Improving crops in Latin America

by B. Donini*

Agriculture makes a vital contribution to the economic and social development of countries in Latin America. Agricultural production can be increased in a number of ways: rational land use; cultivation of new land of the tropical and subtropical forest areas; use of suitable technology; and genetic improvement of crops.

Currently available resources are not used to the full, however. This is also true of the genetic resources of the local varieties of legumes, root and tuber crops, oil-seed crops, cereals, pasture grasses, fruit-plantation and forest trees, as well as industrial crops. Exploiting the genetic resources available in the region may also bring new species of crops into wide cultivation. Lupine, quinoa, Inca wheat, arara, oca, olluco, isano, and others are regarded as species which could be economically important, as they are sources of protein, oil, vitamins, sugar, starch, and alkaloid. Improved crop varieties would increase agricultural production of food, wood, and energy-related products, substantially raising the income and living standards of the population of Latin America. To improve crop production from the currently cultivated and the newly introduced species, more efforts are needed.

Mutation-breeding is one important tool in developing new, better-performing varieties. Radiation and some chemicals (called mutagens) induce mutations by altering genes and creating genetic variability. Plant breeders can derive from induced mutations additional genetic resources for improving crops.

The FAO/IAEA seminar** provided an opportunity for plant breeders and agronomists to become familiar with the latest advanced techniques of mutation breeding and, it is to be hoped, stimulated researchers to make more extensive use of induced mutations. The seminar identified the main problems which need to be solved to develop better varieties for Latin American countries, and the potential contribution of mutation-breeding in this task. Among the problems the following need attention: improvement of crop resistance to pathogens and pest; tolerance to environmental stresses; and improvement of quality and yield. Such problems are common in most of the crops cultivated in the region and provide an incentive for a co-ordinated approach in a regional programme.

Two main points are relevant to the mutation-breeding approach: the use of locally adapted varieties as material to start with; and suitable screening procedures to select the induced mutations. Cases were mentioned at the seminar in which radiation or chemical mutagens have helped produce desired genetic variability which was not available in the original genetic resources and which has led to the release of new varieties. Practicable procedures for changing of traits in the cultivated varieties and the possibility of selecting for improved attributes were discussed at the seminar. Examples: the improvement of protein content in wheat and of nutritional quality in legumes, the increase of oil content in oil-seed crops, the reduction of alkaloid content in *Lupinus mutabilis* and cassava, the increase of resistance or tolerance to diseases and pests in legumes, cereals, and other crops.

Diseases are the major problem encountered, limiting crop production in various species. On the other side, induced mutants for resistance are rare, consequently methods of selection have to be improved and large populations screened.

Participants at the seminar reviewed work on a wide spectrum of crops: cereals (barley, wheat); sorghum; quinoa; legumes and vegetables (pea, chick-pea, tomato, pepper); oil-seeds (sesame); fruit-trees; tuber crop (potato); and others. New mutant varieties of wheat, sorghum, and legumes are already being cultivated and new promising lines have been obtained and tested. The two mutant wheat lines UACH-2-I and UACH-3-I, obtained in Chile, have higher protein content and more of the amino-acid lysine essential for human nutrition. In barley, mutant lines from the variety Zapata were selected in Peru. They have improved resistance to leaf-rust *Puccinia hordei;* they ripen earlier, and have higher yields. High-yielding mutant lines of sorghum induced in the locally adapted varieties, are already in advanced phases of agronomical trials and ready for release in Venezuela. Early mutants induced in the pea varieties Alderman and Amarilla are being evaluated in the highlands of Peru for their adaptability and suitability in crop rotation with cereals. A mutant line of chick-pea with erect growth habit and tolerance

* Mr Donini is a staff member in the Joint FAO/IAEA Division of Isotope and Radiation Applications of Atomic Energy for Food and Agricultural Development.

** Seminar on the utilization of induced mutations for crop improvement for countries in Latin America, jointly organized by the IAEA and the Food and Agriculture Organization (FAO) and held, at the invitation of the Government of Peru, in Lima, Peru, from 17 to 23 October 1982.

In the foreground of this photograph is a short mutant variety of sorghum. The original, tall variety can be seen in the background. In this Venezuelan project, it was found better to start from locally adapted varieties than introduce new ones to the region.

to root-rot disease has been isolated and tested. The cultivated area of this crop could extend to Chile. New promising mutant lines for erect growth habit, earliness, and increased yield in legumes — cow-pea and mungbean — were reported by a participant from Venezuela. In the latter species two mutants having non-shattering pods make harvesting easier. They are valuable material and are now undergoing regional trial.

Results of induced mutation on soy-bean and French-bean for disease resistance to blight-virus and leaf-rust as well as to common bacterial blight were reported by the Brazilian participant. In an attempt to transfer the tolerance to golden mosaic virus of the French-bean induced-mutant TMD-1, crosses have been carried out with other varieties of importance for Brazil. In a special session of the seminar, scientists working in an FAO/IAEA co-ordinated research programme on the improvement of leguminous and oil-seed crops in Latin America through induced mutations exchanged information on the work plans of the project and on the problems to be solved. The five-year programme is intended to support research to produce better varieties of legumes and oil-seed crops (which are a source of higher quality food in Latin America) and at the same time contribute to the earning of foreign exchange. General discussion of the data presented at the seminar dealt with techniques of using physical and chemical mutagens, procedures of handling treated material, and methods for selecting induced mutants.

Particular attention was also given to the subject of *in vitro* mutation-breeding to improve vegetatively propagated crops. This technique is regarded as an effective tool for inducing and isolating somatic mutation in a wide number of cultivated fruit-tree, root, and tuber crops. Closer co-operation of Latin American countries already working on this subject has been recommended.

In the round-table discussion which concluded the seminar, the importance of crop-variety improvement through mutation-breeding was reaffirmed. It was stressed that agricultural production is an important source of foreign exchange for most countries in the region and the primary source of employment, either in production or in the processing industries.

The IAEA is providing financial and technical support. The Plant Breeding and Genetics Section of the Joint FAO/IAEA Division is currently co-ordinating a regional project on improvement of leguminous and oil-seed crops through induced mutations. Also, other projects on cereals and sorghum, legumes and vegetatively-propagated crop-plants are co-ordinated with specialized institutions of the region. Moreover, through technical assistance, the Agency organizes interregional and regional training courses on induction and use of mutations in plant breeding, and supplies the services of experts to advise Latin American countries in how to develop improved varieties through mutation-breeding. These forms of technical assistance: training of personnel in mutation-breeding in Latin America; providing expert services in the specific discipline of plant-breeding; phytopathology and agronomy; etc., are fruitful and they will continue.