

GMOs and Organic Agriculture.

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Presented at the ACORN 2003 Organic Agri-Food Conference, 15 March, Halifax, NS

My central theme is that GMOs are incompatible not simply with organic agriculture, but with agriculture in general. Indeed, GM crops are just as incompatible with both non-GM and GM conventional agriculture as they are with organic agriculture. I will present evidence to support the following points:

1. **GM is uncontainable.** GM crops are incompatible with everything else because *pollen moves* and *people make mistakes* - and as a result, neither GM seed nor the patented genes they bear can be contained. Inability to contain novel traits, including pharmaceuticals and industrial enzymes, will oblige consumers - earthworms, robins, and bobcats as well as humans and domestic livestock - to ingest compounds never before in the foodchain.
 2. **Costs have been externalized involuntarily to society and the environment.** Responsibility for dealing with risk of contamination is vested entirely in those who choose *not* to grow the crop - organic or otherwise. .
 3. **GM contamination poses both known and unknowable risks.** Known risks of genetic pollution include for conventional farmers, complications in weed control, evolution of resistant weed populations, and for both organic and conventional farmers, loss of premia for IP crops.
 4. **Most of the GM risks confronting organic farmers are almost as problematic for conventional farmers.** United we stand. Divided we fall.
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GM is Uncontainable

GM can reach your farm in many ways, including cross-pollination from a neighbor, wind blown seed (canola; forages), and from the purchase of contaminated seed.

Cross-Pollination (genetic pollution). The European Commission commissioned a study on the feasibility of **co-existence** between GM, conventional (non-GM), and organic farming in Europe (Bock et al., 2002). The study modeled

- 3 different threshold scenarios, 0.1, 0.3 and 1% contamination,
- for each of canola, corn, and potato,
- at each of 10 and 50% GM adoption rates.

They concluded that achieving the 0.1% threshold which is closest to the requirements of organic practice was nearly impossible for all scenarios, even with significant changes in cropping practices. Thus, allowing some farmers to grow GM crops necessarily precludes other farmers from growing organic or any non-GM, identity preserved (IP) crop.

Even a threshold of 0.3% contamination in canola and corn was found to require significant changes in farming practice, such as staggering flowering time between GM and non-GM fields of the same crops, and management on a regional rather than individual farm basis.

Incompatibility in canola seed production fields was even greater. They estimated contamination from 0.4 to 1%, depending on farm type. To achieve a threshold of 0.3% contamination in canola seed production (recall that the CSGA allows only 0.25% same crop contamination in Canadian canola seed fields) would require significant changes to farm practice. However, to do so on a seed-saving farm was found to be unrealistically expensive (Bock et al., 2002). Thus, in addition to foreclosing on organic farming, they found that inclusion of GM canola on the farm landscape would also force an end to the practice of seed-saving for this crop.

Soy and Wheat? Crops like corn and canola, which are known to be fully or partly cross-pollinating, are most likely to be contaminated by genetic pollution and over long distances. But even wheat and soy, which are considered selfing species, actually do cross-pollinate to a degree unrecognized by most of us. Degree of outcrossing in these species is a variety-specific trait (up to 2.5% in soy (Ahrent and Caviness, 1994); up to 10% in wheat (Hucl and Matus-Cadiz, 2001)), but also varies with environment. A soybean researcher, for example, was able to increase yield by up to 16% simply by putting bee pollinators onto a soybean field - something which could only happen through cross pollination (Erickson, 1975).

The Western Experience. In his submission to the Royal Commission on Genetic Modification in N.Z., Lavern Affleck, a Saskatchewan farmer, reviewed how his neighbor's windrowed RR canola crop had been blown hundreds of meters out onto his adjoining field. Affleck stated bluntly, "Canada has gone blindly into broad scale experimentation with the Canadian land base. It is an experiment which cannot be retracted, and was entered into without sincere reflection as to possible ramifications. In our experience crops (and weeds) are spread in so many ways (wind, the waterways, on the roadside, on farm machinery and trucks) that it is impossible to prevent accidental releases into unwanted areas. We now have some degree of GE crop contamination across our entire Canadian Prairie land base"(Affleck 2000).

Humans make mistakes, as shown most clearly by the *StarLink* and Prodigene examples. *StarLink* is a type of Bt maize which is genetically engineered to synthesize the Cry9C insecticidal protein to protect against selected insect pests. Although restricted to livestock feed uses due to concerns about allergenicity, and although grown on just 0.2% of US land sown to maize in 1999, almost a quarter of the grain samples tested early in 2000 were reportedly contaminated with the *StarLink* GM trait (Shadid, 2001). Aventis reportedly paid hundreds of millions of dollars to rectify the mistake, including a \$9 million settlement with farmers. Yet, many others were also saddled with externalized costs, including the processors, restaurants, and grain elevators to say nothing of all US corn farmers who had to bear the cost of lower price and lost markets. Prodigene is a Texas biotech company that is strongly associated with pharming - growing pharmaceuticals in field crops. They were also the first firm fined under the US 2000 Plant

Protection Act last fall. They received the maximum allowable penalty of \$250,000 for contaminating commercial soybeans with unapproved GM corn. The corn was reportedly engineered to produce trypsin for diabetics, plus another compound to deal with diarrhea, was not yet approved for commercial production. Their cost was reportedly about \$2.8 million to buy and destroy 500,000 bu of contaminated soy in Nebraska, plus the cost of cleaning out the facility and shipping the beans to be destroyed - about \$3 million in total. They were further ordered to destroy 155 ac of corn in Iowa which had been inadvertently contaminated by their GM corn in the same year - 2002. In addition to the \$250,000 penalty, they were also obliged to post a \$1 million bond.

Monsanto's GT200 gene is another example of the 'adventitious' presence of an unapproved transgene in certified, commercial seed. Although both the GT200 and RT73 genes were created and tested by Monsanto to convey tolerance to glyphosate, only RT73 was eventually marketed. Yet GT200 contamination caused 60,000 bags of RR canola seed to be recalled in 1997 (Hesman, 2002), and again in 2001, when hundreds of tons of Monsanto's *Quest* RR canola had to be withdrawn for the same reason (Kilman and Carroll, 2002). Clearly, it is not to the advantage of the proprietors of this technology to be continually cited for inadvertent contamination of their own seed with unapproved transgenes. They would remove them if they could. The inability of the proprietor to extract errant transgenes presages societal inability to retrieve transgenes found to be undesirable after commercial release.

Another illustration of human action compromising containability on a national level is the documented introgression of DNA from GM maize into native landraces of maize in the region of Oaxaca, in southern Mexico (Quist and Chapela, 2001). Genetically modified maize had not been authorized for commercial production in Mexico, but was nonetheless present in grain being distributed as subsidized food by the government. Farmers receiving the grain as food may have sown some as seed, inadvertently introducing transgenic DNA into their own criollo landraces.

Thus, containment should be recognized as implausible, and potential redistribution into the environment should be explicitly assumed for transgenes authorized for commercial release.

Externalized Costs

Who benefits from GM crops? Certainly the proprietors - Monsanto et al. - have benefitted enormously by diverting an ever larger fraction of farmgate receipts into purchased inputs, especially Roundup. GM crop growers presumably get the agronomic benefits, if any, of GM traits - although the evidence is far from compelling that GM actually fulfills its many promises to farmers. But everyone else - all the neighbors and other growers of the same crop - bear the unquestionable costs of trying to avoid contamination. This includes not just farmers, but processors, elevator operators, custom seeding and combining, the seed trade, etc.

Can you imagine a government which obliged everyone else to bear the costs of segregation, isolation, and labelling so that organic growers could reap the benefits of organic farming?

Conventional non-GM as well as organic farmers suffer from lower prices when buyers shun Canadian grain due to risk of contamination. While organic farmers have literally been shut out of some crops - western canola, and increasingly, Ontario corn - because contamination is unavoidable, all conventional farmers have been compromised when export markets refuse to buy our grain. It must be a heavy blow to be physically unable to capitalize on the price premia being offered by ADM etc. for non-GM grains, and to watch helplessly as Brazil and other nations fill market share formerly occupied by our farmers.

The US government rushed to buy up contaminated StarLink seed corn a couple of years ago, to help bail out Aventis in its self-inflicted crisis. The US government joined various commodity groups in undertaking countless arm-twisting overseas missions to attempt to resurrect failing markets for American GM-contaminated grain. The US, Canada, and 4 other countries sacrificed international stature by fighting endlessly at the Biosafety Protocol negotiations to force the rest of the world to accept GM grain. Just recently, Canada has reportedly now joined the US and other GM grain exporting nations in a pending WTO effort to force Europe to grow and accept GM grain.

Whose money - and whose good name - did they expend in this and countless other actions designed to facilitate the two-way flow of GM grains into commerce and receipts back to Monsanto, Aventis, Syngenta etc?

Can you imagine a similarly heroic level of intervention to force the world to buy organics?

Known and Unknowable Risks

Government and industry proponents are entirely correct when they say that **there is no evidence GM has harmed human health or the environment**. That is a correct statement. But the inference they want you to take is not. The truth of the matter is that there is **precious little evidence** upon which to decide a) *whether* GMOs pose risks, and b) if they *have already* harmed the environment or human health.

Government recalcitrance on mandatory labelling is the centerpiece of societal doubt about GM food safety, according to Marion Nestle's brilliant new text Safe Food. Europe and Japan have labelling. But not us. Now why is that? We're told that it would be too difficult; too expensive. Yet when Calgene released Flavr-Savor tomatoes under the label *MacGregor*, they were not only labelled but proudly labelled as having been genetically modified. The label even explained the details of what had been added, including the antibiotic resistance marker:

“BETTER TOMATOES, RIGHT FROM THE START!”

When Sainsbury's stocked a brand of tomato paste made from GM tomatoes - competitively priced, mind you - they again labelled them as such -

“MADE FROM GENETICALLY MODIFIED TOMATOES”

and reportedly sold very well. This was, of course, in the mid to late 90s, prior to Pusztai’s comments on GM potatoes and human guinea pigs. Nonetheless, these companies somehow managed to cope with the cost/stress of segregation and labelling then. Yet after 42 months of hemming and hawing, the Canadian General Standard Board (CGSB) Committee on the Voluntary Labelling of GM foods cannot even manage a voluntary labelling standard, despite being packed with pro-GM, pro-industry members, with just 4 of 53 voting members representing consumer interests. Why was it entirely feasible to label then, but not now, particularly when every poll shows strong consumer demand for mandatory labels? Why cannot the Canadian government see the writing on the wall?

Well, **it’s really just a matter of control** over choice. Government is compliant in denying or authorizing choice when it suits industry’s interests. When the GM product has no discernable benefit to consumers - as in the case of current GM corn, canola, soy, and cotton crops - then the spin is that labelling is simply impossible - prohibitively expensive, and unfeasible. Yet, when the GM product is designed to be of value to consumers, suddenly all the insurmountable obstacles to labelling vanish - as indeed they must. If the product is going to be sold as ‘genetically enhanced’ in some way, then it must be segregated, processed, and labelled as any ‘identity preserved’ entity must be. The instant the GM companies come up with some product that purports to meet consumer needs, labelling will cease to be an issue.

Are the Risks Real? Who can say, when government declines to fund research into potential health and environmental effects of GM crops? Virtually every authoritative review of GM risk assessment¹ comes to the same conclusion - we just don’t know enough to reach definitive

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Domingo, 2000 (Health risks of GM foods: many opinions but few data. *Science* 288:1748-1749) could find **only 8 refereed studies** evaluating the food safety of GM products, including only 4 actual feeding trials, of which 3 were from Monsanto teams.

EU-US Biotechnology Consultative Forum. 2000. Final Report. (http://europa.eu.int/comm/external_relations/us/biotech/biotech.htm) In areas of controversy about GM risks and benefits, they stated “there is a **lack of substantial scientific data and evidence**”, often (presented) “more as **personal interpretations disguised as scientifically validated statements**” (N.B. emphasis added)

Letourneau, D.K. & B.E. Burrows 2002. Genetically Engineered Organisms. Assessing Environmental and Human Health Effects. CRC Press, Boca Raton. Summarized current state of knowledge in various areas.

NRC (National Research Council), 2002a. Environmental Effects of Transgenic Plants. National Academy Press, Washington, D.C. Identified numerous failings in the current US regulatory process for GM crops.

NRC (National Research Council), 2002b. Animal Biotechnology: Science-Based Concerns. National Academy Press, Washington, D.C. Identified critical deficiencies in the US regulatory process for GM animals, including fish.

Royal Society of Canada Panel on the Future of Food Biotechnology. 2001. Elements of Precaution:

conclusions. The few scientists who have managed to get funding and actually publish their findings do so at considerable personal and professional risk. Examples would include:

- **John Losey**: an as-yet-untured Assistant Professor at Cornell, whose publication in *Nature* about the effect of Bt pollen on Monarch butterflies stimulated other academics in clear conflict of interest to publicly disparage his findings. Anthony Shelton, a colleague of Losey at Cornell, and Richard Roush of the University of Adelaide stated:

"We believe that few entomologists or weed scientists familiar with butterflies or corn production (and the control of milkweed) give credence to the Nature article, but the public and its policy makers have reacted in knee-jerk fashion" (*Nature Biotechnology*, Sept. 1999).

This comment is noteworthy because it was based on remarkably little knowledge of the intimate details of monarch oviposition and feeding behavior, milkweed distribution both locally and geographically, corn pollen distribution and toxicity, and multi-trophic interactions which must be considered to assess the ecological implications of the findings of Losey et al. (1999).

- **Arpad Pusztai**: an imminent senior nutritionist, formerly of the Rowett Research Institute in Scotland, whose brief public discussion of adverse implications from feeding GM potatoes to rats - led a host of industry-compromised academics to wage a vicious

Recommendations for the Regulation of Food Biotechnology in Canada. Royal Society of Canada, Ottawa. 245 pp (available at www.rsc.ca). This group of distinguished senior scientists **identified numerous critical failings** in the Canadian GM regulatory process, and were particularly critical of the pivotal role accorded the unscientific concept of "substantial equivalence".

Wolfenbarger, L.L. and P.R. Phifer. 2000. The ecological risks and benefits of genetically engineered plants. *Science* 290:2088-2093. They noted that **"key experiments on both the environmental risks and benefits are lacking"**. They identified numerous critical deficiencies in the evidence which would need to be rectified before one could determine if GM crops are indeed safe for the environment.

and highly personal campaign to discredit him - and his findings - leaving his brilliant career in shambles. His findings (Ewen and Pusztai, 1999) have not yet been challenged by any published effort to repeat his studies.

- **Ignacio Chapela:** an as-yet-untentured Assistant Professor at the University of California, Berkeley - the same campus which allowed Novartis (now Syngenta) to lease its own academic department for 5 years for \$25 million. His publication in Nature of evidence of GM maize encroachment into Oaxaca, Mexico motivated an industry-inspired campaign to discredit his finding. Using the notorious AgBioWorld website established by Prakash of the Tuskegee Institute as their platform, two employees of a PR firm hired by Monsanto reportedly duped a large number of scientists into signing a petition ultimately forcing Nature to reconsider the publication. They undertook a second, post-publication re-review, with an outcome reflecting dishonorably on Nature. Perhaps due to embarrassment, Nature declined to publish more recent work by Mexican scientists fully corroborating Chapela's findings.
- **David Schubert:** whose recent article in Nature Biotech showing that inserting a single gene into the human genome significantly up- or down-regulated expression of 5% of all of the genes in the genome, elicited a response opinion piece co-authored by no less than 18 contributors, headed by none other than Beachy of the Monsanto-funded Danforth Research Institute

So, where does this leave the public about risks of GM crops? In a quandry, to be sure. GM products may well be harmless, or at the least, no more harmful than conventionally bred crops. But there is literally no evidence to support this hopeful outlook, and there can never be, without mandatory labelling to allow for epidemiological follow-up. Government recalcitrance to apply mandatory labelling, together with their transparent efforts to obfuscate with voluntary labelling, lead rightly or wrongly to the conclusion that there is something to hide.

Find Common Cause

As should be clear from the foregoing, most of the threats facing organic farmers also face their conventional neighbors. It is not to your advantage as organic growers to let your issues be sidelined as 'just organic'. You need to work with your conventional neighbors to raise common issues and demand resolution. United we stand; divided we fall.

Conclusions

Evidence has been provided to support the premise that GM is uncontrollable. Containment is literally inconsistent with plant reproductive biology and with human nature. Containment did not matter with conventional breeding of conventional traits. It matters now because of individual gene patenting and wholly novel traits, obliging involuntary consumption of compounds such as Bt which have never before been ingested on a large scale by humans or livestock. These issues will remain with us for the foreseeable future. The best analogy to this

uncontainable technology is a runaway train - out-of-control, with potentially catastrophic results and the conductor asleep at the wheel.

Government has authorized the commercialization of an unabashedly self-serving, proprietary technology that can exist only by externalizing costs involuntarily to non-GM growers and to society at large. Why has no federally or provincially funded study examined the purported benefits to farmers? Perhaps they fear to reveal that the promised benefits have not been realized. Alternatively, perhaps the government's primary objective in authorizing this technology had nothing to do with benefitting farmers or society at large. The latter interpretation is consistent with the almost complete refusal of government to fund risk assessment research.

Canadian farmers, organic and conventional, need to realize that they have been had - all of them. As divided, factionalized sectors, they have been and will continue to be ineffective in making their case to government, and to the public. It is vital that you seek common cause with your neighbors, all of your neighbors, and with the like-minded NGO community to work together to deal with this vital issue.

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