
Road Bumps and Pitfalls for Agricultural Biotechnology

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The problems for biotechnology vary according to who you are—a large company that deals with important crops and developed-country farmers, a small private company, a public sector entity, university, national agricultural system or a CGIAR institution—which I will come back to. As far as public/private partnerships are concerned, the Rockefeller Foundation has seen success in collaboration with the Gates Foundation in creating such partnerships to tackle medical problems, such as AIDS, TB and malaria, but so far we have not had a single similar success for agriculture. Where you are is important also—the northern markets or Australia is one story and genetically engineered (GE) crops are really taking off in some dynamic developing countries benefiting rich and poor farmers. In Africa, where we spend a lot of our time, the problems are different again.

I am not in the private sector and can only guess as to what is worrying big industry at this point, and whether the Europeans will ever sort it out is an ongoing question that I will not dwell upon; however, there are signs of progress, with GE crops now planted in a few countries within the European Union.

THE NEXT GENERATION

Some large companies are getting close to marketing the next generation of traits, beyond *Bt* and herbicide tolerance. The big questions will be:

- How do you capture value for quality traits?
- Will they require market segregation?
- Will genes for value-added traits be stacked with “conventional” insect resistance and herbicide tolerance?

Clearly, stacking is “in,” to the benefit of companies like Monsanto and companies like Pioneer need to form partnerships to obtain enough traits to stack effectively and be competitive. From the point of view of those of us who support projects on Golden Rice and other nutritional improvements, it is hoped that the private sector will lead the way on stacking of traits and get the regulatory systems to accept them, because when you alter nutrition it is probable that little will be achieved by changing one trait at a time.

Liability issues are of particular concern to smaller companies, with the effect of delaying the release of new products. Multinational companies have invested significant time in Latin America in particular and India in discussions on protection of intellectual property (IP). Interesting models are emerging from Argentina and Brazil in conjunction with Monsanto; where patents have not been filed it may be possible to collect revenue from the end-user.

India is causing concern in demanding pricing structures, resulting in lowering of technology fees. On the positive side, large US companies see India—and China—as possible new markets including for GE products, which may have particular utility in the developing world. For the longer term, there is worry over competition from local producers of GE foods.

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very different.*

The large private-sector companies face many challenges in dealing with issues specific to the developing world and Africa in particular. Clearly, these companies would like to build long-term markets for maize and cotton and are trying to balance humanitarian interests with commercial interests. We are trying to facilitate public/private partnership discussions, but the issues are complex and the cultures of the public and the private sectors are very different. It's a huge challenge.

Where are the public sector and the small private sector in terms of bringing promising new GE products to the market-place? Where are the products listed by Peggy Lemaux¹? Very few have come to market. Salient also is the issue of moving innovations efficiently downstream from universities; I agree with Ralph Hardy² that many scientists in public-sector research lack business skills and know little about developing products that would have market-appeal for the common good.

Freedom to operate is a perpetual problem as is the high cost of regulation, particularly so for smaller-market specialty crops that university and small private companies are interested in.

PUBLIC PERCEPTION

It is difficult to judge the degree to which negative public perception of GE foods remains a significant issue. It is noteworthy that very strong research programs on developing GE crops are in progress in China, India and Brazil. On one hand, EMBRAPA in Brazil and India have a number of strong research institutes, but, on the other hand, there is a dearth of experience in bringing GE crops to market, at least by the public sector. *Bt* rice may be approved for commercial production soon in China and India and it is

¹Pages 31–42

²Pages 43–50

hoped that *Bt* eggplant—an example of a new GE crop resulting from a public/private (Mahyco, India) partnership—will be available to farmers in India, Bangladesh and the Philippines late in 2006.

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The public sector has to strike the right balance between commercial and noncommercial delivery systems. It is the issue of public good and even at the Rockefeller Foundation, which has a history in dealing with issues such as the Green Revolution as well as noncommercial aspects of agriculture, almost everything we talk about now is in terms of building dynamic national economies rather than stabilizing subsistence agriculture as the means of achieving sustainability. We are no longer talking in terms of just giving away GE crops. In any case, liability concerns and lack of adequate distribution systems preclude giving them away. Finding commercial models and developing seed systems beyond maize will be a challenge certainly in the poorer developing countries but may be a struggle also for minor crops in dynamic countries in the developing world.

As far as regulatory aspects are concerned, many countries started by following the US model with a conservative bent, placing restrictions where there was room for doubt. With experience, a risk *vs.* benefit philosophy has become more prevalent with the realization that if the approach is too strict no new products would see commercialization.

In the least developed countries where the Rockefeller Foundation does a lot of funding, particularly in Africa, we have to consider public perception and the NGOs. However, I am becoming more optimistic in this regard. I think that people are tiring of this debate and that there is opportunity for progress. A huge problem is weak research capacity in these small least-developed countries; seldom should you expect to fund projects for development in those countries in isolation. And it's a challenge to find good partners in universities willing to train postdoctorals and build long-term research capacity in those countries. Finding the models for training and partners for projects is a challenge.

In terms of defining the relationship with the private sector, we've seen some public sector projects that are trying to repeat what large private sector companies are doing. For example, developing *Bt* maize for Africa doesn't make sense for the public sector when Monsanto has a perfectly good product. We have to be strategic and examine what the private sector will not tackle.

Many donors who are extremely timid about funding GE projects in the developing world, with the notable exception of the US Agency for International Development, The Rockefeller Foundation and, to some extent, the McKnight Foundation. For this reason, the CGIAR centers are not at the cutting edge of biotech research. None of the

European donors are interested in funding this work. However, the good news is the Gates Foundation is quietly tip-toeing in and it is to be hoped that they will fund successful projects that will encourage them to remain involved, which could significantly change the dynamics.

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INTELLECTUAL PROPERTY

These issues may be simple or complicated. In Malawi, for example, developers of GE crops wouldn't need to worry about patents. A developed-country counterpart interested in partnering with scientists in Malawi might be able to manage the IP, depending on how the project is structured. I was happy to see NABC's guidelines for field-research trials with GE crops (NABC, 2006). My biggest push in Africa is not to convince countries to release GE crops to farmers. It is to encourage countries to let their scientists enter partnerships and develop new crops themselves that are locally appropriate. In order to participate in that development they have to be able to do simple research trials on site, in their own countries. In no other way will this move forward. Africans, Indians, Chinese, all want ownership of these crops as they develop them and if those trials cannot be done, it will never happen. Simple research trials and understanding of how to do them safely and responsibly are required, at low cost and with minimal effort. It should not take 2 or 3 years to obtain a permit for a simple trial, as it does now in Kenya.

Event-specific regulation is a real challenge. If you consider how difficult they are to breed and if we follow the US model of event-specific regulations, then we have a real problem in moving traits to locally adapted varieties of cassava and banana. We need a new model.

And we need regional harmonization in Africa. Although that continent will not be the breadbasket of Europe any time in the near future, there are tremendous opportunities for regional markets in Africa with the growing urban populations. Regional harmonization of biosafety regimes, quarantine restrictions, seed certification and so on will facilitate access to new regional markets.

On the sharing of IP, the Public Intellectual Property Resource for Agriculture (PIPRA) has the objective of assisting public-sector institutions in garnering IP and strengthening management skills. PIPRA now encompasses thirty-seven institutions in six countries. They will meet in the spring of 2007 to explore bringing Europe into the fold, and more countries. They have got an IP database online where they list the licensing for all of their technologies. For anyone interested in obtaining vectors with freedom to operate, PIPRA is now constructing them using its own public-sector IP. We hope that it will become available in a year or two.

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technology transfer in Africa.*

The African Agricultural Technology Foundation is a fledgling organization learning how to broker technology transfer in Africa. Some very smart Africans running it have already had some success. Cambia Biosys has devised another model for possible open-source licensing.

GOOD NEWS

There is some good news and some bad news. The good news is the rapidly increasing global acreage planted to GE crops. And it's noteworthy that GE crops are now being planted in five EU countries. Certainly poor farmers are beginning to benefit along with large farmers in some of the dynamic developing countries, as indicated in published data from South Africa, China, India, Brazil and Argentina. Interestingly, in Africa it is happening in Burkina Faso; Monsanto is partnering tactfully with local scientists there in a series of trials of *Bt* cotton. They are moving the Bollgard-2® trait into locally adapted varieties with very promising results. Working with their most advanced trait is smart management. This approach has changed the mindset of West African farmers to whom we have spoken. Suddenly they are saying, "Hey, if they have it in Burkina Faso then we must have it too." And that is how this will work in Africa: the people have to see it. And even though Monsanto will never get rich from Burkina Faso, it's the kind of thing we need to see happen.

NOT SO GOOD

On the other hand, no GE food crop has been released for commercial use in China or India and it is unclear when this will happen, despite its expectation in recent years. In all of Africa, South Africa is the only country where GE crops are growing, but we are seeing movement in East and West Africa: a lot more interest and a lot less fear. Illegal sale of GE seeds has been a problem, *e.g.* in India with *Bt* cotton and in Brazil with Roundup Ready® soy. It may be less of a problem with the next generation of GE traits, as companies learn how to handle this.

An article out of Pretoria, in South Africa reported that poor farmers were doing well in the early days of *Bt* cotton when only one gin was accessible. The owners of the gin loaned the farmers the money to pay the high cost of the seed, and at the end of the season the loan was returned in kind when the farmers brought their cotton to the gin. Then, a second gin opened and the farmers said, "We'll take the loan and the seed from the first gin but we'll sell our cotton to the second gin." Well, guess what, micro-credit is no longer available for these farmers. These are how institutional problems can create difficulties. We are still trying to get it right between the public and the private sectors.

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IN SUMMARY

We need many skills to strengthen IP regimes. Similarly on regulatory issues, the Specialty Crops Initiative promises to provide cheaper field trials. The need to harmonize in West, East and South Africa is becoming clear; individual countries are too poor to do this on their own. For a long time, 10% of the people have said this is great stuff and another 10% have expressed distaste. In the middle is a vast disengaged majority who really don't care, including many farmers in the developing world. I think that people are just tired of it. Let's get on with it. Let's just move on. It may not be an overflowing cup, but I'd say it's more than half-full.

REFERENCE

NABC (2006) Recommendations for Management Practices for Field Trials with Bioengineered Plants. Ithaca, NY: National Agricultural Biotechnology Council.



DEBORAH DELMER received her BA degree with honors in bacteriology from Indiana University in 1963 and her PhD in cell biology from the University of California San Diego in 1968. She has held faculty positions at Michigan State University, The Hebrew University of Jerusalem, and the University of California Davis where she was chair of the Section of Plant Biology.

With colleagues at Calgene, Inc., Dr. Delmer's group was the first to identify plant homologs of bacterial genes that encode the catalytic subunit of cellulose synthase and she was recognized for her work on cellulose synthesis by the American Chemical Society with their 2004 Anselme Payen Award. She also served as president of the American Society of Plant Biologists and is a member of the US National Academy of Sciences.

Since 2002, Delmer has served as associate director for Food Security for the Rockefeller Foundation where she is charged with grant-making and policy relating to biotechnology's role in advancing improvements in crops for the developing world. She is also involved in efforts by the Foundation to address problems of intellectual property rights and biosafety that are important for development of genetically modified crops important to the developing world.