Concluding Remarks

Kenkichi SAKAI
Chairman
Symposium Organizing Committee

Domestication of world species of plants and further effort aimed at improving yield undertaken by man were at the origin of plant breeding. Rediscovery of Mendel's law of inheritance in 1900 has led to enormous progress in genetics for the past three quarters of the century. Following progress made in genetics, plant breeding became more practical and more systematic. Sophisticated technique such as cross breeding contributed greatly to the increase of crop production. By use of conventional technology unlimited utilization of plant resources was attempted and numerous cultivars of high yielding crops were developed.

Nevertheless, it was quite common for us breeders to be faced with deadlocks, as every breeder has experienced it once in his career. To find a way out of the impasse, we often had to check thoroughly our own genetic materials and proceed to a detailed review of our breeding methods to carry out successfully breeding through the use of appropriate cultivar or variety, unless the objective characteristics or genes controlling the character were present in the materials. Improvement of plant resources is really an architectural performance, which should emphasize the need for germ plasm collections. Recently there has been a growing concern for a more systematic approach to the collection and preservation of plant germ plasm. The Food and Agriculture Organization of the United Nations has played an important role in coordinating this international effort. We understand that these collections must be made and maintained for the future use of mankind.

Continuous efforts to exploit new cultivars by breeders have made it possible to utilize genetic resources of wild species and their relatives. Among the techniques of plant breeding which have been in use we should mention the direct introduction of useful genes, inbreeding and hybridization (intra- inter-species and genera), the use of male sterility for hybrid vigor, bulk population, backcrossing, polyploidy, mutation breeding and associated methods of selection and evaluation.

Remarkable improvements in crop production have been achieved. These include hybrid corn, sorghum, and millet. Very recently hybrid barley has become a reality. We also well know that the creation of high yielding, short statured, lodging resistant photoperiod neutral rice and wheat cultivars has contributed to the "Green Revolution".

Along with such progress, our attention is now directed toward rice and wheat so as to develop species resistant to diseases and insects and which can adapt to climatic conditions and application of higher levels of fertilizers.

Significant progress has recently been made by the use of genetic engineering methods in plant breeding. It is now possible to achieve 1) the artificial synthesis through polyploidy of triticale, a wheat x rye hybrid whose protein content is higher than that of wheat and which is more adapted to semi-arid areas, 2) parasexual hybridization that facilitates the fusion of somatic cells of otherwise incompatible species and 3) gene transfer via bacteriophage.

Haploids are also easily produced from the culture of pollen grains or anthers in some species.

These techniques should enable in the future to create new species or varieties fulfilling our requirements. Such new techniques in plant breeding have been presented in this symposium. I anticipate that greater progress will be continuously made by breeders to improve the productive capacity of various crops.

On the other hand, the world population is still increasing at an annual rate of 1.8 percent, which is equivalent to say that seventy million new mouths to feed are being added every year. As breeders, we must look for some alternatives to meet such a huge demand for food.

The first alternative should be the use of solar energy. The use of net photosynthesis to incorporate photosynthetic products more efficiently into harvested grain by breeding should be stepped up. Improvement of plant genetic architecture for better and more efficient bioconversion of solar energy should be emphasized. It is generally accepted that productivity under conditions of high temperature and prolonged exposure to sun light coupled with high moisture is definitely favored by the C_4 plants such as corn, sorghum millet and sugarcane. Those plants produce higher total digestible nutrients per unit of land, per unit of water transpired, and per unit of time, compared with C_3 plants such as rice, soybeans, potatoes which are more productive in the temperate zones.

It is also well known that some C_4 plants may require only half as much water per unit of dry matter compared with C_3 species. This fact is very important from the viewpoint of land use and water management.

The ability of nitrogen fixation should also be emphasized. It was thought that this property was a characteristic of legumes and was not present in other species. Scientists consider that this property may possibly be transferred to non-legumes by crosses between legumes and non-legumes such as maize and soybeans, through genetic engineering methods. At the same time, we should explore nitrogen-fixing micro-organisms in various cropping systems along with the magnitude of their respective inputs so as to establish optimal plant-microorganism interrelations. We expect such research to be conducted by soil scientists and agronomists. Cropping systems particularly in combination of legumes with high yielding C_4 cereals must be explored by agronomists.

Development of improved cultivars for enhanced capabilities of ion uptake, as well as synthesis of new chemical fertilizers enabling more effective cultivation in tropical soil where nitrifying bacteria reduce fertilizer nitrogen utilization should be considered.

Other objectives of crop breeding should include development of cultivars that meet special consumer and manufacturer needs such as mechanical transplantation, harvesting, etc. Development of cultivars with early or late maturity along with specific plant characteristics is required for efficient application of cropping systems. Furthermore, improvement of cultivars resistant to a wide range of diseases and pests and enabling adaptation to certain soil conditions must be considered. It should however be mentioned here that breeding for resistance to diseases and insects is facing the difficulty of producing new biological races and new insect biotypes. We have thus to devise more logical and effective means to overcome these difficulties.

Breeding offers a considerable potential for increasing production of crops in developing countries. Such undertaking requires however very large investment and highly skilled personnel. The achievement of significant improvement in various crops by which small farmers of developing countries could benefit, requires teams of plant scientists to conduct the adaptive research and evaluations needed to identify selection procedures fitting in the production schemes. Each improved strain or cultivar is the base for further improvement. Research on physiology, genetic control of metabolic systems, genetic and environmental interactions, nature of diseases and insect resistance, stress tolerance and other biological factors are essential to fully understand the potential of genetic resources and to develop effective selection procedures enabling genetic progress. Rapid progress requires major investments internationally and within nations as well for the training of qualified scientists and for financing programs essential for sustained productivity. Strong international cooperation among scientists will certainly contribute toward success.

In this sense, I believe that the symposium we had here was quite relevant and meaningful. Despite the limited number of participants, the magnitude of the techniques covered was conspicuous and I really hope that the symposium will stimulate further research in the field of plant breeding.

Let us work together with greater resolution to meet the people's demand for food. Indeed we are responsible for feeding the next generation.

Thank you