]
- Transgenic Bt crops do not express the common, inactive form of the Bt toxin, which naturally occurs in the soil, but rather an active form that previously only occurred once the toxin entered insect guts.[17] That is, the transgenic plants are constantly expressing a toxin that humans have not been exposed to in the past (unless you are an aficionado of insect guts). You may be thinking, "No problem - I am sure the FDA has tested these crops to make sure they are safe." Think again. Potatoes with Bt toxin genes are officially registered as pesticides with the EPA; the FDA does not test them for any health effects because they are not registered as "food."[2] The next time you eat McDonald's fries or a bag of chips, consider that you are technically eating a registered, patented, yet unlabeled insecticide.
- Cows on the engineered Bovine Growth Hormone (rBGH) suffer one-third higher rates of udder infections (mastititis), for which farmers increasingly must administer antibiotics. Those antibiotics end up in the milk we drink (GAO 1995), increasing the risk of antibiotic resistance in human pathogens. Furthermore, rBGH increases the levels of another growth hormone in milk (IGF-1), which is a likely carcinogen.[18] As a result of these concerns, Vermont Senators Patrick Leahy and James Jeffords have formally requested an investigation into the FDA's hasty approval of rBGH.[19]
- The genes causing resistance to the herbicide Roundup come from a soil bacterium (*Agrobacterium sp.*), a virus, and a petunia. None of the products of these genes have ever been in our food in the past.
- Soybeans engineered with genes from Brazil nuts induced severe allergic reactions from people who had never been allergic to soy.[20] People allergic to a product from an inserted gene would have difficulty avoiding it, because transgenic food is not labeled in the US.
- Out of 177 countries present at the Biosafety Protocol in Cartagena, Colombia, 170 rejected the current, indiscriminate expansion of GMOs (the US did not sign). The governments of the UK, Denmark, Norway and Greece have banned the planting of all transgenic crops. EU countries have rejected all new applications for transgenic products since April, 1998, and the EU continues to ban rBGH. In fact, the US is the only country in the world to have approved rBGH[21]. British and EU supermarket chains have banded together to maintain foods free of GMOs. In Britain, the Local Government Association has placed a 5-year ban on GMOs in all schools, old peoples' homes, and town halls. Delegates from every African nation (except South Africa) formally rejected Monsanto's use of GMOs as "neither safe, environmentally friendly, nor economically beneficial to us."[22]

In all fairness to GMOs, we should note two areas where they are not qualitatively different from other agricultural trends in the last 50 years, but rather they exacerbate trends that had already begun. First, GMOs promote low crop diversity (monocultures) and the loss of traditional crop varieties. That process first intensified with the green revolution of the 1940's, as agriculture became increasingly based on low crop diversity, and as farmers bought their seeds from fewer and fewer seed companies. According to the FAO, 75% of crop diversity has been lost during this century. Agriculture based on low diversity presents dangers not unique to GMOs. For example, in 1970 the southern corn industry collapsed when 80% of US corn was bred to have a particular gene for male sterility - and the same gene made all that corn susceptible to the fungus causing southern leaf blight. To prevent such disasters, it is only logical to foster diversity in agricultural varieties. Yet the USDA continues to promote GMOs, which are produced by only a few agro-chemical-seed companies. Such a strategy furthers erodes the genetic diversity we need to avoid repeating past agricultural collapses.

Second, GMO-based agriculture is not qualitatively different from modern seed-breeding in another sense - they both foster farmers' dependence on corporations. In both systems, farmers must return to the seed company every year for new seeds. With the Green Revolution, high crop productivity was based on hybrid crosses. As you may have learned in biology class, the first generation from a hybrid cross (the seed the farmer buys) has the beneficial traits of both parent lines, but the second generation (the seed produced in the field) is a genetic mishmash and therefore unproductive. This approach forces the farmer to return to the seed company every year for more seed (see Lewontin and Berlan [23] for arguments against hybrid-based agriculture). Transgenic crops intensify such dependence when patent laws prevent farmers from replanting seed they have grown. Moreover, if Monsanto, the second largest seed company in the world, succeeds with its plans to insert "terminator" genes into all of its seeds, then the crops produced will be sterile. Whereas hybrid breeding makes it unlikely for farmers to replant seeds, and patents make it illegal, this new technology makes it impossible !

In 1945, at the beginning of the Green Revolution and the industrialization of agriculture, the US had six million farms; we now have well under 2 million.[24] On average, 1000 farmers have gone bankrupt every week since 1945. As small farmers succumbed to debt burdens produced by the increased dependence on agro-chemical companies, corporate farms and banks controlled more and more land. Today, just 4% of those landowners possess 47% of the farmland.[25] These trends will only be exacerbated by GMOs. As one Idaho potato farmer admits, this abuse of biotechnology "gives corporate America one more noose around my neck."[2]

Our objective in writing this is not to turn the reader against science or genetic engineering in general (we are all scientists at the UofM). The movement against GMOs should not be oversimplified as objecting to all forms of genetic engineering. While some people in the movement may take that position, others would argue that genetic engineering has a role in some situations (e.g., medical), and under proper socio-economic conditions (ask-who benefits from the technology?). Such distinctions are debatable, but in the mean time corporations are unleashing GMOs on millions of acres without sufficient genetic and ecological testing. Moreover, even when some testing has been done, if the data threaten the interests of agro-chemical companies, their publication is suppressed and the researchers are attacked.[26]

(continued on next page)

What Can We Do About GMOs?

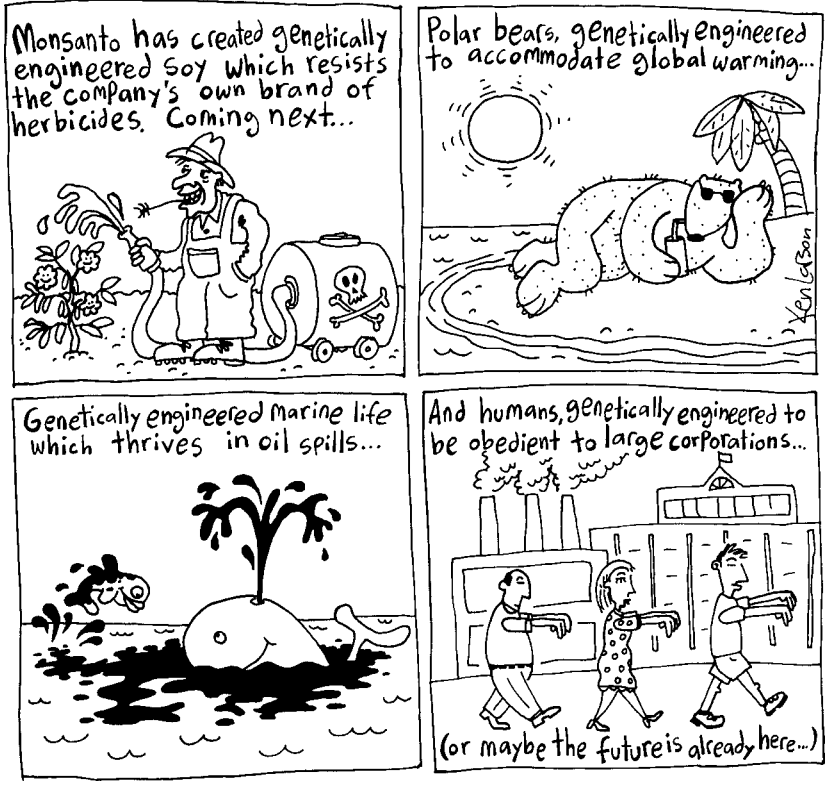
1) Buy organic. Food labeled as "organic" does not contain GMOs, and should not in the future. Current labeling is based on the California organic standards, which do not allow the use of GMO seed. Last year the USDA tried to make a national standard that would include GMOs in "organic" food, but 280,000 people wrote back in protest. As it now stands, future standards for nationally certified organic food will NOT allow GMOs.

2) Sign a petition that requests labeling of all food as to whether or not it contains GMOs. One such petition is available at the People's Food Coop, Ann Arbor. Copies are also available from the source - the Mothers for Natural Law, PO Box 1177, Fairfield, Iowa 52556; www.safe-food.org, or phone 1-877-REAL FOOD. In the past, producers have been sued by Monsanto et al. when they have labeled their products as GMO-free.

3) Write to our government. For example, Secretary of Agriculture Dan Glickman (USDA, 14th and Independence Ave, SW, Washington, DC 20250).

4) Educate yourself. Two well-researched sources are the Sept/Oct 1998 issue of The Ecologist, and the cover article in the Oct. 25, 1998 New York Times Magazine. Consult web sites of the Rural Advancement Foundation International (RAFI), Pesticide Action Network (PAN), Consumers Union, Campaign for Food Safety (www.purefood.org), Organic Consumers Association (www.organicconsumers.org), Greenpeace, etc.

5) Join a movement. The best way to avoid despair is to become politically active (preferably with a lot of singing). A student group is forming at UM called the Basic Food Group (see inset). Consider joining them and/or any of the organizations listed above. ☑



New local group to fight GMOs and related issues-

Basic Food Group

Technology is revolutionizing the way food is produced, from the development of new pesticides to the genetic engineering of many of our basic crops, but scientific research on environmental and consumer safety standards lags far behind the release of these technologies into our fields and onto our tables. Furthermore, farmer's rights to grow crops freely and independently are being eroded by large agro-chemical corporations. We are a group of citizens called the Basic Food Group, who believe that the food we eat impacts the environment, human health, and the rights of farmers who work to provide us with nutritious, safe food. We encourage you to participate with us in the global grassroots outcry against large-scale, corporate, genetically manipulated agriculture and to turn to locally grown, organic food.

We will be putting up a website and organizing in the fall on The University of Michigan campus. For more info please contact: **foodsafe@umich.edu**

References

1. *U.S. group welcomes tight EU control on gene food*, in *Reuters*, April 23, 1999.
2. Pollan, M., *Playing God in the garden*, in *New York Times Magazine*. Oct. 25, 1998.
3. Steinbrecher, R.A. and P.R. Mooney, *Terminator technology - the threat to world food security.* The Ecolo gist, 1998. **28**(5): p. 276-279.
4. Gould, S.J. and R.C. Lewontin, *The spandrels of San Marco and the Panglossian paradigm: a critique of the adaptationist programme.* Proc. Roy. Soc. Lond. B, 1979. **205**: p. 581-598.
5. Jackson, W., *Arches, spandrels and genomic architecture*, in *The Land Report*. 1998, The Land Institute: Salina, KS. p. 3-4.
6. *Unpalatable truths.* New Scientist, 1999. 17 April.
7. Ronald, P.C., *making rice disease-resistant.* Scientific American, 1997. **277**: p. 100-105.
8. *New York Times*. 19 Nov, 1997. p. C1.
9. Andow, D. *Transgenic insecticidal crops*. in *Ecology, society and sustainability: Beyond the conservative assumptions*. 9 April, 1999. Symposium at the Univ. of Michigan.
10. Brookes, M., *Running wild.* New Scientist, 1998. 31 October.
11. Snow, A. and R. Jorgensen. *Costs of transgenic glufosinate resistance introgressed from Brassica napus into weedy Brassica rapa*. in *Ecological Society of America, Procedings.* 1998. Baltimore, MD.
12. *Gone with the wind.* New Scientist, 1999. 17 April 1999.
13. Bergelson, J., C.B. Purrington, and G. Wichmann, *Promiscuity in transgenic plants.* Nature, 1998. **395**: p. 25.
14. Mackenzie, D., *Gut reaction.* New Scientist, 1999. 30 Jan.: p. 4.
15. Cho, Y., *et al.*, *Explosive invasion of plant mitochondria by a group I intron.* Proc. Nat. Acad. Sci. USA, 1998. **95**: p. 14244-9.
16. Leake, C. and L. Fraser, *Scientist in Frankenstein food alert is proved right*, in *UK Mail*. 1999.
17. Tokar, B., *Monsanto: a checkered history.* The Ecologist, 1998. **28**: p. 254-261.
18. Kingsnorth, P., *Bovine growth hormones.* The Ecologist, 1998. **28**: p. 266-269.
19. *New study questions rBGH safety*, in *The Capital Times*. 20 Dec., 1998.
20. Nordlee, J.A., *et al.*, *Identification of a Brazil-nut allergen in transgenic soybeans.* The New England Journal of Medicine, 1996. March 14: p. 688-728.
21. *Global action intensifies against Monsanto and the gene giants*, . 1999, Campaign for Food Safety #18.
22. Bruno, K., *Monsanto's failing PR strategy.* The Ecologist, 1998. **28**: p. 287-293.
23. Lewontin, R.C. and J.-P. Berlan, *The political economy of agricultural research: the case of hybrid corn*, in *Agroecology*, C.R. Carroll, J.H. Vandermeer, and P.M. Rosset, Editors. 1990, McGraw-Hill. p. 613-628.
24. Rosset, P.M. and M.A. Altieri, *Agroecology versus input substitution: A fundamental contradiction of sus tainable agriculture.* Society and Natural Resources, 1997. **10**: p. 283-295.
25. Lappe, F.M., J. Collins, and P. Rosset. World hunger: Twelve myths. 1998. Food First Books - Grove Press,NY.
26. Gorelick, S., *Hiding damaging information from the public.* The Ecologist, 1998. **28**(5): p. 301.