

# Impact of International Centers on Plant Breeding Training

Gurdev S. Khush<sup>1</sup>

University of California, Davis, CA 95616

International agricultural research centers (IARCs) sponsored by the Consultative Group on International Agricultural Research (CGIAR) have been in the forefront of training plant breeders. Out of 15 IARCs, 9 have major responsibility for crop improvement. All of these centers are located in the developing countries with a mandate for improvement of specific crops (Table 1).

Remaining centers are the International Plant Genetic Resource Institute, Rome, Italy (IPGRI), the International Center for Living Aquatic Resources Management, Penang, Malaysia (ICLARM), the International Food Policy Research Institute, Washington, D.C. (IFPRI), the International Water Management Institute, Kandy, Sri Lanka (IWMI), the International Livestock Research Institute, Nairobi, Kenya (ILRI) and the Center for International Forestry Research, Bogor, Indonesia (CIFOR).

CGIAR centers are nonprofit, apolitical, international organizations for science based agricultural development. The centers are autonomous entities supported by more than 50 governments, foundations and development banks. CGIAR's goal is to develop increased public goods for food security, livelihood resilience, poverty reduction, and sustainable management of production systems. One of the important thrusts is human resource capacity building and knowledge dissemination. This is achieved through following training activities:

- Higher degree training (MSc and PhD level) especially scientists from the national agricultural research and extension systems (NARES) who are exposed to international standards of agricultural research so that they can step into research positions in their countries.
- Train NARES scientists in both public and private sector in specific scientific and communication skills for field and laboratory applications and present their findings in appropriate fora.
- Expose farmers, nongovernmental organization (NGO), and civil society organization (CSO) partners to practical skills through farmer field days.
- Disseminate customized knowledge for primary users and to farming communities using information and communication technologies.

## PLANT BREEDING TRAINING IN CGIAR CENTERS

Crop based CGIAR centers have placed major emphasis on training plant breeders from the inception of their programs. The following types of training programs have been implemented (Table 2).

<sup>1</sup>Retired from the International Rice Research Institute, Los Baños, Philippines, and adjunct professor.

*Long-term in-service training.* Field technicians and researchers from developing countries were trained for at least 6 months (one full crop season). In a few cases this was preceded by 2 to 3 months of intensive English-learning programs to enable trainees from non-English speaking countries—especially from Francophone countries—to enhance skills in comprehension, speaking, reading, and writing. The research itself would start from planning of field experiments, field preparation, field layout, sowing, and managing the trials throughout the crop season. During the crop season, trainees were taught how to record observations and data on various traits and also manage weeds, pests, and diseases. Lectures on agronomy, soils, physiology, pathology, and entomology were given to enhance the basic knowledge and understanding. Lectures on genetics and plant breeding, hands-on practice on choosing parents for hybridization, raising F<sub>1</sub> hybrids and evaluation of segregating populations, and yield evaluation of elite lines formed integral part of the program. Participants were also taught statistics and experimental designs. They learnt recording postharvest data, tabulation, and statistical analysis of trial data. Each participant was asked to prepare a report of the research conducted and present the results to the group. Overall, the participants were given training needed to make them practical plant breeders. This type of training was more emphasized during 1960s, 1970s, and 1980s when there was paucity of trained plant breeders in developing countries.

*Short-term in-service training.* This program is similar to the above except the participants come for training in specific aspects of plant breeding, such as techniques of hybridization or hybrid seed production or to learn specific skills such as techniques of grain quality analysis. This type of training lasts for 4 to 12 weeks and the trainees work with scientists in respective areas of specialization. There is no rule on the number of trainees, and

numbers may vary from one to a few. These types of programs are still active.

*Training courses.* The centers organize training courses on specific topics depending on the demand from NARES partners. Variable number of participants is selected for each course. The courses run for a fixed duration. Center scientists serve as resource speakers. Trainees are provided with lecture handouts and are asked to do laboratory, greenhouse and field work. Some of the courses components are similar to in-service long-term training. Some of the courses offered at IRRI are listed in Table 3. As an example a genetic evaluation and utilization course (GEU) was taught at IRRI during 1975–87. In total, 439 plant breeders were trained in techniques of crop improvement.

*Degree training.* All the IARCs have had training programs leading to master's or doctorate degrees. Since centers are not degree awarding institutions these programs are implemented in cooperation with universities either in the IARC host country or universities in the countries of candidates. The candidates register for the degree program and take course work at the university and conduct thesis research under the supervision of one of the center scientists. The degree is awarded by the university. For example degree candidates register and take course work at the nearby University of the Philippines and conduct thesis research under the supervision of an IRRI scientist. The degree is awarded by the University of the Philippines. IRRI scientists have been appointed as affiliate faculty members of the University of the Philippines and can serve as members of student advisory committee. Students may also register in a university in their own country and come to IRRI for thesis research after completing the course work. A degree is awarded by the university. In such cases, a memorandum of understanding is prepared to implement the joint degree program between the center and the university. Many scientists

Table 1. International agricultural research centers (IARCs) sponsored by the Consultive Group on International Agricultural Research (CGIAR) that have a mandate for crop improvement; CIAT = Centro Internacional de Agricultura Tropical, CIP = Centro Internacional de la Papa, CIMMYT = Centro Internacional de Mejosamiento de Maize y Trigo, ICARDA = International Center for Agricultural Research in Dry Areas, ICRAF = International Center for Research in Agroforestry, ICRISAT = International Crops Research Institute for Semiarid Tropics, IITA = International Institute for Tropical Agriculture, IRRI = International Rice Research Institute, WARDA = West African Rice Development Association.

Center	Location	Mandate crops
CIAT	Cali, Columbia	Global: beans, <i>Cassava</i> , pastures Regional: rice (for Latin America)
CIP	Lima, Peru	Global: potatoes and sweetpotatoes
CIMMYT	El Batan, Mexico	Global: wheat and corn
ICARDA	Aleppo, Syria	Global: lentil, barley, faba beans Regional: chickpea, forage legumes, wheat
ICRAF	Nairobi, Kenya	Regional: agroforestry
ICRISAT	Patancheru, India	<i>Sorghum</i> , <i>Pennisetum</i> , peanuts, chickpea, pigeonpea
IITA	Ibadan, Nigeria	Global: cowpea, cassava, soybean, yam Regional: maize
IRRI	Los Baños, Philippines	Global: rice
WARDA	Monrovia, Liberia	Regional: rice (for western Africa)

Table 2. Types of training programs in plant breeding in Consultive Group on International Agricultural Research (CGIAR) centers.

In service training: long-term
In service training: short term
Training courses on specific topics
MSc and PhD degree training
Postdoctoral training
Apprentices

from developing countries have been trained at the degree level by all the IARCs and many of them hold senior positions in the agricultural research organizations and universities in their respective countries. Several serve as staff members of IARCs.

*Postdoctoral training.* Young PhDs from developing countries and a few from developed countries are awarded postdoctoral fellowships and work with center scientists for 2 to 3 years. This enhances their scientific horizon and they contribute to center research programs. Sometimes midlevel scientists come to centers for short-term (6 months) or long-term (1 to 2 years) assignments and are classified as international fellows or visiting scientists.

*Apprentices.* Students from developed and developing countries often visit ICRISAT for short periods, mostly during the summer, to conduct short-term projects including data analysis, report writing, and technical training. The goal is to give the students experience in international centers.

### PRESENT STATUS OF PLANT BREEDING TRAINING IN IARCS

About 60 to 70 international plant breeders work in IARCs and have the responsibility for training plant breeders. Thousands of plant breeders have been trained at IARCs. The exact number of those trained at ICRISAT, for example, is given in Table 4.

Throughout 1960s to 1980s funds for training came from the core budget of centers. However, from the 1990s onward, core support for centers has declined and more and more center research is funded through bilateral projects. Trainees are primarily supported from bilateral grant funds. These projects generally have a training component. Thus, postdoctoral and degree candidates are supported from such funds. This has resulted in an increase of degree and postdoctoral training (Table 5) and reduction in in-service training.

In contrast to core support for training during 1970s and 1980s most of the support for training now comes from bilateral donors (Table 6).

### FUTURE OF PLANT BREEDING TRAINING IN IARCS

As mentioned above, the support for IARCs

has declined over the years, and the number of plant breeders on center staff has also declined. This has resulted in reduced capacity for training. As a result of shift in nature of funding, postdoctoral and degree students are now being trained in molecular and cellular techniques and little or no exposure to field oriented training. This trend needs to be reversed. Only way to do so would be to restore

core support for training in CGIAR centers. The future plant breeders must be trained in conventional methods of crop improvement as well as modern techniques of molecular marker applications in plant breeding. They should also be cognizant of potentials of genetic engineering applications and aware of societal perceptions about the food products produced from genetically modified organisms.

Table 3. Examples of training courses offered at the International Rice Research Institute (IRRI).

Course	Years offered	Participants trained (no.)
Genetic Evaluation and Utilization	1975–87	439
Genetic Resource Conservation and Management	1985, 1988, 1989	28
Database Management for Genetic Resources	1988	9
G × E Interaction	1995, 1997, 2000, 2001	28
AFLP Analysis for Rice Improvement	1996	4
Hybrid Rice Breeding	1996–99	35
Hybrid Rice Seed Production	1991–98	95
International Rice Information System	2002	17
Molecular Markers in Rice Breeding	2001	14
Plant Breeding	2002, 2005	38
Advances in Marker Assisted Breeding	2005	18

Table 4. Number of crop improvement training program participants at International Crops Research Institute for Semiarid Tropics (ICRISAT) during 1974–2004.

Category	Participants (no.)		
	Female	Male	Total
In-service (long-term)	106	869	975
In-service (Short-term)	45	227	272
Research fellows	118	552	670
MSc and PhD scholars	69	134	203
Postdoctoral fellows	11	49	60
Apprentices	89	76	165
Total	438	1907	2345

Table 5. PhD students and postdoctoral scientists at four Consultive Group on International Agricultural Research (CGIAR) centers during 2005; IRRI = International Rice Research Institute, CIMMYT = Centro Internacional de Mejoramiento de Maize y Trigo, ICARDA = International Center for Agricultural Research in Dry Areas, ICRISAT = International Crops Research Institute for Semiarid Tropics.

Degree	IRRI	CIMMYT	ICARDA	ICRISAT
MSc	8	9	6	4
PhD	20	16	5	36
Postdoctoral	6	9	3	5

Table 6. Some of the bilateral donors for plant breeding training in Consultive Group on International Agricultural Research (CGIAR) centers.

Initials	Bilateral donors
ACIAR	Australian Center for International Agricultural Research
ADB	Asian Development Bank
AUSAID	Australian Agency for International Development
BMZ	German Federal Ministry for Economic Cooperation and Development
CIDA	Canadian International Development Agency
DFID	Department for International Development, UK
FAO	Food and Agricultural Organization of United Nations
IAEA	International Atomic Energy Agency
IFAD	International Fund for Agricultural Development
JICA	Japan International Center for Agriculture
RF	Rockefeller Foundation
SDC	Swiss Agency for Development and Cooperation
SIDA	Swedish International Development cooperation Agency
USAID	United States Agency for International Development
WB	World Bank