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Article

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Journal of Innovation & Knowledge (JIK)

Provided in Cooperation with:

Elsevier

Suggested Citation: Roberts, Richard J. (2018) : The Nobel Laureates' campaign supporting GMOs, Journal of Innovation & Knowledge (JIK), ISSN 2444-569X, Elsevier, Amsterdam, Vol. 3, Iss. 2, pp. 61-65,
<https://doi.org/10.1016/j.jik.2017.12.006>

This Version is available at:

<https://hdl.handle.net/10419/190730>

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Conceptual paper

The Nobel Laureates' Campaign Supporting GMOs

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ARTICLE INFO

Article history:

Received 13 December 2017

Accepted 13 December 2017

Available online 27 March 2018

Keywords:

GMO

Hunger

Nutrition

Crop

Pest

Food

Precision agriculture

ABSTRACT

More than 800 million people suffer from hunger in the world. Using modern plant breeding methods to generate so-called GMOs (Genetically Modified Organisms), agricultural scientists have shown that crop yields and nutritional quality can be greatly improved. Many GMO varieties have been specifically developed with the aim of being resistant to pests, tolerant to drought and containing beneficial nutrients. This leads to a reduction in the use of insecticides in water and on land. If anything, the GMO varieties are safer than traditionally bred varieties because they are made in a very precise manner. However, the scientific evidence on this issue is being ignored by the Green Parties such as Greenpeace who continue to deny the science and mislead the public. 129 Nobel Laureates have joined in a campaign to convince the Green Parties and the public that they should support the use of GMOs, especially for the sake of the developing world.

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Introduction

The majority of the people who suffer from hunger in the world live in developing countries (FAO, 2017). According to statistics from the U.N. Food and Agriculture Organization (FAO), in 2016 there were 815 million people who go to bed hungry every night. This is up from 777 million in 2015. 98% of these people live in developing countries and 75% of them live in rural areas, especially in Asia and Africa where they are reliant on locally grown food (Table 1). The FAO estimates that about 50% of the people who suffer from hunger in the world are small farming communities who live in marginal areas prone to be affected by natural disasters such as drought or floods. Another 20% consist of the families of landless farmers, while around 10% live in communities that depend on fishing, farming and forest resources as a means of subsistence. The remaining 20% live in slums that are on the periphery of the big cities in developing countries. Although women are the main producers in the world due to cultural traditions and social structures, they are the most likely to be affected by hunger and poverty. In turn they are also more likely to give birth to children with growth retardation or low birth weight and the subsequent developmental consequences that produces.

There are many factors that lead to low agricultural production. For instance, natural disasters such as floods, tropical storms and long periods of drought are increasing, which bring devastating consequences for low income people living in developing countries.

Droughts such as the ones in Ethiopia, Somalia and Kenya in 2011 or in the region of the Sahel in West Africa in 2012 proved devastating. In many countries climate change is already causing adverse conditions to crop growth while more and more fertile lands suffer from erosion, salinization and desertification. In addition, whereas agricultural breeding practices developed in the West have focused primarily on improving the yields and nutritional benefits of the crops that are eaten in the developed world, very little attention has been paid to trying to improve the crops that are widely eaten in the developing world. This has led to an imbalance in both yield and nutrition between the annual food production in the developing world as opposed to the developed world.

Another equally important factor is that many developing countries lack a good agricultural infrastructure such as serviceable roads, silos and irrigation. This leads to a high price for transportation, a lack of storage and intermittent water supply facilities. All of this conspires against crops and ready access to food. In contrast, investments in land, efficient use of water and the use of resistant seeds can bring great improvements. Most scientists with intimate knowledge in the biological sciences, medicine, genetics, agronomy, etc. including many Nobel Laureates, have constantly advocated for the introduction of better crops developed using GM methods that lie as the basis for GMOs (Genetically Modified Organisms), which can help to reduce the problem of hunger and poor nutrition throughout the world. In opening the Nobel campaign, Dr. Richard Roberts, the campaign organizer and 1993 winner of the Nobel Prize in Physiology or Medicine quoted the Laureates' letter "As scientists we understand the logic of science. It's easy to see that what Greenpeace is doing is damaging to the citizens of the

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<https://doi.org/10.1016/j.jik.2017.12.006>

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Table 1

Percentage and number of people affected by severe food insecurity, measured using the Food Insecurity Experience Scale (2014–2016).

	Severe food insecurity – prevalence			Severe food insecurity – number of people		
	2014	2015	2016	2014	2015	2016
	Percentage			Millions		
WORLD	9.2 (±0.5)	8.8 (±0.4)	9.3 (±0.4)	665.9 (±35.7)	645.1 (±31.7)	688.5 (±27.6)
AFRICA	25.0 (±0.8)	25.1 (±0.7)	27.4 (±0.7)	289.5 (±9.6)	298.0 (±8.7)	333.2 (±8.6)
<i>Of which:</i>						
Sub-Saharan Africa	28.3 (±1.0)	28.7 (±0.9)	31.0 (±0.8)	265.0 (±9.5)	275.7 (±8.6)	306.7 (±8.3)
ASIA	7.7 (±0.1)	7.0 (±0.7)	7.0 (±0.6)	337.0 (±34.1)	306.7 (±30.1)	309.9 (±26)
<i>Of which:</i>						
Central Asia and Southern Asia	14.4 (±0.5)	12.3 (±1.6)	11.1 (±1.3)	268.7 (±36.2)	233.1 (±31.1)	211.9 (±24.4)
Eastern Asia and South-Eastern Asia	2.0 (±0.2)	2.1 (±0.3)	3.1 (±0.5)	44.7 (±5.1)	48.1 (±7.6)	70.5 (±11.8)
LATIN AMERICA	4.7 (±0.3)	4.8 (±0.3)	6.4 (±0.3)	27.7 (±1.8)	28.1 (±1.6)	38.3 (±2.0)
NORTHERN AMERICA AND EUROPE	1.4 (±0.1)	1.6 (±0.1)	1.2 (±0.1)	15.6 (±1.6)	17.1 (±1.6)	13.0 (±1.3)
<i>Other country group:</i>						
Western Asia and Northern Africa	10.7 (±0.6)	10.5 (±0.6)	11.8 (±0.7)	50.3 (±2.9)	50.7 (±2.9)	57.9 (±3.2)
<small>NOTES: Prevalence is calculated as the number of people living in households where at least one adult has been found to be severely food insecure, as a percentage of the total population. Margins of error are in parentheses. SOURCE: FAO, Voices of the Hungry project.</small>						

developing world and is anti-science” (Achenbach, 2016). He continued saying “Greenpeace initially, and then some of their allies, deliberately went out of their way to scare people about GMOs. It was a way for them to raise money for their cause”. Such efforts to denigrate GMOs is damaging the opportunities for the developing world to improve their agricultural practices.

Genetically Modified Organisms (GMOs) and methods

Food means agriculture. Agriculture started about 12,000 years ago in the Middle East when the hunter-gatherers realized they could locally grow some of the plants that they were harvesting in the forests every day, thereby making their lives a lot easier. They began to develop villages and primitive societies started to emerge (Roberts, 2017). However, at first the farmers merely grew crops that consisted of species with the most beneficial features that they had found in the wild. During the 19th and 20th centuries, when plant breeding methods were introduced the breeders began to perform artificial pollination and produce new crops with beneficial properties. These were first made by crossing different natural varieties of the same species. Later they crossed different species within the same genus and even between different genera. By means of these techniques, farmers produced genetically modified plants without knowing any of the details of just what modifications had occurred (Parra Fernández, 2017). In Mexico and in Central America, maize was developed from a plant called teosinte, which was a miserable thin grass barely good enough to eat. Over time breeding resulted in the much larger and more nutritious ears of corn that one can see in the supermarket today. This was achieved not by using the modern GM methods, but rather using traditional methods of cross-breeding.

In the first half of the 20th century breeders began to produce new plant varieties with genetic mutations that were artificially introduced using irradiation techniques in which thousands of seeds were irradiated with X-rays, gamma rays and nuclear radiation involving massive bombardment to produce new varieties with more desirable properties such as faster growth, larger fruit, more nutrition, better taste, etc. A similar set of mutagenic

techniques used chemicals to produce mutations, again in the hope of trying to alter the genetic material of the plant so that desirable traits are produced. These methods are all considered safe by the green parties, even though the complete range of mutations that are introduced into the plant are usually unknown and uncharacterized.

In the 1980s a breakthrough occurred. Marc Van Montagu, Jeff Schell and Mary Dell Chilton discovered a natural gene transfer mechanism that operated between *Agrobacterium tumefaciens* and plants that it was able to grow on (Van Montagu, 2011). This bacterium was found to inject DNA from a plasmid that it contained and this DNA carried genes able to synthesize hormones that produce a tumor in the plant. This was the first well-documented example of transfer of DNA between kingdoms. Van Montagu and Schell realized that it could be possible to replace the tumor-causing genes by other genes that might introduce desirable properties into plants in much the same way that traditional breeding did. However, by carrying out this alteration in a precise way, this would introduce a precision to plant breeding that was missing from traditional approaches. For the very first time these techniques, developed in a number of laboratories, allowed the precise introduction of genes into plants in a way that would allow the plant breeders to know exactly which genes had been introduced and would facilitate the monitoring of both their presence and their effects in the recipient plant. This is the so-called GM method. It is important to realize that GMOs result from the application of a method and are not in and of themselves a product. This is just the same as making something by hand or by machine which both describe methods and tell you nothing about the nature of the final product. If one is concerned, it is the product that needs to be tested, and universal condemnation should not be applied simply because of the method of production.

One example of the need to consider the product and not the method is found in the case of celery, a product of traditional breeding. A number of years ago, certain women in the U.S. worked in factories cutting up celery so that the smaller pieces could be packed up for sale in supermarkets. However, they discovered that if they did not wear gloves and so got the celery juice on their hands, they developed a contact dermatitis. This was caused by

compounds called psoralens that were present in the celery juice (Ames, Profet, & Gold, 1990). These not only cause dermatitis, but can even cause skin cancer. When we eat celery we get very low doses of psoralens and it is not a problem; our bodies easily detoxify it. However, if celery were a GMO product under existing regulations, it would be banned. One would not be allowed to sell it and one would not be allowed to eat it. However, celery was never tested in the way that GMOs are, and this entered the food supply just because it was a natural product and assumed to be safe, but as this example shows, natural does not guarantee safe, just as GMO does not mean dangerous.

Some benefits of GMOs

Vitamin A deficiency is a leading cause of blindness often leading to mortality throughout the developing world. Every year 2 million children, mostly in developing countries, either die or suffer from developmental defects because they are deficient in vitamin A. Without vitamin A proper development does not take place and children frequently die by the age of 4 or 5. If we compare this with acquired immune deficiency syndrome (AIDS), tuberculosis or malaria, there are many more children dying from vitamin A deficiency. In the 1990s two scientists, Ingo Potrykus and Peter Beyer decided to tackle this problem (Potrykus, 2010). Recognizing that rice was a crop that was widely cultivated in the developing world and a major source of nutrition, they decided to try to improve it so that it would produce β -carotene, the precursor of vitamin A in the grain of the rice plant where it is not normally found. The hope was that by suitably engineering rice to produce β -carotene they would be able to provide a good dose of vitamin A for these children and so help to prevent childhood blindness and other developmental defects. Their first success in transferring the genes to produce β -carotene came in February, 1999. Had this been a “normal” plant, the plant breeders would have made the necessary agronomic improvements so that it could become a widely grown crop within a few years. However, it was a GMO. As a result, the green parties and the anti-GMO movement began a concerted campaign to stop its development, by introducing hurdles at every step of the way. Unfortunately, they were successful and it was only in December of last year, 2017, that so-called “Golden Rice” was approved as a food source. This was done in the country of Bangladesh, which desperately needs it and it is very much to their credit that they took the necessary regulatory steps to allow it to be grown (Ahmad, 2018).

An example of a GMO that has not attracted the attention of Greenpeace, are the bacteria and yeast that have been engineered to produce human insulin (Walsh, 2005). In fact, almost all diabetics around the world who need insulin injections, receive human insulin that come from pharmaceutical companies who used GMO methods to put the gene for human insulin into bacteria or yeast. Why are the anti-GMO people not offended by this? Perhaps it could be because it has pharmaceutical benefit. Perhaps this is also why they were so concerned about Golden Rice, because it too has pharmaceutical benefit. The difference is that the production of human insulin in yeast or bacteria did not involve plants – although it might have done – whereas Golden Rice would be one of the first plant GMOs to show similar benefits. It is hard for me to understand how anyone could be opposed to producing a food plant with such obvious beneficial pharmaceutical effects as preventing childhood blindness.

In general, genetically engineered plants are made by inserting genes of particular interest into the plant. One common gene that is used is that for Bt-toxin, a naturally produced toxin from *Bacillus thuringiensis*, which is a very potent insecticide. In fact, Bt-toxin is the favored pesticide of organic farmers. They merely spray the

toxin on the plants. Agricultural scientists realized from fairly early on that introducing genes such as that for the Bt-toxin, might allow plants to become pest-resistant naturally, and so remove the need for constant spraying. Many such plants are now grown around the world and in general, the properties of the GMO plants containing Bt-toxin are identical to their non-GMO counterparts. Bt-cotton in India has provided substantial economic benefit to the farmers and Bt-brinjal (eggplant) is proving equally beneficial in Bangladesh.

An interesting example of how GMO approaches might have significant economic and nutritional effects, concerns bananas (Walsh, 2005). In much of Sub-Saharan Africa, especially in Uganda, as much as 30% of the calories eaten by the average person comes from bananas. Unfortunately, a disease called *Xanthomonas* wilt is threatening bananas in Africa and it is a disease for which there is no known naturally resistant variety of banana available (Dale, Paul, Dugdale & Harding, 2017). This means that traditional breeding methods cannot be used to introduce resistance. Because of this disease, the annual production of bananas in Uganda is dropping precipitously and so far the only means of stopping its spread is by spraying plants laboriously with chemicals able to kill the bacterium that causes the disease. However, local scientists working at the National Agricultural Research Organization in Kenya noticed that the sweet pepper, which is widely grown and eaten, is resistant to the *Xanthomonas* bacterium. They found that two genes in the pepper are responsible for this resistance and so they isolated these two genes and moved them into banana plants (Ssali, 2014). The results were spectacular. The bananas were now resistant to *Xanthomonas* wilt and had no obvious problems. This was a massive scientific breakthrough, but again because the new bananas were made by GMO methods, the anti-GMO activists have been trying very hard to stop its dissemination. However, it has been shown by bioinformatics analysis that these GM Bananas do not pose a risk of allergenicity or toxicity (Jin, Goodman, Tetteh, Lu, & Tripathi, 2017). However, recently a bill was passed in the Ugandan Parliament that set out the regulations that would be necessary to grow this new *Xanthomonas* wilt-resistant banana. This has not yet been signed into law by the President, but it is very much hoped, especially by the farmers in Uganda, that it soon will be. If it is, this could set a very important precedent for Sub-Saharan Africa.

Another example of a GMO success story concerns the Fall Armyworm, which is widely distributed in the Americas (Andrews, 1988). This was a major problem in the southern part of the US, because of the voracious appetite of the caterpillars of this insect (Fernandes & Carneiro, 2006, chap. 2) and is also considered a main pest of maize in Brazil (Cruz, 2008; Gallo et al., 2002). It has been spreading very rapidly and is now causing a lot of damage in Africa, especially in Zimbabwe and much of sub-Saharan Africa. However, there is a GMO solution. Maize, that carries the Bt gene, has proved resistant to the Fall Armyworm. This is widely grown throughout the USA and was also adopted in South Africa when the Fall Armyworm appeared there. However, the anti-GMO activists have been very vocal about Bt-Maize and have convinced many African leaders to avoid it. It is high time that sense and science prevail. The devastation caused by this disease is likely to lead to widespread hunger unless Bt-Maize is adopted as the crop of choice.

Another rather interesting disease is Papaya Ringspot, which is caused by a virus that likes to grow on papaya plants and is transmitted by insects. When it first appeared in Hawaii, scientists at the University of Hawaii managed to develop ringspot-resistant papaya plants using GMO methods. At the present time, almost 80% of all of the papayas coming from Hawaii and widely eaten in the US, are GMO papayas (Held, 2016). One might have thought this would have been welcomed, but unfortunately it was not. The anti-GMO movement has been so successful in scaring people about the dangers of GMOs that now they are trying to make sure that all foods sold in the US and elsewhere, will carry a warning label if they

contain a GMO ingredient. Such would be the case for Hawaiian papayas. The government in Hawaii became convinced that labeling foods containing GMOs was a good idea and tried to introduce a bill in their government to enforce GMO labeling. Of course, the papaya farmers in Hawaii were very upset at this since they felt it was likely to undermine their ability to sell papayas within the US. They protested loudly, to a point where the government decided they had to do something about it. What did they do? Well, they did not abandon the GMO labeling scheme, instead they said that because GMO papayas had been developed many years previously, they could be exempt from the law and it would only be new GMO products that would need to be labeled. This is hypocrisy on the grandest scale. People have been eating GMO papayas for many years, not just in the US, but elsewhere in the world and nothing has happened to them. In fact, since the very first GMO crops were introduced, there has not been one – not a single example – of a credible problem caused by GMOs. Interestingly, Thailand, which has a no-GMO policy has also been experiencing a problem with papaya ringspot virus. So what did the farmers there do? Well, they took GMO papayas that had been developed specifically to counteract their version of the virus and are now growing them widely. As usual, the farmers knew what was good for them.

Controversial opinions about Genetically Modified Organisms

Given the many benefits that plants developed by GMO methods provide and the precision of the science that goes into developing them, one might wonder how and why they are controversial. The answer is simple. When Monsanto first tried to introduce GM crops into Europe, the Europeans became afraid that Monsanto and other big US agricultural companies were trying to take over their food supply. However, they could not ban Monsanto because most of the seeds grown in Europe came from Monsanto and had been produced by traditional methods. They decided therefore, to launch a campaign against GMOs by claiming they were dangerous and in this way, they could link GMOs with big agribusiness. This was wildly successful. They were able to raise visions of “Frankenfoods” and other scary scenarios, which caused many people to become frightened by the term GMO. This turned out to be the best fundraising campaign that Greenpeace ever had. This was a campaign based on fantasy. It ignored the science available at the time and has continued to ignore the science to this day, even though we now know that GMOs pose no unusual risks. Greenpeace continues to ignore the science, ignore the potential benefits from this technology and is still trying to spread word everywhere about the dangers of GMOs. This has been successful to a point where even now, when there is so much scientific evidence showing that GMOs are safe, that fundraising opportunities continue to overwhelm the science.

It is for this reason that in 2015 I began planning a campaign among Nobel Laureates defending the reputation of the GMO method as a way of improving agriculture, not just in the west, but especially in the developing world. More than 100 Nobel Laureates wrote a letter to the leaders of Greenpeace, to the leaders of the United Nations and governments around the world on June 29, 2016 saying “We urge Greenpeace and its supporters to re-examine the experience of farmers and consumers worldwide with crops and foods improved through biotechnology, recognize the findings of authoritative scientific bodies and regulatory agencies and abandon their campaign against GMOs in general and Golden Rice in particular”. The laureates asked that Greenpeace cease and desist in their campaigns and accept that this was an area where they had made a mistake – one that was particularly costly for the developing world.

The Nobel Laureates Campaign Supporting GMOs held a press conference on June 30, 2016 at the National Press Club in Washington, DC to present their letter advocating that GMOs not be vilified (Nobel, 2016). We expressed the views that what Greenpeace is doing is highly damaging to the developing world and is anti-science.

The Nobel Laureates never got a direct reply from Greenpeace. Later though, Wilhelmina Pelegrina, a campaigner for Greenpeace in Southeast Asia told the Washington Post that the organization was not blocking Golden Rice, but rather that the initiative had failed to provide a solution and is not currently available for sale even after more than 20 years of research (Achenbach, 2016). She continued arguing “As admitted by the International Rice Research Institute, it has not been proven to actually address Vitamin A deficiency, so to be clear, we are talking about something that doesn’t even exist”. She failed to mention that her organization had done everything they possibly could to stop the development of Golden Rice.

At a meeting at the European Commission in 2015, I decided to talk about GMOs in the context of medicine for the poor. I had been asked to speak about the future of medicine and I took the tack that when people think about medicine for developing countries they should realize that the needs are very different from those in developed countries. In Europe, the US, and Japan, people have a lot of money. They can afford to pay for their expensive medicines. But if you live in the developing world, you need practical, cheap solutions. But among all else, if you are hungry, you need food. And food can be medicine. This was well-received at the European Commission, but has not yet attracted sufficient support in Europe to overcome the politics of the green parties. One argument often put forward by the green parties is that there is plenty of food in the world and the real solution to hunger is to redistribute it properly. I believe this is a false argument. While it is true that people should redistribute food, I also note that in the US there are people who go to bed hungry every night because even here in the US where there is an abundance of food and excellent distribution networks, the food often does not get to the people in need, most often for economic reasons. Moreover, one could just imagine how difficult it could be to take excess food and deliver it to the developing countries in Africa. It is just not practical, and furthermore, it is not what the people want. They want to be able to grow their own food on the land right next to them.

In addition to the Nobel Laureates, professional scientific societies around the world have all come out affirming that the GMO method is safe and there is really no reason to worry about the method and if anything, it is safer than the traditional ways of breeding crops (for example see: Royal Society, 2016).

Conclusions

All serious scientific studies; i.e., those published in prestigious journals, show that the plant varieties prepared by GM methods are not more dangerous than those available by traditional breeding techniques. If anything, the GMO varieties are likely to be safer than traditionally bred varieties because they are subject to many more controls. Traditional methods are not precise in the way that the GM method is. Another problem with traditional breeding is that it is usually done with one variety at a time because it is a slow method and the result is often a new, improved variety that becomes a monoculture. In contrast, the GM method lends itself to modifying many different varieties rather easily and is much faster than traditional methods. Furthermore, at the current rate of climate change, there is a desperate need for new and faster methods.

The green parties and especially Greenpeace, constantly advance new arguments to support their opposition to GMOs. They claim that the safety of long-term consumption is not proven. Apparently 20 years is not enough! However, they seem unconcerned about the safety of long-term consumption of novel plants made by traditional methods. Why the double standard?

Another argument frequently used by the anti-GMO movement is that GMO plants become the proprietary property of the large agribusinesses. The basic methods for production of GM plants are fairly straightforward, can be practiced by scientists in the developing countries who can then, if they wish, obtain their own intellectual property covering the new varieties. In many cases the underlying technology that is needed is either freely available or licenses can be obtained at low cost for scientists in developing countries. The financial motivation for the large agribusinesses comes from supplying food for the developed world, not for the developing world.

Particularly disturbing, is paragraph 72 from a recent EU report that urges its member states not to support GMO crops in Africa. This is something that the Nobel Laureates find particularly offensive. Not only should the developed world not be telling the developing countries what kinds of crops they can and cannot develop so that they can feed themselves, but it is particularly distasteful that such an obvious anti-science attitude is being promulgated by the green parties. If they are so concerned about food safety, then they should be demanding that all foods, not just those produced by GM methods, are fully tested in exactly the same way. I suspect the traditional food industries would not tolerate such an approach. Certainly, the organic farmers would not be in favor of the costly procedures that might be required to satisfy regulations of this sort.

The Nobel Laureates Campaign was initiated to express a respect for science, to insist that non-scientific statements be withdrawn and to make sure that one of the most promising technologies, the GMO method would be available for the benefit of the developing world. There are no serious well-accredited scientists arguing that the GM method is dangerous per se. It is high time that Greenpeace admitted that this was one issue that they got wrong. That way they can hold their heads high and focus on the many good activities

they engage in to promote biodiversity and the health of the natural environment.

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