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Potential impacts of GMO on the environment

For years have experts [e.g. from OECD or the European Commission] emphasized the lack of reasonably justified concerns related to the production, distribution or consumption of GMOs. In this context we can distinguish the influence of GMOs on the social environment and the natural environment. The European legislation, and the Polish legislation based on it, is still highly restrictive. This problem is also very complex in the USA. Many citizens of North America ask a difficult question: "What are the Europeans afraid of? Maybe the European fears are justifiable? Maybe in Europe they know "something" that we, Americans, do not? Then maybe it is justifiable to give up the innovative achievements of genetic engineering?" Such a concept would be impossible to realize, as it would mean that the already "consumed" technological progress has to be resigned from, thousands of jobs would be lost, the cheap production of better quality products would have to be given up.

People have applied genetic technologies for thousands of years, often recklessly, but most importantly without realizing that they are making any actual selection. Farmers selected "best" plants from their cultivations or best animals from their stock for further cross-breeding in order to obtain selected traits. In the past centuries breeders had not been aware of complex genetic processes and still had intuitively selected and cross-bred parent organisms to obtain offsprings with appropriate sets of genetic traits. Traditional breeding, however, imposes the inheritance of both good and bad traits. The parent had been often selected for a one trait, and meanwhile the rest of its genes, and consequently the rest of its traits, could have been neutral or even undesired. Conventional cross-breeding requires to combine the whole genome of two parent organisms, and by obtaining a one specific gene [i.e. trait] we also obtain the rest of them. In the traditional breeding most time and efforts devoted to obtaining a new trait is wasted on the elimination of undesired genetic traits. The additional genes collide with good breeding traits of parental organisms. It often takes a lot of time to identify these genes and it is troublesome to remove them.

Technological development, and specifically the application of genetic engineering in breeding, made it possible to add a desired gene to the complete genome of a desired parental organism. What is more important and more difficult, and at the same time makes the technique innovative, is that it is possible to transfer genes between distant species. This process allows to obtain offsprings almost identical to their parents, but having a one additional, desired trait transferred from a different biological system, without burdening the modified genome with undesirable genes. We call this process the technology of recombined DNA. Genetically modified varieties are studied in much greater detail in terms of safety and environmental risk as compared to varieties obtained through mutations. In the case of crops obtained through mutations we have no idea what genetic changes have been

triggered and we have only a faint, or even no idea about the molecular characteristics of the new trait, even if it is visible. In the case of rDNA technique we know exactly what genes have been inserted and at the same time their complete molecular characteristics is also known. The applied control procedures make genetic engineering even safer thanks to rigorous requirements concerning characteristics and detailed studies. In this way we are able to fully control the planned changes, introduce only minimum disturbance to the biological balance and maintain control over the processes executed at every stage of work. This gives a real possibility to eliminate errors at the stage of laboratory work, before introducing a new system into the open environment. It should be stressed that man has never "invented" any gene and our actions amount to copying the nature and using the resources of biodiversity in a **balanced** way.

Some adversaries of genetic engineering stand against "hybrids that do not exist in nature" and reject food obtained using methods other than "natural". At the same time a lot of "acceptable" crosses are obtained from plants of the same species, but so physiologically and geographically distant from each other that their DNA would never have been combined without the interference of man. Consumers that expect only "naturally obtained" food products should resign from most of the products that are currently available on the market. Even potatoes which are so popular in Central Europe and have served as a nutrition base for millions of people for the last several centuries are very different from their progenitors, not to mention they are complete strangers in this geoclimatic zone.

Why did farmers and breeders resign from the biodiversity of varieties for the favour modern breeding? Consumers prefer uniformity, breeders favour quantity and people from food processing industry demand both at the same time. The traditional varieties and biodiversity of most crops cannot compete in terms of yield capacity or quality. Modern breeders who use breeding hybrids provide more benefits for both farmers and producers while decreasing the costs born by consumers.

Practically none of the products that we currently consume has anything to do with the products from thousands of years ago. In this case consumption refers to both food and industrial products [e.g. cotton]. In reality the development of civilization can be measured by the sophistication of selection, breeding and their impact on our life standard, consumption and food resources. Those of us who expect only natural, non-modified food are left with products such as berries, mushrooms or fish. But even these seemingly unchanged organisms are subjected to the impact [stress] of the surrounding environment and consequently they also become modified.

It is also crucial to note the difference between the popular opinion and the view of scientists. This problem is perfectly illustrated by the issue of horizontal gene transfer. This phenomenon is commonly associated with the possibility of accidental gene transfer, e.g. by consumption or accidental contact of non-affined species. It is a common belief that such phenomenon could be highly dangerous for both humans and the environment. Experts claim that this kind of gene transfer is unlikely to occur. Scientists have known for years the incidences of horizontal gene transfer between bacteria or in the

process of symbiosis [e.g. of *Papilionaceae* plants and *Rhizobium* bacteria]. However, the molecular processes that occur in these cases have occurred in nature for ages and are not in any way hazardous to the environment.

I am deeply convinced that is not possible to "run away" from biotechnology. Genetic engineering creates the possibility of the most controlled changes and modifications. It should be emphasized that the control should apply to both the production cycle and the supervision during the distribution of an innovative product in the environment. It is impossible to give up the modifications of the genomes of living organisms, though it is justifiable to limit these modifications to reasonable needs and to ensure technical control. It is essential to establish an appropriate system of legal regulations and provide the supervision of state authorities that popularize [or will popularize] among the society the belief that modern, innovative biotechnology does not environmentally or socially threaten our environment.

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