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Commentary

Europe on Transgenic Crops: How Public Plant Breeding and Eco-Transgenics Can Help in the Transatlantic Debate

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Although a range of views about transgenic crops is found in both the United States and Europe, some aspects that are particularly characteristic of European views are seldom mentioned in the United States. Awareness of these viewpoints is critical to improve the clarity of dialogue, focus on ultimate outcomes, and inform the development of consensus-building research, extension, and education activities.

Key words: anthroposophism, development, diversity, environment, GMOs, organic, private sector, public sector

In the debate on transgenic crops, philosophic views are as important as scientific data. Certain views regarding transgenic crops are more characteristically European, less frequently articulated in the United States, and, consequently, often less understood here. A clear understanding of these views and what they imply is necessary for effective dialogue. Insight into philosophical positions is critical to focusing discussion clearly on likely ultimate outcomes. Such insight also informs the development of consensus-building research, extension, and education activities.

The present paper grew out of one-on-one discussions with founders of biotechnology start-up companies and science-entrepreneur incubators in Germany, seminars with several hundred university students in Austria, and conversations with state and national government officials in both countries and Croatia. These discussions extended to journalists, "green" parliamentarians, and representatives of both nongovernmental organizations (NGOs) and large businesses in all three countries. The occasions were an Embassy Science Fellowship (ESF) with the US Mission to Germany in 2002 and an ESF in the office of the Foreign Agricultural Service (FAS) of the US Department of Agriculture in Austria in 2003. The views expressed in this paper are personal and do not represent the position of CSREES, USDA, or any other agency.

The paper is offered as a commentary and brief introduction to some more-commonly held European views on transgenic crops—as well as some implications of those views that are often overlooked. The author's immediate objectives are to encourage all participants in the GMO debate to address philosophical and scientific issues separately, explicitly, and thereby more clearly, and to point out action areas (particularly for research) that resonate positively across many groups regardless of their position on transgenic crops. The ultimate objectives are to contribute to a broader appreciation of positive biological and social-economic possibilities presented by transgenic crops and to encourage research on the full spectrum of choices for farmers and consumers.

Viewpoints in the Debate about Transgenic Crops

A Scapegoat for Other Problems

Restricting transgenic crops looks to many, particularly in Europe, like a one-stroke, painless way to solve a host of real and difficult concerns—ranging from poor eating habits, food safety, and antibiotic resistance, through environment and landscape, industry consolidation, small-farm survival, and loss of diversity in nature and agriculture. There is widespread and understandable sense of urgency among voters and politicians to do something about these issues, even though none of them are caused by transgenic crops, and all of them predate transgenics—some for as a much as century or more. Activists on the antibiotechnology soapbox have not hesitated to exploit the situation by pretending that all of these problems are new, that agriculture was a utopia until just yesterday, and that the solution is simple—just ban biotech. Serious attempts at finding solutions, such as the 2004 European Conference on Rural Development (http://europa.eu.int/comm/agriculture/events/salzburg/index_en.htm) convened by former EU agriculture minister Franz Fischler in Salzburg, Austria, are more difficult and attract little popular attention.

A New Slogan for the Revolution

International environmental advocacy NGOs distance themselves from Western culture. Their bottom-line position appears to be one of opposition not to transgenic crops, nor even to ownership of life, but rather to Western-style private ownership of any kind. After the human and ecological disasters of the socioeconomic experiments of the 20th century, it might have become difficult to attract followers to this view. Transgenic crops provided a opportune new recruiting tool. The endless alarming hypothetical scenarios that are offered about transgenics have revived the old argument that capitalism is antienvironmental. "The environment" has joined "the people" as an appealing slogan for the new century (P. Moore, as cited in Bond, 1999). As long as circumstances surrounding transgenic crops can be distorted to criticize private ownership and initiative, there is incentive to distract attention away from the possibilities of transgenic crops for solving problems and creating opportunities.

The Unappreciated Role of Private Investment

The German government recognized crop biotech as a valuable partner for rebuilding the economies of eastern Germany and neighboring countries. Its competitive BioRegio program in 1996 leveraged a matching private investment of 172 million DM (http://www.bmbf.de/de/962.php; http://www.bmbf.de/pub/bioregionen_broschuere.pdf; Horst Domday, CEO, Munich Biotech Development Bio-M, personal communication, October 2002). However, market access for products of BioRegio companies was blocked by negative public opinion. For example, MBP Cologne, the most successful independent German agricultural biotech start-up, had a transgenic product for the market and was ready for its final round of private investment by mid-2002 (http://www.amaxa.com/_media/pdf/press/biomed-regio_05-2001.pdf). Within weeks after the October 2002 German national elections led to a Green Party Minister of Consumer Protection, Nutrition, and Agriculture, it became clear that sufficient investment could not be raised (Dr. Hans Ulrich Koop, Research Director, Icon Genetics, personal communication, October 2002), and MBP closed its doors.

From conversations with students and politicians opposed to transgenic crops, it appears that many do not appreciate private investment as a key to future opportunities, including their own.

- *They want governments to create jobs, but have not reflected that by calling for "GMO-free" countries, they eliminate a set of opportunities for jobs.* For example, in November 2003, this political advertisement appeared in Viennese bus stops: "300,000 jobs will be lost in Vienna next year! Government, what measures are you taking?" Vienna and neighboring regions have a strong history of science and agriculture. Agricultural biotechnology would be a natural step in the city's contemporary economic development. But agitation against biotech has closed off this option for job creation. Instead, Austrian farmers are paid subsidies to destroy virus-infected orchards and replant with the same susceptible varieties. Because no natural resistance has been found, Austrian researchers designed transgenic trees to resist the virus (Laimer, 2003). Public opinion will not allow the transgenic trees to be field-tested. But neither is there public discussion about the sustainability of subsidies for growing susceptible trees.
- *They describe agricultural development for developing countries as superfluous, and propose as a better solution the redistribution of food from rich to poor countries, but have not observed that this could make poverty permanent.* Developing countries need locally-earned income to realize their own aspirations. Agriculture is often the only practical starting point for income in rural areas (Lipton, 1999), but production environments in the poorest areas are often degraded by poverty, drought, war, or all three. Market quality standards are another challenge (New Partnership for Africa's Development Market Access Initiative; http://www.nepad.org). Transgenic crops will be important to help developing countries achieve productivity and quality (Huang, Pray, & Rozelle, 2002), as will organic agriculture (see FAO's organic agriculture website, http://www.fao.org/organicag), depending on the situation. Both options should be available**.** Students and NGOs propose that feed grain production in developed countries be replaced by food production for poor countries. There is little notice that this proposal is inconsistent with the pro-indigenous, pro-tradition positions of most antibiotech NGOs. If practiced generally—that is, not limited to emergencies—it would destroy traditional societies, at the same time that it closed off an accessible route to development for many poor countries.
- *They miss the possibility that transgenic crops can create incentives for win/win private investment with small-scale farmers.* In spite of the importance of agriculture in poor countries, decades of international public investment have not been able to achieve agricultural development on the scale required, especially in Africa. Private investment that engages local entrepreneurs could be an impor-

tant partner for scaling up development. Until recently, private investment in small-scale agriculture in developing countries has not been feasible, because there has been no way to recover investment in providing useful inputs to this user group. Crop biotechnology may be the innovation that finally creates favorable conditions for private investment with small-scale farmers (e.g., The African Agricultural Technology Foundation; http://www.aftechfound.org). Intellectual property rights are often brought up as an obstacle to development of agricultural biotech for developing countries (e.g., Egziabher, 1996). They may prove to be just the opposite.

Different Views of Nature

Throughout its history, the West has seen the natural world as an imperfect environment. In this environment, humans use their creativity to overcome obstacles of climate and competing organisms to make a living, build civilizations, and accomplish other goals—including the goal of protecting nature from abuse. In contrast, postmodernist philosophy regards the natural world as an organism, perfectly able to accomplish its own goals. In this view, humans should strive to minimize their interference with nature (see Kershen, 2000).

Biotechnology is a product of the first view of nature. From this viewpoint, for example, gene flow from approved transgenic crops is not different from gene flow from any contemporary crop. Much of the opposition to biotechnology in Europe originates from the second view. From the postmodernist view, crop biotechnology per se is a violation of nature. The least presence of even benign transgenes in gene flow would be unacceptable even if no consequences to the environment were observable.

In Germany and Austria, postmodern opposition to transgenic crops is shaped by Anthroposophism, whose founder, Rudolph Steiner, was influenced by the thinking of the 19^{th} century poet and dramatist J.W. von Goethe (Steiner, 1924/1979). Faust, Goethe's famous antihero, rejects wisdom in favor of action ("*Im Anfang war der Tat*," in Goethe's original). He sells his soul to the devil and in return achieves fame as an engineer. By his acts—building dikes and strong-arming land from the sea—Faust transforms the natural world. But to Margarete, a pure and defenseless woman, his actions bring disaster. In a modern-day Anthroposophist version, Faust might well be recast as a genetic engineer.

Points of Positive Resonance

Of the many issues around transgenic crops, only two resonated positively with essentially every type of European audience: classical plant breeding in the public sector and the use of transgenic biotechnology to enhance diversity. These two areas of broad agreement are rich in opportunities for action.

Public Plant Breeding

In any conversation with Europeans about transgenic crops, public plant breeding is soon brought up, either as positive alternative or essential capacity. Strong public plant breeding programs would address some of the most frequent European objections to transgenic crops and would ensure that up-to-date public varieties are available for farmers to choose according to their needs and preferences. These varieties can be tailored to any farming practice, from organic to high-input. Moreover, only the public sector is in a position to explore the full potential of transgenic approaches for diversity and other environmental goals, because these are often purely public goods (i.e., nonappropriable, nonexcludable; Smale, 1998).

A few plant breeding programs exist exclusively for organic farming, such as the Louis Bolk Institute in the Netherlands (http://www.louisbolk.nl/e/index.htm); Kultursaat, Gut Wulfsdorf, Germany (http://www.gutwulfsdorf.de/1024/frameset.html); and projects of the Organic Farming Research Foundation (http://www.ofrf.org/press/Releases/PR.050802.Spring2002-Grants.html). In the United States, however, organic farming organizations are increasingly following the century-old tradition of other farmers' organizations by collaborating with public plant breeding programs at state universities, whose rigorous classical breeding methods can develop varieties for their specific needs. Examples include the Public Seed Initiative (Cornell University and USDA with the Northeast Organic Farming Association of New York and the Farmer's Cooperative Genome Project-Oregon Tilth; http://www.plbr.cornell.edu/psi/) and corn breeding at the Michael Fields Institute (with Iowa State University, USDA, and the Practical Farmers of Iowa; http://www.michaelfieldsaginst.org/corn_breeding_project.htm).

Private seed companies are also supporters of public plant breeding. Examples include the Pioneer Fellowship in Plant Sciences (Agronomic Science Foundation, http://www.agronomy.org/asf/02asfreport.pdf) and the Raymond F. Baker Center for Plant Breeding at Iowa State University (http://www.agron.iastate.edu/agron/

centers/centers.html). Private companies need promising experimental germplasm and new sources of genetic diversity to combine with their elite materials to create new commercial varieties, but development of such resources is generally too high-risk, and the return to investment is too long-term, for a private investor. Consequently, in the United States, material from public breeding is the principal source of genetic diversity in commercial varieties (Frey, 1998). Private biotechnology companies value public plant breeding for similar reasons.

It is likely that some advocates of strong public plant breeding see it not as a component of a balanced public-private system but rather as taking the place of private-sector breeding entirely. This would create an imbalance of a different kind, as the private initiative that gets products to market would be lacking (Duvick, 2003). Compared to restrictive regulation of private breeding and biotech companies, strengthening public breeding programs is a more constructive way to ensure that the private sector will not overdominate.

Due to broad support for public plant breeding among all groups in the transgenic crops debate on both sides of the Atlantic (e.g., in the United States, Advisory Committee on Agricultural Biotechnology, 2001; Frey, 2000; Mellon & Rissler, 2004), one might expect an inflow of resources. This is not the case. In the United States, federal funds for applied agricultural research, including plant breeding, have been effectively flat since 1980 (Fuglie et al., 1995; Kerr, 1987). National competitive grant programs for plant breeding are few and far between. State funding for plant breeding has declined steadily for over a decade (Frey, 1996; Traxler, Thro, & Acquaye, 2004) and probably longer.

Transgenic Crops for Enhancing Diversity

Among European audiences recently, no topic elicited as many questions as this one. It directly contradicts the popular message that transgenic crops are the end of biodiversity. The negative popular message is so entrenched that an audience member in Prague in 2003 accused the translator of mistranslating my descriptions of increased diversity through transgenic crops.

Some examples are already in the fields. Herbicide-resistant transgenic crops have made new crop rotations possible, due to more flexible weed control and less persistent herbicides (e.g., grain legumes in Canadian canola rotation; Orson, 2002); more birds and beneficial insects are seen in cotton fields (Anderson, 2003). Still in the research phase is use of transgenic fungi to slow down a devastating disease that has almost eliminated the native chestnut tree from North American forests (Choi & Nuss, 1992; NE-140, 2003). Research that awaits funding will restore traditional varieties that have been lost due to disease susceptibilities, such as locally preferred cassava varieties in Africa (Thro & Spillane, 2003; Thro et al., 1998).

A long-run global impact of biotechnology may be increased space for wilderness (Huang et al., 2002). "The greatest threat to the Earth's biodiversity is habitat loss, through conversion of natural ecosystems to agriculture," states the *Declaration in Support of Protecting Nature with High-Yield Farming and Forestry* (Borlaug et al., 2002). Growth in the number of people, and in their expectations, increases pressure on land. Conservation of biodiversity in situ will continue to be possible if high-yield practices allow the same amount of land to support a higher standard of living, more people, or both.

However, what is referred to as *nature* in Europe is in fact an ancient agrarian landscape. Increasing productivity in order to return some areas to original ecosystems does not address habitat for poppies, meadowlarks, and other beloved plants and animals that depend on human landscapes. Transgenic crops are popularly equated with management practices that exclude agrarian wildlife. However, they can be part of a healthier traditional farm environment. For example, deployment of transgenic crops could dramatically reduce use of fungicides (e.g., Gianessi, Sankula, & Reigner, 2003), pesticides that are more heavily used in Europe than in North America.

In practice, examples of transgenic biotechnologies to enhance diversity are still few. Other examples are scientifically possible and would be eloquent arguments for transgenic crops. There is urgent need to develop and deploy transgenic crops that specifically embody benefits for diversity, the environment, and rural habitat. Because the number of successful agricultural products that can provide both public goods and private return will be limited, public-sector investment will be essential to develop these applications.

Constructive Response

In Discussion

There are many opportunities for constructive engagement in the debate about transgenic crops. For example, the ability to see a subject in different aspects and bring these deftly into discussion is underdeveloped among moderates. This is no minor disadvantage. Learning theory teaches that the unexpected "take" on a message is often the one that brings an individual to a change of opinion. Opponents of transgenic crops know this. They do not invest in studies to assess impacts of transgenic crops. They invest in memorable stunts. Activitists wear white biohazard suits to destroy fields of transgenic potatoes having changes in starch content (visual message: the harmless appearance of these potatoes is deceptive) and to climb cathedral towers bearing protest banners (visual message: we bravely resist "gene food;" e.g., Global 2000, Austria, fund raising pamphlet *Our gene-technique campaign chest is empty!* and http://www.global2000.at/index1.htm).

One response to attention-getting stunts is to ask simple but memorable questions. Questions like the ones that follow were useful in introducing new perspectives about transgenic crops in conversations with students, who had not yet chosen a definite stance. They were less useful in conversations with NGO staff, who already had staked their careers on opposition to transgenic technology.

- What reasons would be sufficient to deny developing countries the chance to use resources they have in abundance as a path to development (i.e., sunlight, renewable biological processes, and human intelligence)?[1]
- What would happen to organic farmers if transgenic crops disappear? What would be the effect on their market popularity and price premiums? Would they drop back to pre-GMO-era levels?
- Why is the environment healthier in countries where agricultural productivity is high? Observant travelers notice that where productivity is low, environments are devastated unless protected (Ammann, 2003).

Public-sector scientists in many countries have founded independent groups to provide accurate information to the public about transgenic technologies. Examples include Dialog Gentechnik (Austria; http://www.dialog-gentechnik.at), Hrvatske udruge genetickih inzenhjere (Croatia; http://www.hugi.hr), Biotrin (Czech Republic; http://www.biotrin.cz), and the African Biotechnology Stakeholders Forum (ABSF, based in Kenya; http://www.absfafrica.org). These groups rely on voluntary time contributions of researchers from their leading national institutes. In Germany, public sector researchers have more local and frequent public contact than is common in the United States (H. Saedler, Director, Molecular Plant Genetics Division, Max Planck Institute for Plant Breeding Research, Cologne, personal communication, October 23, 2002; Horst Domday, personal communication, October 2002). Networking with these groups can suggest examples of activities that might be effective elsewhere.

In Research, Extension, and Education

Research can strive to maintain strong public plant breeding. It can develop additional eco-positive transgenic crops with unique benefits for diversity, management flexibility for wildlife, and other environmental benefits. Research and extension together can provide the best possible technology options for alternate systems (such as organic agriculture), thereby supporting true choice—that is, a range of viable choices—for farmers and consumers. Educators can provide citizens with an understanding of the basic economic principles that underpin democracy: What does democracy cost? Where does money for public services and subsidies come from? How is this related to transgenic crops and to technological innovation in general?

Conclusions

Philosophical opposition to transgenic crops makes common cause but has diverse origins. Some opposition is simply our human tendency to want immediate solutions for perennially difficult problems. Other objections are more deeply rooted and less likely to respond to scientific data. An understanding of the nature of objecting views is critical for clarifying what issues are actually part of the debate. For example, dialogue with opponents of private investment in biotechnology is as much about the role of private enterprise in development and democracy, as it is about science. Dialogue with opponents of science per se is as much an examination of ways—including science—to reduce the human footprint rather than enlarge it, and the ecological research necessary to discern the most beneficial approaches. In both cases, discussions may be clarified by specifying and comparing visions for the future. Research and extension initiatives that would help to build consensus include support for public plant breeding to serve a variety of agricultural production systems and choices, and development of transgenic crops with specific environmental benefits.

1. *A country that views biotech as a path to development is Cuba, which has few natural resources except its people. Cuba invested significantly in biotechnology (de la Fuente, 2001). Other terms of the development equation—capitalism and democracy—have been missing.*

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