General Discussion

Chairpersons: Rana, R. S. (India) and Hayashi, K. (Japan)

Chairman: Hayashi, K. (Japan): Before we start the general discussion, I would like to emphasize two important aspects relating to plant genetic resources. There are organizational aspects covering four areas as follows; 1. Aspects relating to biodiversity and sustainability which are common problems to both developed and developing countries. 2. In the developing countries there is an increasing number of activities relating to plant genetic resources. 3. International systems are involved in problems relating to genetic resources, in particular the CGIAR which has developed long term priorities and strategies among which problems related to genetic resources rank fourth. Within the CG system, IBPGR shows a new emerging power to address worldwide these problems at the level of the CG centers related to commodities, at the level of the IBPGR itself and the national agricultural systems. 4. Japan, the host country of the Symposium, is also involved in these problems through MAFF which celebrates one hundred years of agricultural research and the Tropical Agriculture Research Center which will be reorganized into a new center in October. It is anticipated that genetic resources management will be an important area in the new Center. There are also scientific aspects. As you may be aware of, in 1980 the IBPGR sponsored a meeting on genetic resources of the Far East and the Pacific and in 1987 a meeting on crop genetic resources of East Asia. Compared with the two previous meetings, the current symposium showed a remarkable development. Indeed wider areas of research were covered and in the presentations the analysis of the research data was deeper and the discussions were well documented. One of the major achievements of the Symposium was to demonstrate the dynamic nature of plant genetic resources.

We will now start the general discussion by asking the chairpersons of the respective sessions and sub-sessions to sum up the major outcome of the presentations during these sessions. For the keynote address, Dr. Ishihara made several comments.

Ishihara, S. (Japan): Is not there an unwelcome consequence to the efforts of promoting capabilities for utilizing genetic resources, as a result of the increased awareness of potentials for commercial profits on the part of individual countries owning resources? Is there any specific provision in the mandate of international organization such as IBPGR to prevent the creation of institutional barriers by which such countries try to monopolize the exploitation of genetic resources? On the other hand, what could be done to strike a balance between the requirement to stimulate resources development by giving preferential rights to supplier countries and the requirement for free and open access to resources needed for the welfare of the international community?

Iwanaga, M. (IBPGR): Article 15 of the Convention sets a framework for access to biological diversity (i. e. mutually agreed terms). The Conference of the Parties which is the highest government body of the Convention should define this aspect through the drafting of a protocol for practical application. I personally propose to develop a "multilateral system to deal with agrobiodiversity" as no country, however rich in biodiversity is self-sufficient to satisfy its needs of genetic diversity of major food crops. A form of compensation system should be developed through the establishment of an international fund.

Chairman: Hayashi, K. (Japan): I would like to ask Dr. Valkoun to summarize the presentations during the session on exploration and collection.

Valkoun, J. (ICARDA): In the four presentations all the speakers were concerned about the genetic erosion taking place in Asia and South Asia and emphasized the need for further collections of genetic resources in these areas. Prof. Sakamoto emphasized the importance of studies of crops based on ethnobotanical knowledge in the conservation of genetic resources of crops. Dr. Rana stressed the diversity of genetic resources in the Indian Subcontinent and the need for their preservation. He also outlined examples of subregional cooperation among the countries of the region. He indicated constraints on free access to genetic resources and the lack of sustainable funding for genetic re-

sources. He urged collaboration with NGOs, CG system, government and international organizations. Dr. Zhou described the genetic resources of underutilized crops in Asia. She stressed the need for conserving and collecting these crops for future utilization. Dr. Okuno summarized the results of recent collections conducted in collaboration between Japan and national programs in various countries. He indicated the need for sharing the resources thus collected with the national organizations and outlined future programs of collections of genetic resources organized by Japan. There was a general consensus among the speakers for the need for future germplasm collections and close collaboration with national programs as well as for raising funds for genetic resources collection and conservation.

Chairman: Hayashi, K. (Japan): I would like to ask Prof. Sakamoto to summarize the presentations in the subsession on exploration and collection.

Sakamoto, S. (Japan): In all the presentations the speakers indicated that there is a vast potential for the utilization of plant genetic resources for breeding purposes of various crops in the southeast and southeastern areas. In Bangladesh there is a high variability and diversity of rice germplasm due to the environmental diversity where ecotypes of rice are grown in three overlapping seasons. Although Sri Lanka is a small island, due to the high ecological diversity and rich floristic diversity with a high endemicity, there is a high genetic diversity. In Thailand there are many indigenous species of fruits, such as mango, durian, mangosteen which offer a great potential for future utilization for the improvement of tropical fruit varieties. However, there are problems. For example in Bangladesh, due to the extensive introduction of modern rice cultivars, genetic erosion of rich landraces proceeds rapidly. There is an urgent need to collect rice genetic resources, mainly wild races and species from hilly and tribal areas. In Vietnam, there are highly diversified forms of legume species that have not been studied properly and international collaboration for the collections should be promoted. It was also indicated that trials for the introduction of tropical food legumes such as beans and bambarra groundnut to Okinawa as summer crops were successfull.

Chairman: Hayashi, K. (Japan): I would like to ask Dr. Muñoz to summarize the presentations during the session on evaluation and utilization.

Muñoz, C. (Chile): In the three presentations of this session the speakers reported results on the classfication of rice, potato and sweet potato cultivars using RFLPs. Questions and comments mainly dealt with whether RFLP analysis is the appropriate tool to use. Though all three presentations referred to RFLP analysis, we should not consider this technique as the only approach for classifying, identifying cultivars and germplasm or evaluating genetic diversity. This method supplements others like morphological, biochemical or physiological methods. Since it requires handling of isotopes and more sophisticated protocols than RAPD, methods that do not require the use of isotopes should be preferred. It was considered that the advantages and disadvantages of two methods (RFLP and RAPD) may become clearer after a larger number of trials are conducted using various crops, probes and restriction enzymes. This aspect should be further discussed by the participants. Also, mitochondrial DNA analysis was considered to be an additional approach for the molecular characterization of plant germplasm, particularly in cases where nuclear DNA analysis had already been performed.

Kaneda, C. (Japan): I would like to ask two questions to Dr. Kawase regarding intra-varietal polymorphism of RFLP. 1. How many plants did you analyse per entry? 2. Did you notice differences among regions in the degree of intra-varietal polymorphism?

Kawase, M. (Japan): 1. We used 50-200 individuals for each accession as a bulk population from which DNA was extracted for the RFLP analysis. When we encountered intra-varietal heterogeneity, the most frequent genotype estimated was taken as the representative for the studies. 2. It is difficult to determine whether there was any tendency for intra-varietal variation because the accessions used had different histories. Some were collected through explorations while others were given by institutions, both of which were cultivated more than once after introduction. Some accessions were subdivided into different accessions after introduction when morphological heterogeneity was detected. It is impossible to compare such different accessions for the occurrence of intra-varietal heterogeneity.

Kaneda, C. (Japan): I anticipated such an answer. I once grew 70 varieties from one State of India (70 plants per accession) and observed different types within one variety. This is a common problem in the handling of germplasm which should be solved. Indeed it is not surprising to observe intra-varietal polymorphism as often farmers mix types in one field to avoid damage from biotic or abiotic stress.

Chairman: Rana, R. S. (India): It is obvious that the value of germplasm collections lies in their assessment and utilization. It was shown during the session that wild relatives and landraces can be effectively utilized for the improvement of crops such as rice, cowpea and mungbean. I would like to ask Dr. Konishi to summarize the presentations during the session.

Konishi, T. (Japan): During the presentations the speakers indicated that landraces and wild relatives can be utilized for the improvement of the resistance to pests and weeds in various crops. Emphasis was placed on how to collect a large number of germplasm samples from various regions and how to screen for resistance under suitable conditions. Dr. Ikeda and collaborators indicated that landraces and wild relatives of rice from Sri Lanka and South India were resistant to the brown planthoppers while wild race and relatives were resistant to tungro and that no cultivated varieties were resistant to RTVB. Dr. Thavarasook and collaborators found one accession of wild mungbean that was resistant to bruchids. The resistance was controlled by a single dominant gene introduced to recommended varieties by the backcrossing method. Dr. Singh reported that a landrace of cowpea was resistant to two kinds of weeds. Hybridization between susceptible varieties and the resistant landrace gave rise to a new resistant variety. Dr. Jiang reported on Yunnan as being a center of diveristy of Asian cultivated rice. Rice collections in Yunnan revealed the presence of a large variety of agriculturally important races. Some of the resources are available for rice breeding. Drs. Egawa and Tomooka studied the phylogenetic differentiation of *Vigna* species based on cytological observations and isozyme analysis. They emphasized the presence of crossability and bridge species for *Vigna* breeding. All these presentations provided important information on how to use genetic resourcees for breeding.

Chairman: Rana, R. S. (India): I would like to ask Dr. Singh to summarize the presentations on conservation of genetic resources.

Singh, B. B. (IITA): There were 4 presentations covering different areas and aspects of conservation. Dr. Riley described the organization of networks for germplasm conservation and defined the role of IBPGR and national programs. Dr. Ishikawa described and reviewed various methods of *in vitro* cryopreservation based on dehydration and high lighted the vitrification method. Dr. Valkoun described attempts at *in situ* conservation which is a new concept. He indicated that further studies should be carried out on the selection of areas and species as this method may not be applicable to all species and areas. Dr. Muñoz reported on *in vitro* conservation of vegetatively propagated crops which is applied by national programs. The major advantage is that it is possible to obtain virus-free plants which can be transferred from regions to regions. He presented a method of detection of virus infection based on the presence of double-stranded RNA.

Watanabe, I. (Japan): Seed multiplication is a form of conservation of genetic resources. When I was a soybean breeder I spent time multiplying seeds. During this procedure we often observed the presence of duplicated materials which we hesitated to discard. As the number of germplasm samples is increasing it would be desirable to develop a method enabling to differentiate apparently similar accessions in order to discard them.

Chairman: Rana, R. S. (India): This is a problem that all of those concerned with the maintenance, multiplication and distribution of genetic resources are facing.

Iwanaga, M. (IBPGR): Rationalization of germplasm collections is extremely important as it is well known that duplicated accessions are often present in collections. As a result, the efficiency of gene bank management is reduced. The decision to discard accessions is a matter of management for the curator of a gene bank. A scientific basis is required to solve the problem. Fingerprinting by the use of molecular markers could become a useful tool for the identification of possible duplicates, as this method is not influenced by the environmental conditions. At CIAT, I found that in the case of cassava accessions, the use of 20 molecular tracers and esterace isozymes enabled to

reach a probability of error of 0.01%.

Takagi, H. (Japan): Although I am using RFLP as marker for varietal identification of sweet potato, I consider that this is only one of many techniques. It would be desirable if a consensus could be reached among the researchers working on a particular crop. In this regard, I wonder if the IBPGR could not act as a catalyst to lead international working groups in that direction.

Valkoun, J. (ICARDA): The use of genetic resources databases may enable to identify obvious duplicates.

Iwanaga, M. (IBPGR): When we conducted comparative studies on "common accessions" of seed-propagated crops, namely self-pollinated common bean from CIAT gene bank and USDA gene bank, we observed a greater variability in the CIAT materials, suggesting the presence of erosion due to problems of management associated with the large number of germplasm requests at CIAT.

Singh, B. B. (IITA): Duplications from the germplasm collections may be eliminated as and when better DNA fingerprinting techniques are developed. However, it may not be desirable to discard the duplicates. For use by the breeders, a representative sample of germplasm may be selected by Genetic Diversity Analysis and by taking lines from each group. This could reduce the number of lines to be screened by breeders. In case the breeder does not get the desirable trait from the first sample, he should be given another sample of different lines by reproducing the same diversity groups.

Chairman: Rana, R. S. (India): We usually hesitate to discard duplicated accessions. Various approaches can be recommended, namely, passport data, collector's data, call collectors to identify duplicates. We organize annual workshops of users who may accept duplicates. It is desirable to notify the collector prior to deciding to discard materials. I would now like to ask Dr. Riley to summarize the presentations on data management.

Riley, K. W. (IBPGR): Two papers were presented during that session. Dr. Umehara described the activities of NIAR Gene Bank which is a highly sophisticated gene bank dealing with passport and evaluation data as well as stock control systems. He indicated that this system could be used in other gene banks with some modifications, however. Dr. Kitamura referred to the DNA Information and Stock Center in Japan (DISC) which will start its operation on October 1, 1993. He mentioned that DISC will prepare mapping data bases of agriculturally important organisms in addition to distributing DNA clones such as cDNA or RFLP markers. He described similar systems developed worldwide such as the Human Genome Project, Arabidopsis Genome Project, Plant Genome Data and Information Center at USDA, etc., which are involved in the sequencing of DNA and more conventional methods of conservation of genetic resources. It appears that these information systems involving the use of computers and user-friendly software could be applied to solve some of the problems relating to genetic resources management including the handling of duplicates and other areas.

Hamamura, K. (Japan): In the present concept of genetic resources conservation, materials stored are regularly checked for their viability and non-viable materials may be discarded. However with the advances in the field of biotechnology, DNA can be recovered from dead tissues. I suppose that some research field like "relics conservation it may become necessary. The conditions of conservation may become easier and only the information attached to the materials may become important.

Nakagahra, M. (Japan): I would like to inform the participants that MAFF has set up a new fund for the organization of a meeting on the management of genetic resources each year. The first meeting will be held in March 1994 at the National Institute of Agrobiological Resources (NIAR). The main theme will cover the conservation and utilization of tuber crop germplasm. Experts from Japan and foreign countries will be invited to participate in the meeting.

Chairman: Rana, R. S. (India): I would like to briefly conclude the symposium. The theme of the symposium was particularly timely and appropriate considering the need to conserve the vast pool of plant genetic resources for further promoting their utilization for human welfare. I would like to emphasize the need for harmonizing the apparent contradiction between the concept of the Convention stating that nations exert sovereign rights over their own biological resources and the previous consensus reached by many organizations, including FAO that genetic resources are "common heritage of human kind". It is important to reach a consensus to promote the utilization of genetic re-

sources for a common cause, namely for fighting hunger. Also, in relation to the Convention, it is essential to consider activities for the collection and conservation of genetic resources worldwide undertaken by international organizations in collaboration with the national programs.

Although farmers' rights on landraces are broadly recognized, mechanisms of implementation must be developed. It is important that plant genetic resources are safely conserved, studied and utilized to sustain advances in crop productivity and to stabilize agricultural production. The need to carry out basic studies was also highlighted during the symposium. Japan with its strong research basis and scientific capability should play a major role in the activities related to the management of plant genetic resources in the tropics, in particular I appreciate the efforts of the Japanese Government in assisting several national programs in the preservation of genetic resources. Finally, I would like to emphasize the need for utilizing the materials collected among the nations and to return the seeds to the farmers, as almost 95% of the genotypes belong to landraces.