PERSPECTIVE

Moving the Debate on Genetically Engineered Crops Forward

The recent perspectives about crop GEOs (genetically engineered organisms) by Holzberg and Lassen et al. (volume 30, issues 1 and 2, respectively) highlight the need for ASPB to continue to be actively involved in the GEO debate to provide accurate information to its members and the public. Here, we would like to counter some of the oft-repeated scientific myths that we do not believe move the discussion forward or provide new scientific insights that help resolve the GEO logjam.

1. *GEOs have definable scientific properties and can thus be discussed as a meaningful category.* We prefer to use the term GEO rather than GMO (genetically modified organisms) because it provides a clear distinction from traditionally bred crops. Each crop GEO is different and must therefore be considered on its own merits or demerits. It is absurd to equate vitamin A rice (generated by funds from nonprofit institutions; major beneficiaries are young children in developing countries) with Roundup-Ready® corn (privately funded; major beneficiaries are large growers and private companies in the developed world). The process of genetic engineering is no more hazardous than hybridization, inbreeding, and mutagenesis, which are all components of traditional breeding. The importance of critically evaluating product rather than process has been emphasized in three independent National Research Council reports (http://www.nap.edu/catalog/10258.html). Generic discussions of the benefit or risk of "GMOs" are not scientifically credible.

2. *"Public skepticism" about complex technology, especially when it does not have large and direct benefits to individual consumers, can be taken at face value.* People will tend to reach wildly different conclusions about genetic engineering depending on how they are educated and particularly what context they are given and who they trust. A recent USDA study of consumer demand showed how willingness to pay for biotech foods depends greatly on what the consumer is told and who is doing the telling (http://www.ers.usda.gov/publications/tb1903/tb1903.pdf). This study also found, as have many other studies of risk perception, that negative messages tend to be more penetrating than positive messages. Anti-GEO activists therefore have a much easier time than those trying to promote balanced or positive perceptions of genetic engineering. Finally, because the largely urban public knows little about agriculture or breeding, it can be easily misled about technologies. In a survey of consumer attitudes about labeling by the Center for Science in the Public Interest, 40 percent said they wanted the use of hybrid corn to be disclosed (http: //oregonstate.edu/instruct/bi399/documents/CSPI_2001_presentation.pdf)! "Public skepticism" needs to be interpreted very carefully.

3. *Corporate profit motives and business practices tarnish the science and technology by association.* Genetic engineering approaches did not originate with industry, nor are they being used only in industry. They are simply a powerful set of techniques that can be used in plant breeding where conventional methods fail or are inefficient. The profit incentive and patent system, although by no means perfect, do provide strong motivations to companies to develop new methods and products. The legal protection provided by patents can result in scientific advances being publicized that may have otherwise been kept as company secrets. Because of the complex laws relating to use of GEO crops, companies are likely to profit only if their products benefit farmers or consumers and do not pose unreasonable risks to the environment or health in accordance with accepted government standards. These standards define the rules and the playing field on which companies must operate. Given the continued rule of law, the profit motive and public benefit are not inimical in a democratic society.

4. *Labeling and process knowledge is a consumer right, regardless of its scientific basis and social cost.* Although labels themselves are inexpensive to print, the identity segregation, tracking, and testing systems that a meaningful labeling system requires can be very costly to society. This is especially true when, as in the European Union, very small levels of GEO ingredients must be carefully identified in all derivative products. Societies therefore choose not to label many trace ingredients or specific aspects of crop and food production that may be of some nutritional or environmental relevance, even though this

information would be of interest to many consumers (e.g., pesticide residues, varieties, fertilizers, irrigation practices, origins of processed foods). Labels also tend to be viewed by consumers as "warnings" and thus can stigmatize crops that may have economic, health, or environmental benefits. Under current law, the FDA seeks to avoid information on labels that consumers may find "misleading" with respect to nutrition and safety. For example, a label on a genetically engineered papaya indicating that it contains "trace amounts of papaya ringspot viral DNA" would be accurate but misleading because the average consumer does not know that the non–genetically engineered fruit is likely to be virally infected and would therefore carry higher levels of papaya ringspot viral DNA as well as protein. Generic GMO labels are also of negligible public value, as the variety of genes, insertion events, and products makes such a system nearly useless for tracking epidemiological patterns or for inferring personal risk or benefit. Finally, there has been no public uprising to label conventionally bred crops, even though their nutritional and toxicological properties vary widely and have been far less well studied than GEO crops. The decision whether to label GEO products is both scientifically questionable and fraught with social and economic tradeoffs. It is anything but simple and clear, nor is it an inalienable right.

5. *GEO crops contaminate neighboring crops and thus cannot coexist with other farming systems.* All food is "contaminated" to various degrees by many sources, including bred and wild crop relatives, weeds, dust particles, insect and rodent parts, fungal toxins, agrochemicals, and much more. We could avoid most of these contaminants by growing crops in contained, clean indoor facilities, but economics dictates otherwise. Instead, we identify tolerances that allow us to take advantage of the economic benefits of growing crops out of doors while limiting exposure to undesired substances to low, but non-zero, levels. Different farming systems already coexist that have adapted to these realities. For example, the USDA national organic program standards (section 205.671) tolerate set levels of pesticide drift, allowing organic farms to be located next to conventional farms. The standard practice for organic growers is to notify their conventional neighbor that the farm is certified organic and to remind them of the pesticide limits. The same can be true of GEO crops if tolerances for pollen drift are set at reasonable levels and if liability is clear.

6. *GEO releases should be delayed until extensive, rigorous research is done that determines the long-term environmental and health impacts of each GEO.* Such an approach requires absolutes—but these are not delivered by science or any other secular form of knowledge, and such a rigidly "precautionary" stance would preclude any kind of innovation in agriculture—conventional, organic, or transgenic. It also ignores the benefits of GEOs compared to alternative systems; in adopting new technology we seek to solve problems, for which we accept some level of new risk. For example, although Bt has been consumed for more than 50 years as a natural contaminant and as spray residue with no apparent detriment to health, the consumption of slightly higher concentrations in engineered crops has not yet been tested over generations. However, we also know that insecticides—synthetic and biologically derived—are extensively used in many crops and can be highly toxic (220,000 deaths per year, primarily of farm workers in developing countries). Bt cotton has already led to enormous reductions in insecticide use (over 150 million pounds in China in 2001, equivalent to 25 percent of all the insecticide sprayed before the adoption of Bt cotton), and the exposure of farm workers to broad-spectrum pesticides has been correspondingly reduced. Societies will always be considering benefits, risks, and uncertainties in all their decisions about new technologies.

7. *Modern organic methods have solved problems created by the previous industrialization of agriculture, and there is no need for further advances.* Although even the most fervid organic advocate would not agree with this statement, it is heard increasingly from the urban public that is removed from the farming process and the harsh realities of life in the developing world. In even the best-managed farming and food distribution system, there are large challenges and opportunities to improve production. Thirty percent to 40 percent of potential global food, fiber, and feed are lost to insects, nematodes, diseases, and weeds. Sixty percent to 70 percent of these losses are in the developing world, at a cost of $300 billion per year. Abiotic stresses account for even larger yield losses. Incremental increases in the nutritional content, disease resistance, yield, or stress tolerance of crops can go a long way to alleviating poverty by enabling farmers to produce and sell food locally, as well as by providing more nutritious food to help offset the malnutrition that is experienced by one in six people in the developing world. Clearly there is tremendous

need for—and given our rudimentary knowledge of genomes and molecular physiology, there is likely to be vast room for—crop improvement. GEOs, by enabling crop domestication to proceed without the limitations imposed by natural or random mutation as sources of variation, could logically play a large role.

With the arrival of GEOs, plant breeding, previously among the least controversial of agricultural technologies, now appears to have become the most hotly debated. One reason is that genetic engineering enables an extraordinary level of novelty, and thus ecological complexity, so that it is difficult for societies to come up with general rules governing deployment. To aid in this process, ASPB must encourage science-based evaluation of each GEO crop, or at least classes of GEOs, with an eye toward using GEOs to move agricultural systems toward improved sustainability. We hope that the myths described above do not impede meaningful dialogue.

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