

# *Biosafety and Raising Awareness on Genetically Modified Organisms*

## Summary

This report includes the presentations and discussion sessions of the “Biosafety and Raising Awareness on Genetically Modified Organisms” held at the Department of Environment (DoE), Iran on 16 December 2015. Nationwide advertising was carried out and some 300 people from public, local communities, university faculty, non-governmental and governmental sectors participated in this conference. The conference started with speeches by government officials and continued with three specialized and expert panels with time allotted for discussion and Q&R.

The conference was composed of four sections starting with the opening and introduction section. Starting at 9:00 am, the opening speech of the first section was delivered by Dr. Mahnaz Mazaheri, Education and Research Vice-President of the DoE, followed by Mohammah Taghi Farvar, the Head of Cenesta. Both speeches focused on caution of technology use when natural ecosystems are at stake. Dr. Davoud Hayatgheib continued with a presentation on participation and on Civil Society Organisations (CSOs and their importance in raising awareness followed by Soroush Marzban’s presentations on sustainable agriculture. Marzban is a farmer who cultivates organic rice. The last two presentations were delivered by Dr Mehdi Seyedi, faculty member of the National Research Center for Genetic Engineering and Biotechnology, and Dr. Salvatore Ceccarelli, expert of Participatory and Evolutionary Plant Breeding (PPB & EPB). Dr. Seyedi’s presentation focused on the role of multi-national companies in Genetically Modified Organisms (GMO) production and Cecceralli’s speech focused on why and how to say ‘no’ to GMOs.

The second section of the conference was the first panel of experts presenting and discussing the health, biosafety and technical aspects of using and cultivating GMOs. There were six experts from various institutions including Iran Organic Association, National Genetic Research Center, etc. This was followed by a discussion and Q&R section.

The third section of the conference was the second expert panel focusing on the subject of “Biosafety Law and International Frameworks on Biosafety”. Presentations were made by four law and environmental experts on this subject expanding on the role of biosafety in nature protection, the necessity of labelling GMOs, etc.

The fourth and final section consisted of a third panel of experts on sustainable agriculture and the importance of conserving and utilization of biodiversity. In the following paragraphs, a summary of the speeches and presentations is available.

## Section 1: Opening Speeches

The conference started with the speech of **Mahnaz Mazaheri**, the Education and Research Vice-President of DoE:

As a bio-technologist, I think bio-technology is the science of creation.

In the history of human development, there are three periods of bio-technology use:

- 1- Our ancestors who made yogurt
- 2- Fermenters and cells
- 3- 1970s and so on, genetic modifications on DNA can have positive uses, even some people say this is the highway of survival for human beings. But, each field of science has positive and negative aspects.

We have the experience of green revolution in which pesticides were used and we still see the negative effects it had on our ecosystems.

In 1993, based on article 13 of the CBD, Iran started planning for public education and awareness raising for biotechnology and threat assessment. Things that need to be done for threat assessment of GMOs include:

- 1- Target organism 120 km distance between genetically modified
- 2- Substantial equivalence, comparing the modified product with the original one.

Let the researchers to do the research in the lab and if they see that their products do not have negative effects, they can apply it within the legal frameworks.

The next speech was delivered by **Dr. Mohammad Taghi Farvar**, Head of Cenesta:

I am a follower of Dr Barry Commoner who was always warning about the dangerous side of science, he wrote a book in 1968 called "*Careless Technology*" when the West was realising the negative effects of new technologies./ So, I decided to do a research in third world countries. I found an Egyptian ecologist, who found negative effects of Aswan Dam in the region, and epidemic diseases related to the water stored behind the dam. Also about penicillin, there was research being done that showed the resistance of the human body to penicillin and other antibiotics. So, we can conclude that with all our knowledge and scientific skills, we are still far from understanding the effects of our actions on the environment. Another example, when the chemical pesticides were used, there were only three types of pests, but after using, the pests number became 14 types and many good insects became extinct.

In 2004, in IUCN at Thailand, they decided to put a moratorium on genetically modified crops, until all research is complete and it is found safe to use such technology. Everything related to GMO is banned in Switzerland, and even the research is banned completely; 19 countries in Europe as well as Russia banned GMO products.

So I think when we do not know if the technology is hazardous, then we should be very cautious about producing or using them.

**Dr. Davoud Hayatgheib**, the Head of Iranian Capacity Building Project to Implement the Cartagena Protocol presented the next speech.

We are conducting a project in Iran on increasing capacity for implementing the Cartagena Protocol.

Objective: Capacity building in public awareness and capacity building in biosafety.

This project is not meant for accepting or rejecting the GMO research, but it is to create a safe environment for such research. In 1992 and CBD adoption, the world was conscious about the hazards of research. So the Cartagena Protocol was adopted by the governments. Iran is also a

member of Cartagena protocol and it was discussed and ratified in the congress. Also the COP conferences are held internationally every year.

Important subjects included in the protocol are our main focus:

- Risk assessment
- Risk management
- Handling, packaging, transport and identification
- Public awareness and participation
- Socio-economic consideration
- Monitoring and reporting

Participation and awareness is a very important item; so, the researchers and law makers have to give information and let people participate and use the information.

Public awareness should be carried out through speech to target groups such as farmers, importers, exporters, producers, scientists, and consumers

Mechanisms are based on legal forms. We still have shortcomings in public awareness, we still don't have many books printed and few websites are used. Monitoring is very important and we can say that Cenesta is the only CSO monitoring in Iran. Scientific centres do not exist, we do not have public events to inform the public. We should provide the information on scientific methods and not based on biases.

**Dr. Mehdi Seyedi** is faculty member of the National Research Center for Genetic Engineering and Biotechnology.

The role of international corporations in spreading GMO products is undeniable and the most effective way in stopping them is by raising awareness. They are instruments that the powerful countries are using to control the world:

- Media
- Film
- Food
- Energy

Food control is mainly done by companies such as Monsanto, DuPont, Syngenta, Agrevo, Dow, AutoGen, etc. When speaking of GMO, these companies developed this technology to control the seed markets and then consequentially controlling the pesticides. These companies had the largest approval from APHIS in the US.

Vice President of Monsanto became the CEO of FDA in the US, and this shows the complexity of the relations.

The propaganda is usually done through the international service for acquisition (ISAAA), creating presentations and charts based on incomplete or false data. The invasive plants became resistant to pesticides, pests became resistant and examples of such resistances are seen in Gujarat, India.

Thirteen years and 100 million dollars are needed for research on GMOs health in the United States alone. The threat we are facing now, is that some of the GMO plants are said to be approved, and some unapproved GMO plants are spreading throughout the world and are entering Iran in different ways and we have to be careful.

## Case study report on sustainable agriculture by **Soroush Marzban**:

### History of agriculture

- Traditional (based on social relations of people and their relation to the nature)
  - Food quality
  - Social systems in villages
  - Traditions
  - Low production
  - High labour intensity
- Industrial revolution and modern agriculture

Social change in Iran is happening rapidly and our traditional ways of life such as architecture that was based on the climate and local conditions, culture and village structure will be lost. But, we still have traditional and sustainable ways of agriculture and big corporations are not yet intruding.

We need to consider the challenges and turn them into opportunities such as:

- Multiple product agriculture
- Agriculture forests for wood production
- Compost based on natural manure
- Restoration of 200 varieties of rice

### **Dr Salvatore Ceccarelli** presentation:

In the beginning, a short video was played: Feeding the world with no GMO

Major issues faced by world are water, climate change, poverty, and biodiversity; now, diabetes and obesity is added. Seeds are the basis of agriculture and food.

GMO is only one type of biotechnology; so, being against GMO does not mean being against biotechnology.

GMO crops cannot be the solution because they are against the natural selection theory. When the environment of an organism changes, the individual can adapt to the environment and the speed is highly based on the biodiversity of that organism. For example, in 1997, a type of Roundup cotton was introduced which increased an invasive weed.

GMO is a temporary solution that creates larger and more resistance problems. This is not a new situation, same as what happens to human body and antibiotics. There are two types of resistance: Vertical and horizontal resistance. Vertical resistance is based on only one gene; so, the invasive plant or insect gets chance to adapt and resist the resistance. But horizontal resistance is based on many genes. GMO resistance is vertical and unsustainable.

Now, there are charts and evidences explaining the success in growing GMO products. But the farmers say that there are no seeds available – the GMO seeds. So, is this a success or not having a choice?

GMO in fact is controlling the seed market and pesticide market which is interconnected.

Solutions: We are trying to bring back biodiversity in the farms of Iran and other countries. The research is taken from research field to agriculture field with participation of farmers such as organic farming in Italy.

After testing the genotypes, they have to be tested in the farms, and these types of biotechnology don't have anything to do with GMO. Participatory plant breeding is combining participation

with evolution, which was announced in 1956 in the US. They grow a mixture and let the adaptation happen in the field in a natural way, and the farmers in Iran can explain it better. After years of production, the seeds are not similar to the original seeds because they have evolved. One of the factors is climate change because it is unpredictable, and when we want to find adaptable types, we need to grow a mixture that can slowly adapt without our predictions. So, we are using the natural selection to our benefit. The farmers then go and choose the best seeds and decide to grow that.

## Section 2: First Expert Panel

**Dr. Khadija Razavi:** Our concern for having this annual event is public awareness, and especially the government authorities

**Dr Hamid Ezzat Panah:** Importance of analysis of nutritional science.

We are what we eat. In the pyramid of importance of food, the basis is safety of the food, then nutritional quality and finally wellbeing

- 1- Enough
- 2- Food security

Legal rules must be based on safety and analysis of danger of food consumption. Food chain is very long and complex and the research for defining the quality of food also needs to be continuous, long-term and thorough.

The risks involved makes precaution the base of analysis. Consumers have the right to know what they eat. We should have a clear statement about risk assessment, risk management and risk communication. Risk assessment and risk management have to be assessed in two separate departments, because otherwise, they can easily cover the cause and issue, incorrect or biased statements. Consumer protection has to be one of the duties of ministry of agriculture and health. Speaking about GMO, labelling, and public awareness, consumer voice is an institution to gather people's voice and grade different brands.

That is the difference between wise and senseless, the senseless uses, then thinks, and wise first thinks and then uses. That is why we need to do the risk assessment first, and then start to consume. EFSA European Food Safety Agency has done the research catering to their needs and we need to do it ourselves because our eating habits are different from Europeans.

**Dr. Ali Ardakani:** GMO products and health

As a genetic scientist, I state that GMOs are not equal to natural. The assessment cannot be done on all aspects. That is why there are many reports that show only one side of the story.

There are examples of research on the effects of GMO on mice demonstrating effects on liver, kidney and hypophyses. Monsanto does short-term assessments of the effects of their food products (seeds) on health, but Manuela Malatesla is a scientist who increased the time and assessed in a two-year period instead of six months. The imported goods have to be labelled as GMO so that people can have the option to choose.

**Dr. Azad Omrani,** member of the Iranian Organic Society Board of Directors: Technical aspects of GMO production

Patent comes when there is economic benefit and control in the production line. Gene transfer is not natural. The cell is distorted. We cannot know where the transferred gene goes or what

happens to it in the future. Introducing gene is not enough. Translation matters too. GMO and natural proteins differ from each other in various aspects.

### **Section 3: Second Expert Panel** Bio-safety law and international frameworks

Dr. Hayat Gheyb

Awareness raising about the hazards on biodiversity and human health

Biotechnology objectives since 1992:

- Poverty elimination
- Safety for human and livestock
- Decrease in use of pesticides
- Increase life condition of farmers

28 or 29 countries practise GMO agriculture: 87% in Americas, 2% Africa 11% in Asia

4 GMO products cover 96% of the GMO agriculture: Soybean, cotton, corn and canola

There are two types of GMO: Pesticide resistant or herbicide tolerant

Challenges in GMO farming:

- 1- In the past 25 years, the rate of hunger did not change
- 2- Research shows that main sugar in soybeans decreases
- 3- Third research shows that the assessment of the hazards of GMO needs to be in short and long time, also the direct and indirect target groups
- 4- Study on insects
- 5- Brazil is the second largest GMO producer, where the use of pesticide increased and rate of cancer went up.
- 6- Countries in Europe are using labelling but Iran has not entered into research, although we have institutions and knowledge; but, not many dissertations are done on this topic.

#### **Dr. Shahboddin Montazami**

About bio-safety, we do have a law. We are not against bio-technology, because genetic modification is only one branch of bio-technology and we are not against the modern science.

Problems

- 1- Limits of this law is not clear, speaking about live creatures, but does not specify what exactly.
- 2- Is the law implemented? Health and environment, are the government organs responsible of implementing the law?
- 3- What is the scope of the law? How about farmers? Or the consumers?

The non-governmental part is not clear.

We need to give the right to the consumer to know and decide.

#### **Dr. Mahdavi Damghani**

The necessity of labelling

It is the absolute right of the consumer to know what he/she is using in every product, not just GMO products, but everything, based on the civil law.

We see a huge gap between pro and against GMO.

Questions have to be answered about food safety (FAO 1996). All people at all times should have access to safe and sufficient and health food.

### **Ali Razmkhah**

Spoke about the Cartagena Protocol and the law of biosafety in Iran. The law is not yet implemented in Iran, but even if it is, there many unclear points which will have obstacles.

## **Q&A Session:**

### **Panel 3: consisting of farmers, bakers and CSO members**

During this panel, farmers introduced their best practices and products. To create an environment to share knowledge and experience, this panel used the examples of several PPB and EPB cases to show that GMOs are not necessary for Iran.

### **Salvatore Ceccarelli**

Good morning. I have to apologize because after so many trips to Iran I still do not speak Farsi. We have translated most of these slides to Farsi, and before I start with my presentation, I would like to mention that a few days ago, some activists sent me a movie and I thought I'll show you because it is a nice introduction to my talk. In fact, the movie only says 'no' to GMO and my presentation is about saying 'no' to GMO because we have other alternatives. So, do not be surprised if in the movie there is not much science because the science will come after.

Last sentence of the short video clip: It's OK to say no to GMOs! YES

Yes, but what is the solution? And we need a solution because I am not talking specifically about Iran but on a global level. We have major problems such as water scarcity, poverty, hunger, malnutrition, biodiversity and climate change. More recently, another problem is the increase of diseases such as diabetes and obesity. Obesity is officially a disease because of all the associated illnesses it causes. Seeds are related to all these problems. Everybody agrees that when we talk about seeds, we are not only talking about agriculture, but we are talking about food, and because our health depends on food, when we talk about seeds, we are actually talking about our health.

Why I think that GMO crops are not the solution? GMOs are crops, which are obtained by transferring a gene from one species to another, a process that does not happen in nature. Therefore, when we talk about GMOs we are not talking about biotechnology because GMO is only one type of biotechnology. Being against GMOs does not mean being against biotechnology. There are well-known examples that everybody knows such as the golden rice that was obtained by inserting in rice two genes, one from daffodil (a flower) and the other from a bacteria (*Erwinia uredovora*). The most widely grown GMOs are those resistant to herbicides, particularly Roundup, and those resistant to insects because of the Bt gene extracted from a bacteria. There are many things that are usually said about GMOs, many which are true and many which are not true.

People say that GMOs are sterile! This is not true. GMO seeds cannot be sown again, but this depends on the type of contract made with the company. GMOs do NOT increase yield: this is true and there is a lot of data showing this and even companies have admitted that they do not increase yield because they have not been created to increase yield. GMOs can solve the problem

of hunger: well they have been around for over 30 years and the number of hungry people is the same. GMOs decrease pesticide use: the United States Department of Agriculture says that it is not true. GMOs reduce agro biodiversity: this is true because it is true that in theory the same gene can be put in many genetic backgrounds, but because it is very expensive, this is not done!

It also said that GMOs are different from non-GMO, but this is not true. If you look at a GMO cotton and non-GMO cotton, they look alike. It is true that GMO seed is more expensive. In India, GMO cotton is 10 times more expensive than non-GMO cotton. It is very often said that GMO food is a risk to health; here I have put many question marks because science is saying one thing and its contrary, so it is a thing that is still uncertain. GMO genes can be transferred to other crops in a process called genetic contamination; while this is true, it must be remembered that genetic contamination has always happened.

There is a very hot discussion about GMOs, as we have seen this morning, between those who say they are a success and those who say they are a failure. The arguments that are used are the safety of food and the genetic contamination. I prefer to use another argument: GMOs are not the solution because they ignore a fundamental biological principle that is the Fundamental Theorem of Natural Selection (FTNS), formulated in 1930 by Fischer. The original formulation of the theorem is quite complicated, but what it says is that when the environment surrounding a living organism changes, that living organism will evolve slowly or rapidly to adapt to the new environment. The speed of this adaptation depends on the amount of diversity that the population of the individuals has. One recent example is from genetically modified cotton for resistance to Roundup in the US. It was introduced in 1997 and in 2004, a farmer started reporting the presence of weeds resistant to Roundup. In 2012, the Crop Science Society of America News, reported that in Georgia nearly every farmer (94%) had to hand-weed more than 50% (54%) of the genetically modified cotton.

Several similar cases have been reported by the most important scientific journals. For example, the resistance to Bt maize by the root worm. There is also the last title that says that when you start applying pesticides, you change the relationship between natural enemies; so, you have another insect that becomes dominant. Therefore, the use of a given pesticide may decrease but the pesticide against a pest that previously was not a problem would increase!

Therefore, in the best of the hypotheses, GMOs can be a temporary solution to a problem that very quickly generates another problem, namely a more resistant weed, insect or fungus, which requires another GMO!

This is nothing new as it happens to us with antibiotics. There are diseases that 30 years ago we could cure with one antibiotic and now we need three. In the US, 23,000 people a year die because of this acquired resistance to antibiotics by bacteria. In plant breeding, this is well-known since 50 years since people have been talking about horizontal and vertical resistance. Vertical resistance is due to a single gene that gives complete protection. So, a plant is completely resistant, while horizontal resistance is based on many genes, does not give complete protection but is durable. However, it is much more difficult to breed for horizontal resistance than for vertical resistance. The other difference between vertical and horizontal resistance is that vertical resistance, being based on only one gene, is within the evolutionary capability of the



disease or the insect and therefore the insect or the disease is able to overcome that resistance. On the contrary, horizontal resistance, being based on many genes is a much more difficult obstacle for an insect or disease to overcome. GMOs belong to the first category. When I submitted a paper mentioning the data for the United States Department of Agriculture indicating that with the exception of glyphosate in cotton, there has been a substantial increase in the volume and number of herbicides used, one of the referees said that I was only talking about currently grown GMOs without mentioning the second-generation GMO crops. When I documented, I found that there are already weeds resistant to two or more herbicides even before the new GMOs are produced.

One recent paper in *Crop Science* has used this graph to show that GMO crops are a very big success because almost every farmer is growing GMO corn or GMO soybean. But, is this really good science? Now, I've been to the US two times in three weeks. If you talk to American farmers, they will tell you that when they go to the market to buy seed of soybean or corn there is ONLY GMO seed. So, is that a commercial success or a lack of choice??

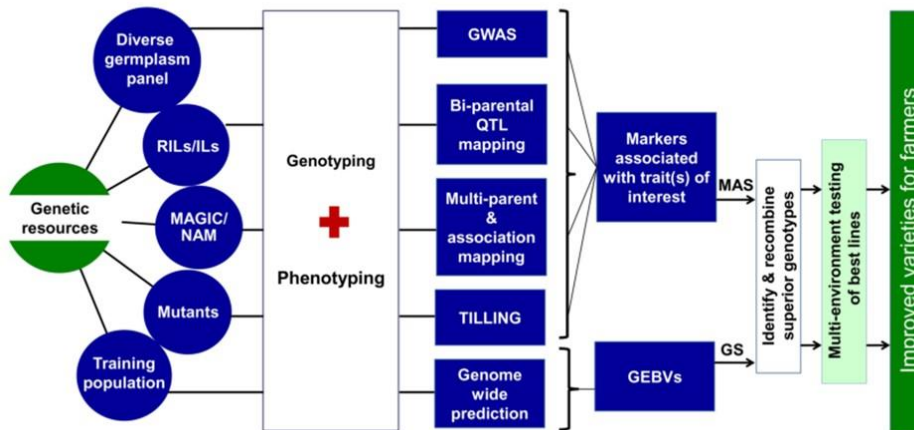
The global seed market, which is a market worth billions of dollars, is in the hands of a few big corporations. GMOs have to be seen in this framework as the perfection of seed monopoly because of those companies that have the monopoly of the seed market, only few are capable of producing GMOs. As you are the only one selling seeds (GMO producing companies), the farmers is obliged to buy that seed from you but this is not a sign of the success of a technology. Some of these companies are also controlling the pesticide market so providing the full package.

So? What is the solution? Well I have been trying in several countries, including Iran, to initiate a type of plant breeding which brings back diversity in farmers' fields. By conducting trials in farmer's field instead of research stations, we involve farmers in all the most important decisions. I have been doing this in a number of countries and with a number of crops such as tomato for organic agriculture in Italy. Participatory plant breeding is fully compatible with genomics. This is a graph that has been published by these biotechnologists and I would like to draw your attention to the right side of the graph that says that after you used the genomic tools to identify the good genotypes, you need to test them in farmers' fields. These are all technologies that do not change the DNAs and therefore have nothing in common with GMOs.

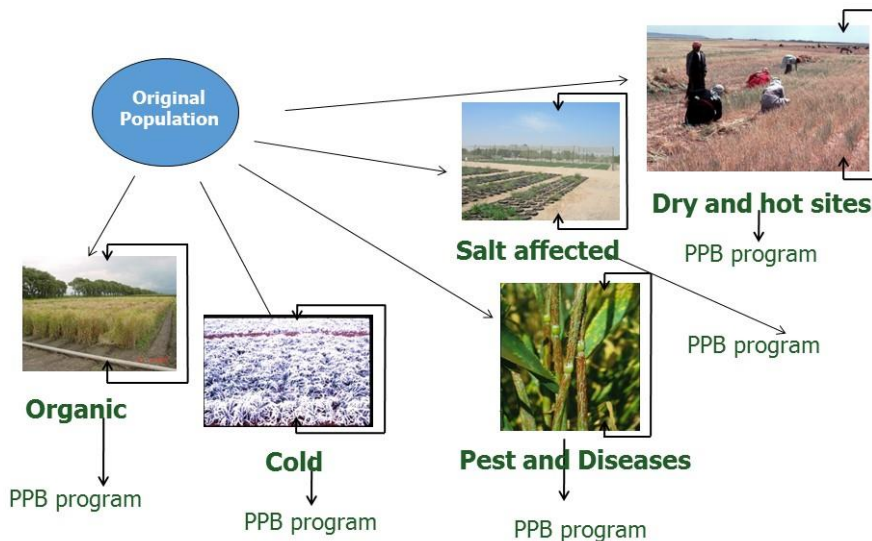
However, the weak point of participatory plant breeding is associated to its collaborative nature: because it is a collaboration between farmers on one side and institutions on the other. If one of the two decides to stop the collaboration, everything will stop. To avoid this danger, we started in 2008 to develop a new method, which combines participation with evolution.

# Genomics Assisted Breeding

Varshney, R.K., Terauchi, R., McCouch, S.R., 2014. Harvesting the Promising Fruits of Genomics: Applying Genome Sequencing Technologies to Crop Breeding. *PLoS Biol* 12(6): e1001883. doi:10.1371/journal.pbio.1001883



# Evolutionary-Participatory Plant Breeding



This method was proposed in 1956 by an American agronomist and consists of making very big mixtures of hundreds or even thousands of varieties (some farmers in this room can give better information because they have been implementing this method for several years) and let these mixtures evolve. Using this method, it is possible to cultivate in many difficult conditions. Organic agriculture is also added here not because it is a difficult agronomic condition but because, not enough research is done to develop specifically adapted varieties. With evolutionary

populations, the farmers plant and harvest, and due to the natural crosses that will occur within this population, the seed that is harvested is never genetically identical to the seed that is planted. In other words, the population evolves getting better with each harvest and slowly adapting to the environment around it including climate changes. One thing that is not said very often about climate change is that nobody today can tell you what the climate will be like in Tehran in 20 years from now! When a research programme for crop adaptation to climate change is started, the type of climate change needs to be specified. The advantage of these populations is that they have a lot of time to slowly adapt without knowing now what the climate will be in 20 years.

In the case of evolutionary plant breeding, we use the fundamental theorem of natural selection to our advantage. It is always possible to use these populations as a sort of germplasm banks to make selection for the participatory breeding. Here, you can see picture of participatory breeding in Ethiopia, Jordan, Iran, India and various regions in Italy. A university in the US is also doing research on participatory and evolutionary plant breeding.

This is the case of a farmer making a selection so that, as the population evolves, the farmer can select every 2-3 years, new varieties. We already started this selection in Jordan, in Italy and in Ethiopia. In Iran, something very interesting happened. A group of farmers used this population to make bread and discovered that this bread is good for health. This experience was repeated in France and in Italy.

### **To conclude:**

While GMOs are temporary solutions which create new resistant strains of weeds, fungi and insects, evolutionary populations are a much more durable solution because they are a mixture; they prevent the evolution new strains of pests, diseases and insects. With GMOs, there is always the need to replace one with other GMOs; on the contrary, through evolutionary breeding, the need of replacement is eliminated.

Evolutionary plant breeding brings back the control of seeds in the hands of farmers, decreases crop vulnerability by cultivating and generating new diversity, is an inexpensive and dynamic way of adapting crops to climate change and, most importantly, evolutionary populations cannot be patented.