Rendiconti
Accademia Nazionale delle Scienze detta dei XL
Memorie di Scienze Fisiche e Naturali
119° (2001), Vol. XXV, pp. 23-25

GIAN TOMMASO SCARASCIA MUGNOZZA *

Genetically Modified Organisms - GMO's **

Almost without exception, the fruit, vegetable and other crop plants grown commercially today have been genetically modified. The adoption of new plant varieties, developed through selective breeding, has been improving the food supply for thousand of years.

The development of genetics in the 20th century was tremendously important in improving plant breeding procedures.

In the last 50 years these improvements, known as the "Green Revolution", helped feed a growing world population.

Application of "genetic engineering" (also known as "recombinant DNA technology" or "molecular genetics") has had already a profound impact in biomedical research and human medicine.

In plant improvement, the first results in obtaining "transgenic plants" (or GMO's) were obtained at the beginning of 80's in Europe (Gent University, Belgium). In the USA, in 1990, the first field trial of transgenic plants was carried out.

As compared with hybridization, the rDNA technology offers the advantage of making possible the transfer, from a source organism to a target plant, of specific, well-characterized genes. Traditional breeding involves, instead, the transfer of a multitude of genes whose functions are, in most cases, unknown.

Each year, however, a great many new varieties of fruits, vegetables and grains are released to farmers and food production. The vast majority of them manifests genetic and phenotypic changes whose chemical or physiological basis is unknown.

The precision of rDNA technology, therefore, may represent a remarkable improvement over traditional cross-breeding, that requires repeated rounds of crossing and back-crossing over several generations to produce the desired combination of traits. Using biotechnology, usually only one or two progeny generations are needed to complete the gene transfer.

* President of the Italian Academy of Sciences, Rome, Italy.

** Lecture held on invitation of the Indonesian Academy of Sciences, Jakarta, 21 June 2000.

At present (1999) the world area cultivated with transgenic crops (mainly soybean, corn, cotton, rapeseed) amounts to about 40 million hectares (in USA and South America mainly, but also in Australia and few thousand hectares in some European Countries).

Research is presently going in several Countries, applied to other crops as: tomato, potato, squash, wheat, rice, cichorium, papaya, cucumber, water melon, apple, grape, olive, cherries, egg-plants, pepper and others. Potential new crops are designed to resist pests, viruses, herbicides, as well as environmental stresses as drought, low temperature, high salinity, or to be characterized by a higher content and quality of substances necessary for human nutrition and health.

Potential risks can, however, stern from the introduction into agriculture of transgenic crops, as: biodiversity reduction, transfer of the transgene into other sexually compatible species, damages to non-target species (e.g.: beneficial insects or wild animals feeding on GMO's).

Furthermore, harmful effects on human health can be related to new toxins, new allergens, and new types of antibiotic resistance.

Nevertheless, the merging of medical and agricultural biotechnology has opened up new ways to develop plant varieties with health-enhancing characteristics. Advanced understanding of how natural plant substances, known as phytochemicals, confer protection against cancer and other diseases is being used to enhance the level of these substances in the food supply. Work is underway that will deliver medicines and edible vaccines through common foods that could be used to immunise individuals against a wide variety of enteric and other infectious diseases.

Undoubtedly safety measures, regarding human health and the biosphere and natural resources protection, are strongly needed and adequate risk assessment must be make before releasing GMO's.

However, regulatory oversight of agricultural biotechnology should be risk-based and guided by the characteristics of the plant, its intended use, and the environment into which it is to be introduced, not by the method used to produce it.

Biotechnology is no more than the latest methodology in a continuum of technological innovations that have enormously enhanced agricultural productivity.

Attention must be focus on high-probability risk, not on hypothetical or unrecognisable risk. Hypothetical concerns are virtually impossible to dispel.

Advisory committees have been established all over the world, at national, regional and international level, because Countries need to develop specific biosafety legislation and regulation. Stringent controls and inspections on the GMO's products, as well as continuously updated rules, are needed in order to confirm the wholesomeness of food and protection of environment and of natural ecosystems.

It follows that many more *ad hoc* studies and research should be executed, and the accomplishment of a full range of investigations for controlling and monitoring the possible harmful effects is strongly needed. For the same reason, a better knowl-

edge of the genomes of cultivated plants and of the function of their genes is urgently required, in order to obtain, through genetic engineering, new crops with superior quantity and quality performances.

Equally important is the release of adequate information towards the public opinion. Modern societies are today better educated, due to the globality and rapidity in the diffusion of information. Therefore, 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.

More food, better food for more people from less land, with less inputs, seem to be the message for the future. These goals can be reached only thanks to an expanded scientific knowledge on biophysical resources and human attitudes, which would allow the setting up of more advanced technologies and more appropriate exploitation of natural resources. Agriculture, during the next 40 years will have to produce an amount of food equal to that so far produced since the domestication of crop plants and animals.