Biotechnology, genetic engineering, agrobiodiversity and biosphere sustainability

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1. Science and Ethics

In order to survive, human society must progress towards a pacific and equitable social life, in accordance with the man and environment rights. Science and scientists, engaged in the advancement of knowledge and consequent benefits for human life, must be conscious and active witnesses of moral and ethic responsibilities of discoveries, inventions, innovations and technological applications. New scientific developments in basic and applied biology, chemistry, agrogenetics, geology, climatology, ecology, economics and social sciences are necessary to satisfy the basic human needs; in particular, those required by sustainable agriculture, wholesome nutrition, food production, storage and distribution.

The emphasis on the ethic dimension of science, of the scientific and technological research system promotes the trust of society and public opinion in the scientific knowledge and its derivatives.

Science is one of the main human strengths to challenge and overcome problems, conditions and limits to mankind development. Nevertheless the best science and the most effective technology will not solve societal problems and may create new ones if their development does not respect human values.

One of the main challenges is the pursuit of the biosphere sustainability, which has to be at one time socially equitable, economically pursuable and ecologically positive.

2. Agriculture, agricultural sciences and biotechnology

Agriculture is one of mankind's oldest activities. It has permitted a progressive increase in the number of humans and, therefore, a wider availability not only of purely physical strength but also of minds, intuition, wits, intellectual capacities, leading to the establishment of civilizations and cultures. The pressure of the demographic expansion and of the increasing human needs and the contemporary scientific and technological advancement are now imposing dramatic changes also on agriculture. The future of agriculture in a broad sense appears to be as a Pandora's box: rich of potentialities, problems, trends and results. Molecular biology, genetic engineering, the use of Genetically Modified Organisms (GMO) in plant and animal science, in sciences of nutrition and crop processing for food and industrial use, their effects on environment and ecosystems and their biotechnological, agrotechnological and industrial applications, are rapidly winning attention and suggesting utilizations. Socioeconomic and environmental consequences will probably be enormous and will raise scientific problems and ethical questions.

3. Problems and concerns

In the course of my address, I intend to outline first the problems and questions proposed to the human conscience and intelligence by the effects and potential advantages, but also risks, consequent to the drastic changes imposed to agriculture by the scientific research. I will then make reference to which responses are expected from science in order to mould changes into strong improvements of agricultural production and its agroindustrial processing. Agriculture could once more propose itself as an instrument of social and economic progress, a driving force of cooperation among peoples, with strong impact on the basic needs of life and freedom of human beings. Assuming that in the pursuit of scientific innovations there is no "no-risk" option, let me list, now, objective problems and concerns.

- Can food and food components from genetically modified plant and animals be harmful to human health?
- Is it feasible that GMOs transformed with DNA that increase their adaptation to agroecosystems when compared to traditional

crops and livestocks, may spread their new DNA in the environment, pass it to other plants and animals wich will be endowed with new traits whose effect is unforeseeable in natural ecosystems? The recipient organisms would be wild plants and animals, which would generate a modification of biological equilibria, a threat to biodiversity and other environmental risks.

4. Thoughts and answers

Point a):

The insertion of one or few genes (carefully defined in its/their genetic information and specific properties) into a pool of about 20,000 genes, often not yet well known, which make up the genome of higher plants, invites to admit that genetic engineering is a better foreseeable and controlled method regarding the gene to be transferred, as compared to the various conventional plant breeding systems, which range from hybridization to experimentally induced mutagenesis (making the whole plant genome interact with physical and chemical mutagens). Furthermore, wholesomeness and safety of food supplies from GMOs are already controlled (of course the control system must be constantly improved) by expert committees of international agencies (e.g.: WHO, FAO and Codex Alimentarius Commission), by national bodies and agencies (e.g. Food and Drug Administration in USA) and regional institutions, as in the European Union. The European legislation, for instance, is very rigorous: it foresees the labeling of all foods containing raw materials from transgenic plants. It has also been demonstrated that, during some food preparation, due to various industrial manipulations, the DNA of transferred genes may disappear, as in the case of soybean oil extracted from seed of herbicide-resistant varieties. It is also to be reminded that toxins or antinutritional factors are present in several food crops (cassava, leguminous species etc.) and are made harmless or less toxic through food preparation. In any case, research and regulations imposing patents safeguarding Intellectual Property Rights and Farmers Rights, and stringent controls and inspections, imposing the labeling of GMO-derived products, as well as continuously updated rules on food safety, are needed in order to dispel doubts and concerns and inspire confidence to consumers.

The very same idea of substantial equivalence, of a GMO-derived food to a conventional counterpart already available as a food supply, is a dynamic concept implying a continuous and increasing assurance of the safety of GMO-derived food products.

Point b):

The chance that genes transferred into a GMO may, by accidental cross-pollination, be transmitted to other species, spontaneous or cultivated ones, possibly spontaneous species, giving origin to new plants herbicide or parasite-resistant, depends on the environmental context where the crop is grown: for instance, on the possible presence of wild species able to hybridize with the GMO. Numerous and exhaustive experiments are needed to ascertain possible cases of interbreeding and study the effects on parasite populations and on the selection of resistant mutants.

A constant monitoring is to be prescribed on the impact on ecosystems and their components. It cannot be excluded a priori that, as soon as there is a spread of the GMOs cultivation, the ability of the GMO individuals to produce compounds capable of degrading herbicides, blocking viruses, making plants more resistant to abiotic stresses, being toxic to pathogens, may be turned against other biotic components in the ecosystem (useful insects, other invertebrates, microflora and microfauna in the rhyzosphere, birds, etc.), threatening the biodiversity to a larger extent than any chemical treatment. These risks also require vast and careful research and constant monitoring, parallel to the spreading of the GMOs cultivation. In fact, new farming systems utilizing GMOs more resistant to biotic and abiotic stresses, with improved organoleptic, nutritional and market quality, must however be economically and ecologically compatible and sustainable.

A special case is represented by the use of antibiotic-resistant genes as markers in the transfer of new genes in the GM crops, and the risk that such resistances be introduced in the human food chain. In order to avoid this harmful effect, this type of markers is being eliminated, even if the origin of antibiotic-resistant mutants is also to be ascribed, since long time ago, to hospitals and veterinarian applications.

5. Considerations and conclusion

So outlined the role of research with regard to problems concerns or refusal in the introduction of the

GMOs in the agrofood sector, I wish to express some ideas about ways to overcome this discrepancy. In fact, on the one hand it is possible to observe an expansion of the use of transgenic plants: their obtainment in still other crops and forest trees, an increase of acreages, a wider range of characteristics modified as for resistance to parasites, quality, productivity, adaptability to different environments, sustainability of farming systems. As a matter of fact, the use of GM crops, is now spreading from North America into other geo-political areas (South America, Far East), and is now involving also various developing Countries, with special attention to crops native to tropics or subtropics, due to the obvious advantage of a larger food availability to fight and control the malnutrition now affecting hundreds of millions of human beings.

On the other hand, a recurrent refusal to accept GMOs must be recorded, and not only in economically progressed countries. A strong public opinion and Governments concerns exist, related to fears of damages to human health, to environment and its resources, in particular biodiversity, and of possible strong disturbances to agricultural systems and commercial relationships. In this respect, clear signs of quarrels at the level of world farm products trade are already evident. It is also meaningful that those signs have manifested themselves during international meetings (Cartagena, Peru, 1999) on the application of the Convention on Biological Diversity.

Moreover, particularly important is the fact that modern societies are today better educated, or at least better informed, due to the globality and rapidity in the diffusion of information and in the action of public administrations, associations and NGOs, willing to protect the mankind and environment health. As a consequence, public opinion and policy makers and Governments must be reassured and be able to rely on a strong and ethically determined engagement of the scientific community, supported by adequate public and private investments. A strong opinion movement and a valid basic and applied research should not only aim at a control of the effects of the GM crops introduction, but also pursue the study and observation of the potentialities of the molecular biology, the genetic engineering, the biotechnologies, as in the food production, in the discovery and elimination of direct and indirect effects, both biological, and economical, and in the introduction and spreading of the GMOs in farming systems, in natural ecosystems, in the world food trade, etc. Studies and researches should not be confined, according to a reductive approach, to the monitoring of the effects determined by the introduction of the GMOs. Rather, holistic criteria should be adopted, and every reasonable hypothesis of interaction among GMOs, human beings and ecosystems investigated. Furthermore, methods adopted and results obtained should be evaluated by independent committees of experts. Full-range investigations, also denouncing risks and chances to overcome them, should be able to guarantee, beyond any reasonable doubt, the compatibility of the utilization of GMOs in agriculture and agroindustry. The public opinion, so reassured, and rationally persuaded that no technological innovation can be a "no-risk" one, would consciously be presented with by the problem of the acceptability and utility of agrobiotechnologies.

Having said that, I wish to conclude as follows:

The great multiplication of studies and research in the field of genetic engineering and agrobio-technologies must proceed at a speed parallel with the galloping spread of the introduction and trade of the GMOs.

We are in the initial phase of a new “green revolution”. As soon as genomes of cultivated plants will be completely sequenced, and investigated the function also of genes that control complex responses, favourable genes can be transfered between philogenetically distant plant species, so over coming increasing levels of micronutrients, able to syntetize pharmaceutical and nutraceutical products and raw materials for industry, with higher economic value, with better adaptation to the agroecosystems and able to detoxify environment.

Therefore, what is needed is a strong multiplying factor of research supported by public funds, by private enterprises; national and regional programs (eg: the "Quality of Life" program of the EU; the OECD plan for a biodiversity data-base global facility); by the international programs of the CGIAR and IPGRI systems, with a stronger engagements e.g. of the World and Regional Banks. Egually important will be the promotion and coordination of the UN Agencies (as FAO, UNESCO, UNDP, UNEP, WHO), as well as the increase of the North-South and South-South scientific and technological relationships. These programs must be granted the greatest attention and support. Special attention should also be given to research on the sustainability of specific agroecosystems (e.g. Mediterranean area) and to the enhancement and exploitation of tipical niche crop productions. The developed countries are particularly called to play such role, in a frame of scientific cooperation and exchange with all other countries, also through Universities, scientific Academies, Research Centers, etc. Furthermore the international corporations should be obliged to open their laboratories also to researchers from developing countries, to make their activities more transparent, to identify the most appropriate procedures of recognition and compensation of the Farmers' Rights, as pointed out also by the Convention on Biological Diversity.

I believe that it is through this way of acting, conscious, responsible commitment of governments, scientists and public opinion, that it will be possible to realize a "synergy" among natural resources, particularly "biodiversity" and "agrobiodiversity", and "biotechnologies", which translates into an indispensable "correlation" between an equitable and solidaristic progress and the respect of the values and rights of nature and human kind.