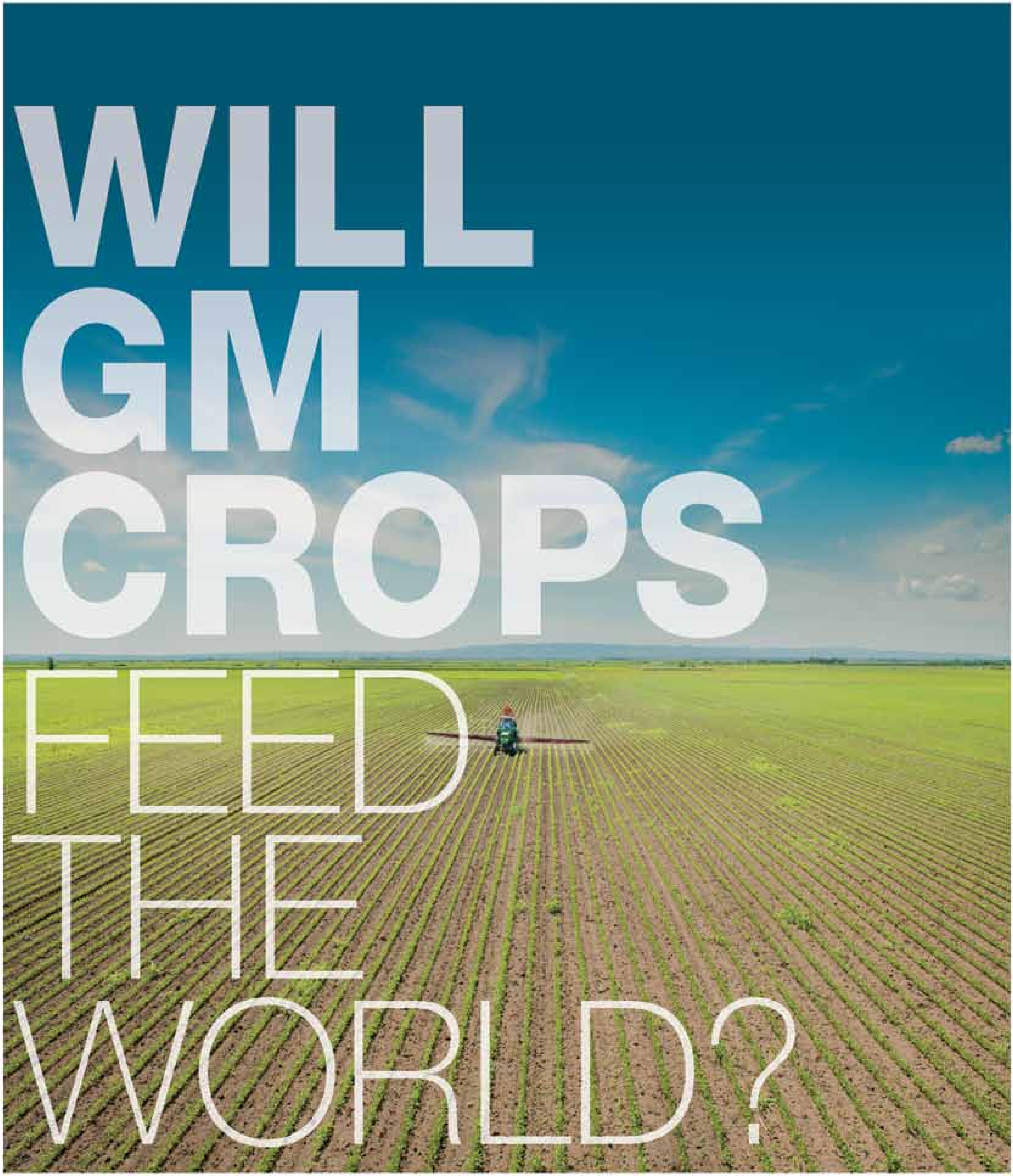

WILL GM CROPS FEED THE WORLD?

cban
Canadian Biotechnology Action Network

OCTOBER 2014

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October 2014

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cban Canadian Biotechnology Action Network | Collaborative Campaigning for Food Sovereignty and Environmental Justice

CBAN is a campaign coalition of 17 organizations working to research, monitor and raise awareness about issues relating to genetic engineering in food and farming. Our members include farmer associations, environmental and social justice organizations, and regional coalitions of grassroots groups.

Acknowledgements

CBAN would like thank Inter Pares and Devlin Kuyek from GRAIN for their helpful review and comments. Thanks also to Mariam Mayet, Director of the African Centre for Biosafety, and Cathy Holtslander, Director of Research and Policy at the National Farmers Union, for their assistance.

Table of Contents

Summary

The promise that genetically modified crops can “feed the world” is largely used by the biotechnology industry to encourage widespread acceptance of this controversial technology, but it is disconnected from the complex reality of world hunger and the limitations of GM crops themselves.

This report challenges the assertion made by the biotechnology industry that genetically modified (GM) crops are needed to “feed the world”. The argument that this technology can solve the problem of world hunger, or be a tool towards ending hunger, is compelling but false.

Experience with GM crops shows that the application of GM technology is more likely to enhance and entrench the social, economic and environmental problems created by industrial agriculture and corporate control.

1. GM crops on the market are not designed to address hunger.
2. GM crops do not increase yields.
3. GM crops do not increase farmer incomes.
4. GM crops increase pesticide use and harm the environment.
5. GM crops are patented and owned by large corporations.

THE CLAIM: WE NEED GM CROPS TO FEED THE WORLD

Proponents of genetically engineered (GE; also called genetically modified or GM) crops claim that we need this technology to address the current global hunger crisis, and to feed a growing global population. We often hear that we will need to double our global food production by 2050 to meet the growing demand, and that GM crops provide an essential way to meet this goal.

The biotechnology industry also tells us that GM crops are better for the environment, and will provide the tools that farmers need in a time of climate chaos. It claims that GM crops provide higher yields and higher incomes for farmers around the world, including small-scale growers in the Global South.

These assertions, however, are not true, and the promise to "feed the world" with GM crops overlooks the real causes of hunger and disregards the many harmful impacts of using the technology.

> "To turn a blind eye to 40,000 people starving to death every day is a moral outrage… We have an ethical commitment not to lose time in implementing transgenic technology.
>
> — Klaus Leisinger, head of Novartis Foundation for Sustainable Development

> "The challenge of feeding the planet and doubling food supply in the next 36 years is the greatest challenge facing mankind today. … There are 7.2 billion people on the planet. There will be 9.6 billion by 2050. The demand for food will double… [Using GM food and data science is] the only thing that will enable us to feed the planet without encroaching on the forests and wetlands…. This represents a business opportunity, but from a societal perspective, it's very important.[1]
>
> — Robert Fraley, CEO of Monsanto, Winner of the World Food Prize 2013

THE REAL PROBLEM

The claim that we need GM crops to "feed the world" ignores the real, root problem: **Hunger is caused by poverty and inequality**. People are generally hungry not because of insufficient agricultural production, but because they do not have money to buy food, access to land to grow food, or because of complex problems like food spoilage, poor food distribution systems and a lack of reliable water and infrastructure for irrigation, storage, transport and financing. If these deeper problems are not addressed, and as long as food is not reaching those who are hungry and poor, increased agricultural production will not help reduce food insecurity.[2]

> "Hunger is not the result of too little food being produced, but rather of marginalization and disempowerment of the poorest, who lack the purchasing power they need to procure the food that is available.[3]
>
> — Olivier De Schutter, former United Nations Special Rapporteur on the Right to Food

We already produce enough food to feed the world's population,[4] and did so even at the peak of the world food crisis in 2008.[5] In fact, current global food production provides enough to feed 10 billion people.[6] The world produces 17% more food per person than it did 30 years ago, and yet, the number of food insecure people is still very high. The recent food price crises of 2008 and 2011 both took place in years of record global harvests,[7] clearly showing that these crises were not the result of scarcity. However, over a third of all global food production – 1.3 billion tonnes – is wasted annually, during production, processing and storage, as well as in grocery stores and from our plates.[8,9]

Hunger is clearly a political, social and economic problem. Its only real solution, then, also needs to be a political, social and economic one.

> "Gene splicing is not intrinsically capable of surmounting obstacles like poor roads, inadequate rural credit systems and insufficient irrigation.[10]
>
> — Dominic Glover, Institute of Development Studies, UK

How many people are hungry?

The most widely reported figure of 842 million hungry people in the world captures only those who are experiencing the most extreme form of chronic, severe undernourishment, and includes only those who do not get enough food energy to support a sedentary lifestyle.[11] This number rises to 1.5 billion or more when we include people who are "food inadequate," or who do not get enough food to maintain a lifestyle with "normal activity" levels.[12] This larger figure – which has not changed significantly in the past two decades – is important because most people living in poverty support themselves with some form of manual labour.

Approximately 98% of the hungry people in the world live in developing countries, and 65% of them live in just seven countries.[a] Women account for 60% of the hungry people in the world.[13]

a These are: India, China, the Democratic Republic of Congo, Bangladesh, Indonesia, Pakistan and Ethiopia.[13]

WHY WE DO NOT NEED GM CROPS TO FEED THE WORLD

1. THE GM CROPS THAT ARE ON THE MARKET TODAY ARE NOT DESIGNED TO ADDRESS HUNGER

TWO TRAITS

In 2013, 57% of the world's GM crops were engineered to be tolerant to a particular group of herbicides, 16% were engineered to be toxic to pests, and 27% were "stacked" with both herbicide tolerance and insect resistance (fig. 1).[14] This means that 84% of all GM crops are herbicide tolerant. Other traits, such as virus resistance and drought tolerance, account for less than 1% of global GM crop acres.

FOUR CROPS

Four GM crops account for almost 100% of worldwide GM crop acreage: soy, corn, cotton and canola (fig. 2).[15,b] All four have been developed for large-scale industrial farming systems and are used as cash crops for export, to produce fuel, or for processed food and animal feed.[16] There are very few GM fruits and vegetables on the market, or GM grains that are used for direct human consumption. In fact, shifts to commodity farming have displaced the cultivation of important local food crops. In Brazil and Argentina, large areas of fertile farmland and forests are now being used to produce GM corn and soy for animal feed and biofuels instead of food crops.[17]

b Along with these four GM crops, small amounts of GM sugar beet (Canada, U.S.), alfalfa (U.S.), some squash varieties (U.S.) and papaya (U.S., China) are also grown, but their acreages collectively account for less than 1% of worldwide GM acres.

FIG. 1: TRAITS AS PERCENTAGE OF TOTAL GM ACREAGE

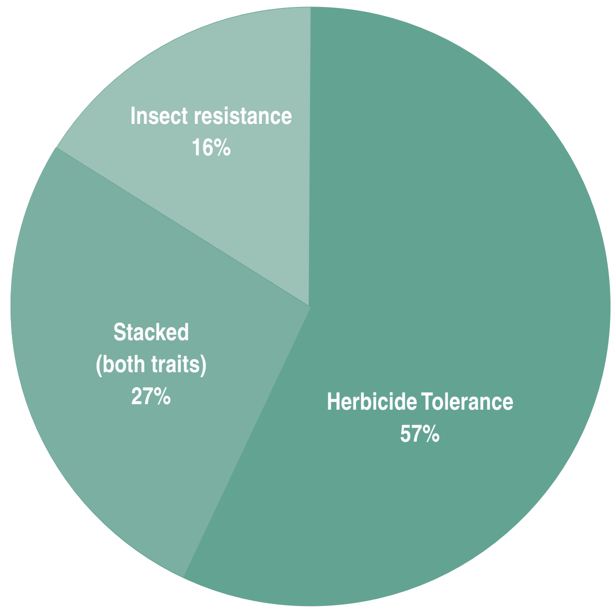
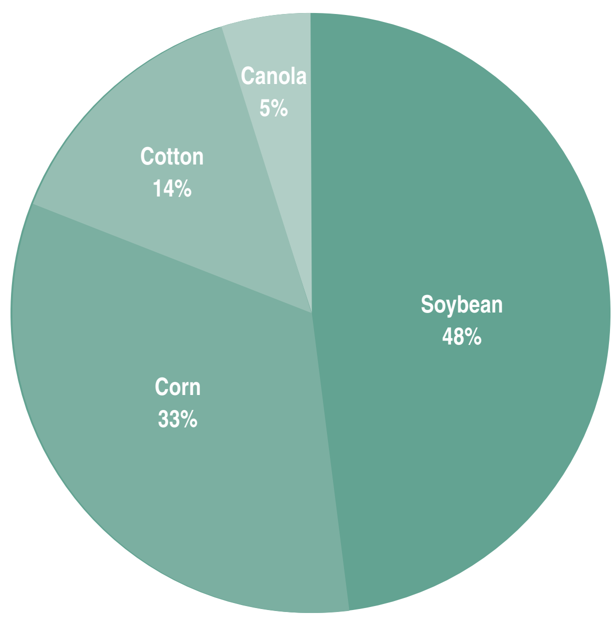


FIG. 2: CROPS AS PERCENTAGE OF TOTAL GM ACREAGE



TEN COUNTRIES

The large majority of GM acreage can be found in just a handful of countries.[18] Just three countries – US, Brazil and Argentina – grow over 77% of the world's GM crops (Table 1). **Ten countries account for 98% of the total GM acres.**[19] These are all countries that either already have highly industrialized agricultural systems, oriented to produce cash crops and export crops, or those that are trying to move towards an increasingly industrialized system. In 2013, 27 countries in the world grew GM crops, but 17 of these grew only 1% or less each of the total GM acreage.

TABLE 1: GLOBAL GM ACREAGE BY COUNTRY

	Country	Area (millions of acres)	Percentage of global GM acres	Crops
1	USA	173.22	40%	Corn, soybean, cotton, canola, sugar beet, alfalfa, papaya, squash
2	Brazil	99.58	23%	Soybean, corn, cotton
3	Argentina	60.29	13.9%	Soybean, corn, cotton
4	India	27.18	6.3%	Cotton
5	Canada	26.68	6.2%	Canola, corn, soybean, sugarbeet
6	China	10.38	2.4%	Cotton, papaya
7	Paraguay	8.90	2.1%	Soybean, corn, cotton
8	South Africa	7.16	1.7%	Corn, soybean, cotton
9	Pakistan	6.92	1.6%	Cotton
10	Uruguay	3.71	0.9%	Soybean, corn
11	Bolivia	2.47	0.6%	Soybean
12	Philippines	1.98	0.5%	Corn
13	Australia	1.48	0.3%	Cotton, canola
14	Burkina Faso	1.24	0.3%	Cotton
15	Myanmar	0.74	0.2%	Cotton
16	Spain	0.25	0.05%	Corn
17	Mexico	0.25	0.05%	Cotton, soybean
18	Columbia	0.25	0.05%	Cotton, corn
19	Sudan	0.25	0.05%	Cotton
20	Chile	<0.25	<0.05%	Corn, soybean, canola
21	Honduras	<0.25	<0.05%	Corn
22	Portugal	<0.25	<0.05%	Corn
23	Cuba	<0.25	<0.05%	Corn
24	Czech Republic	<0.25	<0.05%	Corn
25	Costa Rica	<0.25	<0.05%	Cotton, soybean
26	Romania	<0.25	<0.05%	Corn
27	Slovakia	<0.25	<0.05%	Corn
	27 COUNTRIES	432.93m acres	100%	8 crops

77% 89% 98% OF GLOBAL GM ACRES

Data from ISAAA, James, 2013.[20]

So far, there are no GM crops on the market that are engineered for higher productivity, are nutritionally enhanced, or have tolerance to environmental conditions such as high salinity or flooding. The only exception is Monsanto's GM Drought-Guard drought tolerant corn, approved in the US in 2011.[21] However, DroughtGuard corn only provides modest protection in moderate drought conditions (not during extreme drought), and conventional varieties often perform just as well in these conditions.[22,23]

2. GM CROPS HAVE NOT INCREASED YIELDS

Overall, conventionally bred varieties remain more effective, are less costly to develop, and it is these hybrids – not the GM traits themselves – that account for the yield increases we have seen in major cereal crops like soy and corn in recent decades.[24,25] In addition, farmers around the world have been – and still are – growing and saving seed from ancient and traditional varieties that are drought, flood and salt tolerant, and these seeds are still in cultivation and being saved in community seed banks in several countries.[26]

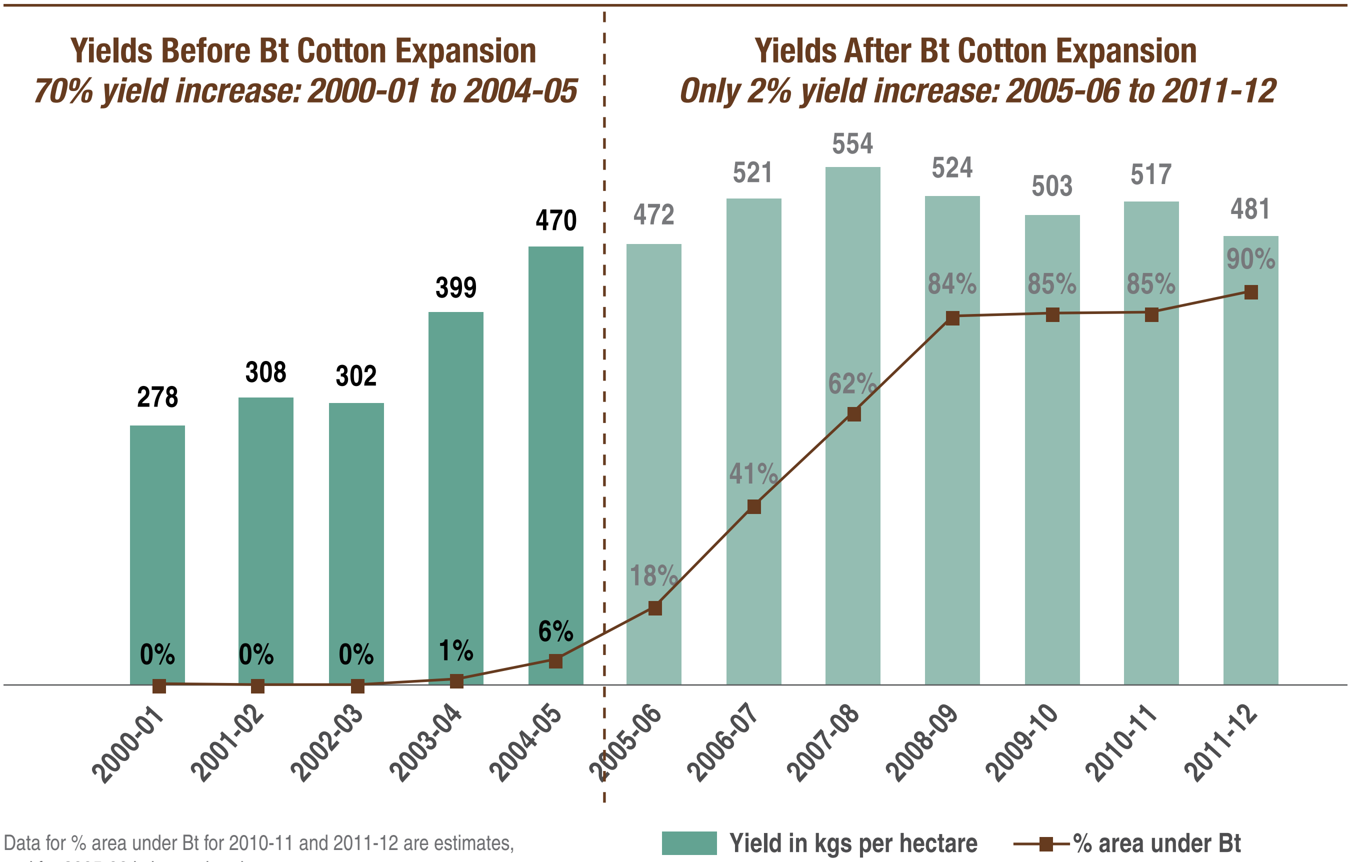
Studies looking at the overall yields of GM crops show that yields have not increased in either the Global North or South with the commercialization of GM crops. A well-known study by Doug Gurian-Sherman found that in the US, for instance, over the 13-year period after GM crops were commercialized, yields from herbicide tolerant soy and corn did not increase.[27] GM insect resistant (Bt) corn varieties showed a yield advantage during high insect infestation levels, but otherwise did not offer an advantage over non-GM varieties. Only 3.3% of the total 28% of corn yield increase from 2004-2008 in the US can be attributed to GM varieties. This equates to an operational yield increase of just 0.2% - 0.3% a year. The other 25% yield increase is due to improvements in conventionally bred varieties.[28]

In India, where over 90% of the cotton acreage is now under Bt cotton, yields have been inconsistent, and especially low in dry areas that are reliant on rainfall. While proponents claim that there has been a countrywide increase in cotton yields since GM cotton was introduced in 2002, studies show that much of the total yield increase in cotton took place before most farmers were growing GM cotton. In fact, 70% of the 73% yield increase reported since GM cotton was introduced took place between 2002 and 2005, when only 0.5% to 5% of the total area under cotton had shifted to GM (fig. 3).[29] Yield increases cannot therefore be attributed to the new GM seed, and were almost certainly due to other factors such as infrastructural improvements to irrigation and seed improvements in hybrid varieties over this period.[30] **Between 2005 and 2012, when over 90% of India's cotton acres were planted with Bt cotton, yields increased by only 2%.**[31]

Some regions in India have experienced drastic failures of GM cotton yields. In the state of Andhra Pradesh, for instance, where land holdings are small, soils marginal, and unpredictable monsoons the only source of water, the government estimates that 3.3 of the 4.7 million acres planted with GM cotton in 2011 had a loss in yield of more than 50%.[32] Overall, in states such as Andhra Pradesh and Maharashtra, average yields are currently either the same as, or less than, the levels they were at before GM cotton was introduced.[33] Farmers in Punjab, who have regular access to irrigation, have seen yield increases in some years. The state of Gujarat accounts for much of the overall increase in cotton production, but along with introducing Bt cotton, has also made several improvements in infrastructure over the past decade, such as constructing dams for irrigation.[34] In a report released in August 2012, the Indian Parliamentary Standing Committee on Agriculture concluded, **"After the euphoria of a few initial years, Bt cotton cultivation has only added to the miseries of the small and marginal farmers."** The committee called for a complete ban on open field trials of GM crops in India, until the country was able to develop a better regulatory and monitoring system.[35]

The failures of Bt cotton crops in India have been attributed to poor quality seeds, the emergence of secondary pests, target insects (bollworm) developing resistance, and the fact that Bt varieties, which were developed in the US, were not well suited to Indian agriculture.[36] This has led to a crop that is poorly adapted to the local environmental – or for that matter socio-economic – conditions of the countries where it is being marketed in the Global South.

FIG 3: BT COTTON: ADOPTION RATES AND YIELD INCREASES IN INDIA



Data for % area under Bt for 2010-11 and 2011-12 are estimates, and for 2005-06 is interpolated

Graph from the Coalition for a GM Free India[31]

> After the euphoria of a few initial years, Bt cotton cultivation has only added to the miseries of the small and marginal farmers.
>
> — Indian Parliamentary Standing Committee on Agriculture, 2012

3. GM CROPS DO NOT INCREASE FARMER INCOMES

Since yields have not significantly improved due to GM traits, and GM crops have sometimes actually failed, farm incomes in the Global South have not seen a consistent or overall increase as a result of GM adoption. Additionally, the cost of proprietary GM seed is much higher than that for traditional and conventional varieties.

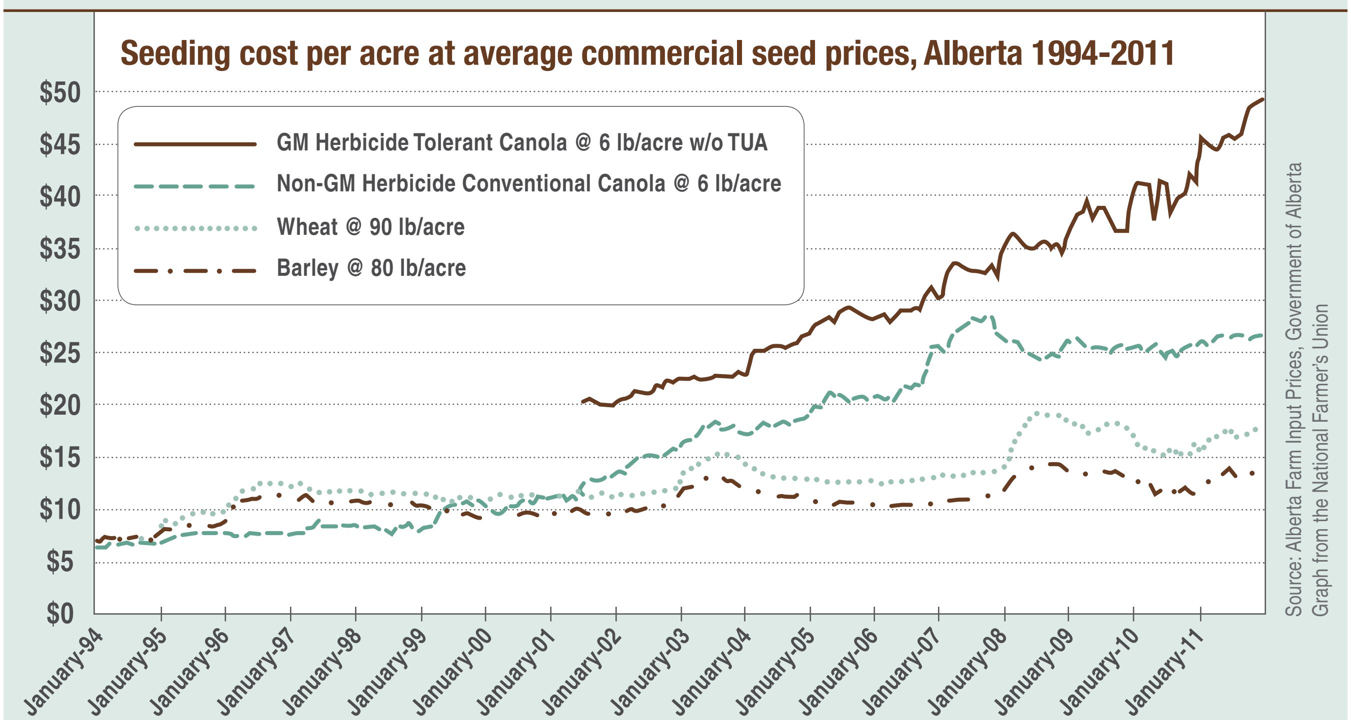
In India, for instance, a packet of GM Bt cotton seeds can cost anywhere from Rs. 700 to Rs. 2000 (CAD$12 to $36), which is three to eight times as much as the cost of conventional hybrid seed.[37] Traditional "desi" or Indian varieties cost even less. In addition, **Monsanto's virtual monopoly over the Indian cotton seed market means that farmers cannot find non-GM seed on the market**. Monsanto's Bt cotton is sold under several brand names because the company has licensing agreements with a number of Indian seed companies. Few farmers have any choice but to buy Monsanto's Bt cotton. Farmers often take out loans in order to afford costly GM seed, and, if yields are low and they are unable to pay back their loans, they are pushed deeper into a cycle of poverty and dependency. This cycle, which began with the shift from traditional, farmer-saved seed to more expensive, proprietary hybrid seeds, has been exacerbated by the introduction of even higher-priced GM cotton seed.

When crops fail, the consequences can be dire for resource-poor farmers, their families and communities. High prices, debt cycles and crop failures have triggered thousands of farmers in the cotton-growing belt of India to commit suicide. In 2008, 16,196 Indian farmers took their own lives. In 2009, this number rose to 17,368. Between 1995 and 2010, a total of a quarter of million farmers committed suicide in India.[38,39,40] A majority of these suicides took place in the cotton growing states in India, some of whose governments have incentivized Bt cotton cultivation over the past decade.[41]

Rising seed and input costs can be seen in other countries as well. In South Africa, where GM maize (corn) was introduced in 1998, seed costs have steadily increased as the acreage under GM corn has grown. In 2004, when 20% of corn seed sold was GM, seed costs accounted for 6% of corn farmers' total expenditures. By 2011, when 77% of the total corn seed sold in South Africa was GM, seed costs represented 13% of farmers' input costs.[42] Seed costs for GM corn increased by 30-35% in just three years, from 2008 to 2011.[43]

Similarly, in Canada, cost for seed of GM varieties of crops is higher than for non-GM varieties, and seed costs, generally, have risen from 2.5% of farm costs in 1981 to 4.5% in 2013.[44] This increase is caused, in part, by the increased use of patented seed, which may come with a "technology use fee". In 2011 alone, farmers would have paid at least $261-million in technology use fees to canola seed companies.

FIG. 4: RISING COST OF SEED PRICES IN CANADA



4. GM CROPS LEAD TO AN INCREASE IN PESTICIDE USE AND FURTHER HARM TO THE ENVIRONMENT

Corporate manufacturers of GM seeds claim that GM crops reduce the use of pesticides.[c] **However, recent studies have found that pesticide use has increased rather than decreased with the cultivation of GM crops, in both the Global South and North**.

Pesticide use related to herbicide tolerant (HT) crops and the emergence of herbicide resistant weeds

In the US, Department of Agriculture data shows that although there was an initial reduction in pesticide applications, this trend did not last. **By 2011, pesticide usage was 24% higher per acre for GM crops than it was for conventional fields**.[45] Herbicide tolerant crops, in particular, have encouraged the use of brand-name chemical herbicides, such as Monsanto's glyphosate-based herbicide Roundup, and have increased herbicide use by 527 million pounds in the past 16 years.[46]

Similar patterns can be seen in Latin America. In Argentina, glyphosate use has increased from 8 million litres in 1995 to over 200 million litres by 2013. All this herbicide was applied on GM soy fields.[47] In Brazil, sales of pesticides increased by 72% between 2006 and 2012. The average consumption of pesticides in Brazil rose from approximately 7 kilograms a hectare in 2005 to 10.1 kilograms in 2011.[48]

This extensive use of Roundup on large areas of land being cultivated with herbicide tolerant crops – corn, canola, cotton, soy and white sugar beet – has led to the emergence of weeds that are resistant to the herbicide, or "superweeds."[49] There are now 28 weeds worldwide that have developed resistance to glyphosate (fig. 5); 14 of them are in the US, and four in Canada.[50] **By 2012, 20-25 million acres in the US were estimated to be infested with glyphosate resistant weeds**. [51]

As a response to glyphosate resistant weeds, companies have developed GM crops that are tolerant to the herbicides 2,4-D and dicamba. Varieties of GM corn and soy tolerant to 2,4-D have been approved in Canada, and are awaiting deregulation in the US. These crops do not provide a long-term solution: In one of the only studies that has looked at pesticide use since the introduction of GM crops, Charles Benbrook predicted that widespread use of 2,4-D resistant crops in the US could increase 2,4-D use by 50%,[52] and will lead to weeds developing resistance to these chemicals as well. In fact, past and current use has already led to 15 species of weeds resistant to 2,4-D around the world (four of these are found in the US and two in Canada)[53] and six species resistant to dicamba, (two of which are in the US, two in Canada, and two in other countries). Exposure to 2,4-D has been linked to a number of serious health problems, and, although it is still commonly used in Canada, it has been discontinued in Sweden, Denmark and Norway.

Pesticide use related to pest resistant crops and the emergence of Bt resistant pests

GM pest resistant crops are engineered with a gene from the bacteria *Bacillus thurengiensis*, or "Bt", to produce a toxin that kills some groups of insects.

The use of Bt crops in the US has reduced the use of insecticides by 123 million pounds.[54] **However, this figure does not represent the full environmental reality, because the Bt plants themselves produce an insecticidal toxin that is not quantified**, and may have adverse environmental impacts, including on soil and non-target organisms. Benbrook estimates that the amount of Bt toxin produced by GM insect resistant corn and cotton in the US is the same or higher than the average rates of insecticide application for those crops.[55]

In India, the cultivation of insect resistant crops such as Bt cotton led to an initial reduction of the Bt crops' target species (*Lepidoptera* species, primarily the cotton bollworm), but that decline then allowed the emergence of secondary pests,

c The term pesticide includes herbicides, fungicides and insecticides.

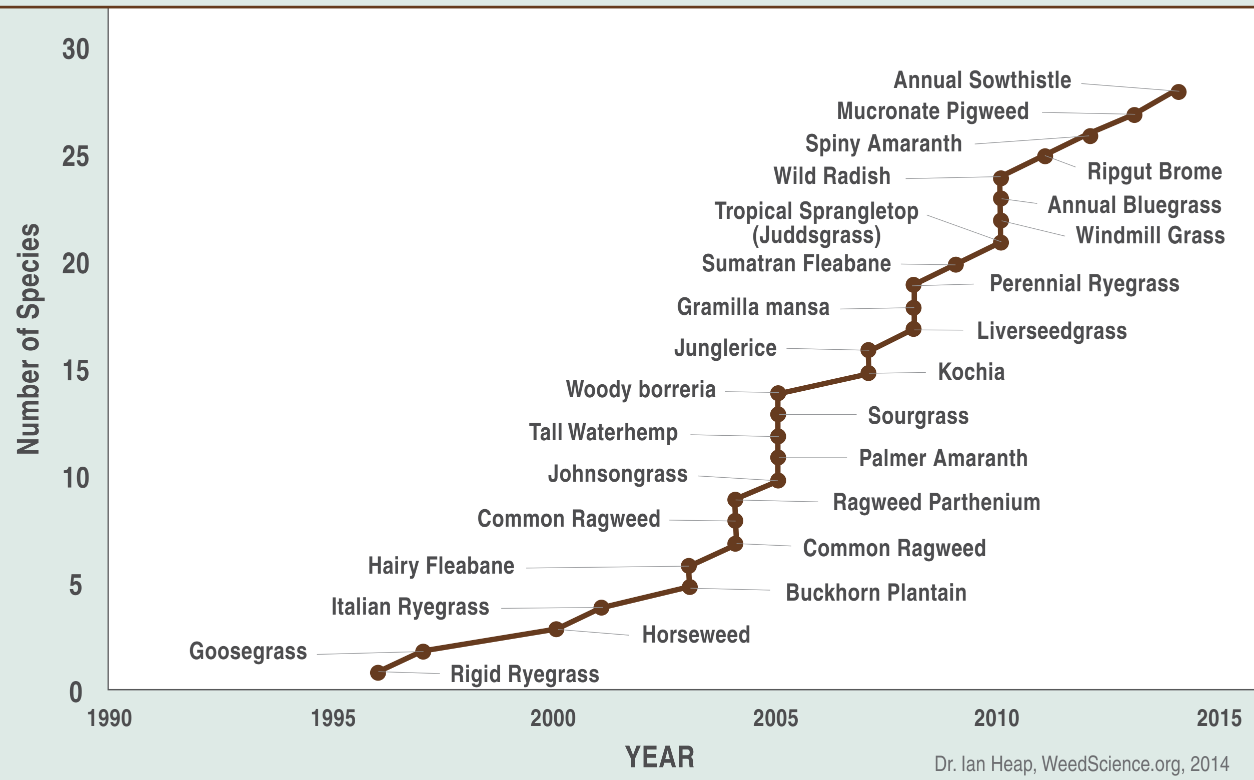
which have not been a significant threat to cotton crops in the past. For example, mealybugs, aphids and thrips now pose serious problems for cotton farmers across the country.[56,57]

In addition, after a few seasons of exposure to Bt cotton, some bollworm species have developed resistance to Bt cotton in India, as well as in other GM cotton growing countries.[58,59] Industry and government scientists are increasingly recommending other pesticides as solutions for both problems, pushing up already-high input costs, and leading to increased risks of harmful environmental and health consequences. **While pesticide reduction was the primary selling point for Bt cotton adoption in India, recent studies have found that overall pesticide use has not decreased in any state that grows Bt cotton, with the exception of Andhra Pradesh.**[60]

The spread of herbicide resistant weeds and insects resistant to Bt plants shows that current GM crops do not fit into a long-term and sustainable approach to farming but are short-lived technologies that create new problems for farmers and the environment. Industry responses to weed and insect resistance, which focus on shifting to other pesticides and GM seeds, merely replace one failing technology with another. Instead of solving a problem for farmers, this technological treadmill further embeds farmers in a cycle of environmental and economic problems and keeps farmers reliant on expensive corporate products.

> Pesticide reduction was the primary selling point for Bt cotton adoption in India, but overall pesticide use has not decreased in any state that grows Bt cotton, with the exception of Andhra Pradesh.

FIG. 5: INCREASE IN GLYSOPHATE-RESISTANT WEEDS WORLDWIDE



Dr. Ian Heap, WeedScience.org, 2014

5. GM CROPS ARE PATENTED AND OWNED BY LARGE CORPORATIONS

GM seeds are not owned by farmers and farming communities, or by people who are living with hunger and poverty. They are patented, owned and controlled by a small handful of large multinational corporations. **These companies profit from the sale of GM crops and royalties on GM traits, while small-scale farmers around the world bear the increased cost of buying seeds and the risks that come with using GM crops**, such as the consequences of possible crop failures, and weed and insect resistance. In addition, due to corporate monopolies in the seed market, farmers are often unable to access non-GM seed.

Six major companies are currently developing and selling GM crops: Monsanto, Dupont, Syngenta, Dow, Bayer and BASF.

- Collectively, these companies control 60% of seeds and 76% of agrochemicals globally. The top ten seed companies control over 75% of the seed market.[61]
- These six companies account for 76% of the private research and development in both sectors, 70% of which is devoted to biotechnology.[62]
- Since GM seeds were first introduced, the market share of the largest three of these companies has more than doubled, from 22% to 53.4%.
- In 2007, these six companies accounted for 98% of global GM acres.
- 85% of this area was cultivated with GM traits owned by Monsanto, the world's largest seed and biotechnology company.
- Monsanto has more than 1,676 patents on seeds, plants and other agricultural applications.[63] As of January 2013, the company had filed 144 seed patent infringement lawsuits in the US, involving 410 farmers and 56 small businesses in 27 states.[64]

Corporate seed ownership means that large agribusiness companies profit regardless of whether people have access to food or not. For example, during the food price crises of 2008 and 2011, when food prices were at record highs and people around the world were unable to afford their basic food needs, major agribusiness companies were still reporting record profits. In 2011, Monsanto reported net sales of $11.8-billion and profits of $1.6-billion.[65] The year before, an estimated 2.40 billion people in the world lived on less than $2.00 a day, and 1.22 billion people lived on less than $1.25 a day.[66]

Contrary to what biotechnology companies tell us, GM crop acreage is not growing around the world because farmers are choosing to buy GM seeds and finding them successful, but rather because these companies control seed markets and reduce the range of seed choices available to farmers. The introduction of GM seed on the market is often followed by the removal of non-GM varieties. In Canada, for example, 80% of 120 registered varieties of canola in 2000 were non-GM. By 2007, only five varieties of non-GM canola were available.[67] Similarly, in India, farmers are increasingly unable to buy non-GM varieties of cotton seed. This pattern also reduces overall agricultural biodiversity. In addition, companies can prohibit farmers from saving seeds that have patented GM traits, and in the case of herbicide tolerant crops, farmers are encouraged to use brand-name pesticides that the crops are engineered to tolerate. These factors underline the fact that GM crops do not expand the choices available to farmers. On the contrary, **GM crops reduce choice for farmers, while increasing risk**.

The full potential of GM technology to support corporate profit at the expense of small-scale farmers and food security is made clear by the development of "Terminator" seeds, which are genetically engineered to be sterile after first harvest. The technology was jointly developed by the US Department of Agriculture and seed company Delta & Pine Land (now owned by Monsanto). The Terminator seeds would stop farmers from saving and replanting seed, and force them to buy new seed on the market every season. The 1.4 billion farmers in the world who rely on farm-saved seed, the large majority of whom are small-scale farmers in the Global South, would be particularly affected by the introduction of such a technology. In response to global farmer protests, there is an international moratorium on field-testing and commercializing Terminator technology at the UN Convention on Biological Diversity.[68]

Relying on corporations to provide technological fixes to the most pressing global political and socio-economic problems merely forces farmers and consumers into positions of dependency.

Haiti Rejects Monsanto's donation

On January 12th, 2010, a massive earthquake hit Haiti, killing 300,000 people, injuring 500,000 others and leaving thousands of people homeless. After the earthquake, much of Haiti's seed stock was used to help feed people who fled to rural areas from devastated towns and cities. Following this, Monsanto donated 475 tons of hybrid corn and vegetable seed, to be distributed by the US Agency for International Development (USAID) to Haitian farmers, but on June 4th, 10,000 farmers joined a protest march against the donation and symbolically burned Monsanto's seeds. Chavannes Jean-Baptist of Haiti's Peasant Movement of Papay called the donation "a new earthquake" and said that, "if people start sending us hybrid seeds that's the end of Haitian agriculture." Though the donated seeds were not GM, the corn was hybrid, which meant that most seeds would not breed true if farmers replanted them, making them dependent on Monsanto for new seed each season. In a message to Haitian farmers, Chavannes said, "Monsanto is taking advantage of the earthquake…to open the country's doors to this powerful company. We cannot accept this."

> "It's difficult, in the short term, figuring out how I am going to make money dealing with people who don't have money. But in practice, the development of agriculture at a village level is something that could make an enormous amount of business sense over time.
>
> — Robert Shapiro,
> former CEO of Monsanto

> "The question we must ask, therefore, is not only whether certain forms of agricultural development increase the volumes of production, but primarily what their distributional impacts will be. Who will gain most? Who will not gain, and who may even lose?[69]
>
> — Olivier De Schutter, former UN Special Rapporteur on the Right to Food

African Countries Reject GM Food Aid

The well-known case of Zambia refusing to accept GM food aid stands testament to the fact that not all countries facing food crises consider GM crops to be the answer. In 2002, a number of countries in Southern Africa were facing the worst food crisis they had seen in fifty years. The crisis threatened 14 million people in six countries, and was caused by a number of factors including political conflict, drought and floods, high prevalence of HIV/AIDS and the lasting effects of trade liberalization programs.[70]

In response, the US sent 500,000 tonnes of corn to the region, approximately three-quarters of which was estimated to be GM. Several of the countries that received the shipments were worried about potential health effects as well as the risk of contamination of their domestic corn stocks, much of which was exported to Europe.[71] While some countries, including Lesotho, Mozambique, Malawi, Zimbabwe and Swaziland, accepted the aid on the condition that it was milled before distribution (thereby reducing the risk of environmental contamination), Zambia rejected the entire shipment. Soon after, Zambia formalized this policy of rejecting GM food aid, following a national consultation with government departments, women's groups, farmers, scientists, and other leaders and citizens.[72] The decision was based on environmental, health and trade-related concerns.[73] In his statement at the time, the Zambian president said, "We may be poor and experiencing food shortages, but are not ready to expose people to ill-defined risks."[74]

"We may be poor and experiencing food shortages, but are not ready to expose people to ill-defined risks.

— President of Zambia,
Levy Mwanawasa, 2002

"It is shameful to me that the leaders of some South African countries who are apparently well-fed, would rather see their populations go hungry then eat the same food we consume daily in the United States.

— US Republican Senator
Charles Grassley, 2003

Is GM "Golden Rice" a Solution to Malnutrition?

Golden Rice is the name of a rice that has been genetically modified to produce beta-carotene, which the body can convert into vitamin A. The biotech industry hopes that it will help fulfill their promise to feed the world.

The rice would be the first nutritionally enhanced GM food. However, Golden Rice is not a proven technology, is not yet available, and is eclipsed by existing, less expensive and less risky solutions to the problem of Vitamin A deficiency.

Vitamin A deficiency (VAD) is a serious problem in communities facing malnutrition. Its impacts are particularly severe for children and, if not dealt with, it can lead to blindness, and even death. The UN World Health Organization estimates that 250 million preschool-age children are deficient in vitamin A.[75]

When it was first produced, an 11-year-old child would have needed to eat 7 lbs of cooked Golden Rice to get their required daily intake of the vitamin.[76] Researchers from Syngenta – which holds the commercial rights for the crop – now estimate that a child could obtain half of their required vitamin A intake from eating 72 g of dry, improved "Golden Rice 2" every day.[77]

Golden Rice has been under development for over 20 years, and is still being tested. In these years, over $100-million dollars has been spent on development and advertising. Researchers from the International Rice Research Institute (IRRI) have said it will be available for commercial planting in 2016 or 2017,[78] and will be offered free for use by poor farmers and in low-income, food-deficit countries.

However, in 2013, IRRI confirmed that, "it has not yet been determined whether daily consumption of Golden Rice does improve the vitamin A status of people who are vitamin A deficient and could therefore reduce related conditions such as night blindness."[79] In 2014, IRRI also said, "average yield from [GM Golden Rice] was unfortunately lower than that from comparable local varieties already preferred by farmers."[80]

Golden Rice has not been adequately tested for bioavailability, to assess the shelf life of the beta-carotene in the rice or the effects of various kinds of cooking methods on it, or for safety.

Golden Rice does not address the root causes of vitamin deficiency. This is particularly significant because there are several alternative ways to address vitamin A deficiency. For instance, **a pre-school child can, on average, get their daily requirement of vitamin A from 75 g of spinach, 2 tablespoons of yellow sweet potatoes, half a cup of most dark leafy vegetables, or two thirds of a medium size mango**.[81, 82]

In addition, the body can only absorb beta-carotene when it also receives fat and protein.[83] Few children who are severely malnourished are getting either. A more sustainable solution would be to strengthen agricultural systems that support the cultivation of a range of crops needed for a healthy diet.

Several countries have also had fast success with food fortification and supplementation programs. Supplementation involves administering 1 or 2 doses of high-dose vitamin A capsules to children every year. These capsules are effective, easy to administer, and a single dose costs just a couple of cents.[84] The Philippines, for instance, has brought levels of VAD to below 5% through supplementation combined with food fortification, nutrition education programs and encouraging home and school food production.[85]

THE REAL SOLUTION

The solution to hunger needs to address the root problem. The hard truth is that a technology cannot possibly end hunger and poverty. In fact, relying on corporate technological fixes creates new problems. In the case of GM crops, it makes farmers dependent on the products of a few large companies whose primary objective is to maximize their profits.

Hunger is a social and political issue. To stop hunger, we need to address its root causes, and get control over our farming and food systems back into the hands of farmers and communities, instead of private corporations.

Food Sovereignty

Food sovereignty is the right of all peoples to healthy and culturally appropriate food, produced through ecologically sound and sustainable methods, and the right of people to define their own food and agriculture systems. The concept of food sovereignty was developed by La Via Campesina, an international movement of peasants, farmers, and agricultural workers. It is a political tool that prioritizes the interests of peasant and small-farmer based economies and food systems, over those dominated by the interests of large corporations.

Food Sovereignty:[86]

- Focuses on food for people
- Values food providers
- Localizes food systems
- Puts control locally
- Builds knowledge and skills
- Works with nature

The current industrial food system produces approximately 30% of all food consumed in the world, while using 70-80% of the arable land, and accounts for over 80% of greenhouse gas emissions and 70% of water resources. In stark comparison, **peasant food systems provide approximately 70% of the global food consumed, from just 20-30% of arable land, and account for less than 20% of fossil fuel and 30% of water resources**.[87]

> “If we do persist with business as usual, the world’s people cannot be fed over the next half-century. It will mean more environmental degradation, and the gap between the haves and have-nots will expand. We have an opportunity now to marshal our intellectual resources to avoid that sort of future. Otherwise we face a world nobody would want to inhabit.
>
> — Professor Robert T. Watson, Director of the IAASTD

Several institutions and new studies have encouraged a diverse, sustainable and community-based approach to future agricultural development. The UN Special Rapporteur on the Right to Food, for instance, released a report in 2010 calling for a shift to agroecology.[88] The report shows that such an approach promises high agricultural performance, progress in ensuring the human right to food, and economic development. It calls for policies that support sustainable modes of agriculture, invest in agricultural knowledge, support partnerships, empower women, and connect producers to fair and just markets. There is also a need to address the political dimensions of hunger. This includes strengthening storage and distribution infrastructure to reduce food spoilage, ensuring access to land and fair incomes for rural and urban poor, and addressing corruption, which often contributes to food stocks not reaching those who need them most.

In 2008, a group of over 400 experts from multiple disciplines, including scientists, government officials, farmers groups, civil society and development and policy researchers, were commissioned to conduct a four-year study on agricultural practices, rural livelihoods and sustainable development. The report produced by the International Assessment on Agriculture, Science and Knowledge for Development (IAASTD) concluded that **the best approach to addressing poverty and hunger lies in strengthening diverse, vibrant and sustainable agroecological methods of farming, and in developing locally-based food economies**. It also found that development approaches based on a quick technological fix rarely provided long term and sustainable solutions, while creating environmental degradation and social inequalities.[89] Industry representatives from agrichemical companies Monsanto and Syngenta were originally part of this project but pulled out when the risks of biotechnology began to be discussed in the report.[90]

GM crops promote an agricultural food system that is clearly incompatible with one that supports farmers and ecosystems. In contrast, an agroecological food system has incredible potential to produce sufficient, high-quality food, while also supporting rural communities, building

> “The right to food is not the right to be fed; it is the right to feed oneself in dignity.[91]
>
> — Olivier De Schutter, former UN Special Rapporteur on the Right to Food

Who Will Feed Us?

- 85% of the world’s food is still grown and consumed within national borders or within regional zones.[92]
- Approximately 85% of the 570 million farms in the world are less than 2 hectares in size.[93]
- Peasants provide 70% of the world’s food on 20-30% of arable land; industrial food system provides 30% of the world’s food on 70-80% of arable land.[94,95]
- Small farms around the world show higher productivity than large-scale farms.[96]
- 1.4 billion people still eat from farmer saved seed.[97]

biodiversity and addressing climate change. This approach has no room for seed that is genetically engineered, developed in labs and not fields, is patented, and is owned by a handful of companies. It is comprised instead of millions of farmers and breeders working together to develop, save and share seed that is adapted to local environmental and social contexts. The global movement to build and expand this agroecological system is growing, and it is this system that promises a truly sustainable, long-term approach to addressing food insecurity.

Ecological agriculture is particularly suited to farming conditions and environments in the Global South, and promises higher productivity and yields. In a study that reviewed 286 ecological agriculture projects in 57 countries, researchers found an average yield increase of 79% when these techniques were applied.[98] The improvements from organic and near-organic agriculture in Africa were even higher: the average yield increase across the continent was 116%, and in Eastern Africa it was 128%.[99] Several other studies have also found that ecological, biodiverse, participatory and community managed agricultural projects have created a host of social, economic and environmental benefits in countries in Africa, Latin America and Asia.[100] The experience of efforts that have so successfully addressed hunger and poverty should guide the way forward. **There is no place for GM crops in an ecologically sustainable and socially just food system**.

> "Small-scale diversified farming is responsible for the lion's share of agriculture globally. While productivity increases may be achieved faster in high input, large scale, specialised farming systems, the greatest scope for improving livelihood and equity exist in small-scale, diversified production systems in developing countries.
>
> — IAASTD Global Report

> "Agriculture must develop in ways that increase the incomes of smallholders. Food availability is, first and foremost, an issue at the household level, and hunger today is mostly attributable not to stocks that are too low or to global supplies unable to meet demand, but to poverty; increasing the incomes of the poorest is the best way to combat it.[101]
>
> — Olivier De Schutter, former UN Special Rapporteur on the Right to Food

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