A REPORT ON AN INTERNATIONAL SYMPOSIUM ON THE USE OF INDUCED MUTATIONS FOR IMPROVING DISEASE RESISTANCE IN CROP PLANTS, VIENNA, 31 JANUARY - 4 FEBRUARY 1977
Forty-one countries and one organization were represented by 90 participants at the symposium, during which 52 papers were presented in 8 sessions.

Safeguarding Crop Plant Production with the Aid of Nuclear Techniques

The production of food by cultivating crop plants is a difficult industry which requires a great deal of investment and labour. Many factors are involved and have to be taken into consideration. In the final analysis, however, a good harvest is not more than what pathogens, parasites and pests have left for the farmer to harvest. Further losses occur after harvest in storage, trade and processing.

It is well known that nuclear techniques can contribute to reduce such post-harvest losses (see *IAEA Bulletin* Vol. 15, No. 1 and Vol. 18, Supplement), but is there anything that could be done, using radiation and tracer techniques, to protect the crop in the field? The so-called "sterile male technique" can be applied against a number of insect pests (see *IAEA Bulletin* Vol. 9, No. 3 and Vol. 15, No. 3). Other pests and diseases can be controlled by chemical sprays, but the chemicals are costly and a drain on hard currency for developing countries. Fungicides and pesticides, of course, are indispensable for protecting field crops and thereby help to feed the hungry part of the world; however, they are not harmless and can be a heavy burden for the environment if applied in excess and without proper controls.

Tracer techniques are used to determine the fate of pesticides and fungicides in the plants, in plant products and in the agricultural environment, thereby helping towards a safer application of those plant protectants (see *IAEA Bulletin* Vol. 17, No. 5 and Vol. 18, Supplement).

A biological means for protecting crop plants from parasitism, as old as nature and quite effective if knowledgeably operated, is the inherent ability of certain genotypes of crop plants to withstand a pathogen attack either by rejecting the infection or by living with the parasite without much ill effect. In nature there is mutual interaction and competition between parasites and plants, leading to a certain balanced form of co-existence. If the former acquires a higher degree of pathogenicity by mutation, the population of the latter will be selected for those types that are best able to survive parasitism and to produce offspring. The genetic variability in such a plant population results from mutation and recombination.

Since under wild and primitive conditions, plants grow in mixtures of genotypes and species, the attack by pathogens is buffered and plant populations have a chance to adapt to a new potentially dangerous situation,. At the same time, diversity is maintained in the pathogen population, thus preventing its eradication or a dramatic propagation of most aggressive types.

In his selection of crop plants for cultivation, man has selected the highest yielding types which have the best quality traits with respect to being adapted to prevailing climatic conditions and carrying resistance to many adverse factors.

However, crop plants usually are rather homogenous and not grown in mixtures. Their wealthy growth makes them attractive hosts for parasites. Therefore, an increased aggressiveness or new virulence of parasites often leaves the crop with little defence possibilities, and heavy epidemics with wasteful crop losses may result. In cereals alone, yearly losses due to plant diseases amount to about 135 million tonnes of grain, which equals roughly half the world wheat production (Cremer 1967). These losses do not only occur in developing countries, although they suffer most from the results, but also occur in developed countries. In 1954, 75 per cent of the durum-wheat production in the USA was destroyed by stem rust, and in 1970 the USA lost about 25 million tonnes of corn (which equals its total annual export) due to a single type of fungus. In such cases, the plant breeder has to intervene by building up defence mechanisms in his varieties. He can do so by crossing with exotic or other introduced genotypes, he may also decide to induce mutations through radiation or other mutagens. Using natural infection or artificial inoculation to test the mutants, the plant breeder may then select those genotypes better able to resist the attack by pathogenic micro-organisms.

Setting up a resistance barrier in the host plants will challenge the ability of the pathogen species in question to surmount it. Often, more aggressive types are already present in the pathogen population and will be favoured automatically by a widespread cultivation of a "resistant" host variety. Spontaneous mutation and sexual recombination will lead sooner or later to a more aggressive pathogen or to one that is virulent to the "resistant" host variety. These processes lead to a continuous need for more genes that render pathogen resistance, and induced mutations play a valuable role in supplementing existing gene pools for such resistance.

To break or at least to slow down the vicious plant-pathogen cycle, it would be essential to have many different gene sources for resistance available and employed simultaneously.

The life expectancy of a resistant crop cultivar depends upon its genetic structure, the genetic potential of the particular pathogen species and the environmental conditions, natural as well as man-made. The efficiency of induced mutation techniques to provide new and desired types of crop plants that are resistant to certain pathogens depends upon the pre-existing host genotype, the effectiveness of the mutagen treatment and – most important – the knowledgeable application of appropriate methods for selection. Highly resistant types are relatively easy to select, moderately resistant types are not. As the latter are said to have a longer life expectancy, more sophisticated selection methods are needed, which can be based on understanding of host-pathogen interactions elucidated by the help of tracer techniques and by using induced pathogen mutants as experimental tools.

The international symposium on induced mutations was organized jointly by IAEA, FAO and the Swedish International Development Authority (SIDA). The participants discussed primarily the methodology and problems related to the use of radiation and tracer techniques for breeding crop varieties with improved disease resistance. Scientists from 41 countries and international organizations participated. But not only were problems, methodology and various approaches discussed, some scientists were able to report positive and practically useful results. Rice mutants with better resistance against blast, leaf blight and sclerotic disease were reported (India, Japan, Korea, France). Improved tolerance to septoria in wheat and to crown rust in oats has been found (Switzerland, USA) and convincing evidence was given that non-specific, medium-level resistance to mildew can be induced in barley (FRG). A potato mutant resistant to wart disease was found in the USSR, and a wheat mutant with improved resistance to stem and stripe rust has been released to farmers in Greece. Among the economically important positive results is the selection of spearmint resistant to *Verticillium wilt.* (USA). This success follows a similar one in peppermint achieved several years ago, which now represents a gain of about one million dollars per year to growers in the USA.

The USA began to support research in this field six years ago and SIDA has given valuable financial assistance to national institutes for specific research and development projects within the frame of a joint FAO/IAEA/SIDA programme.

Safeguarding food production will remain one of the major tasks for agricultural research. This will require continued efforts on both the national and international level. It is hoped that the necessary financial resources will be made available to stimulate and support such research efforts to ensure that present and future generations will have an adequate food supply.