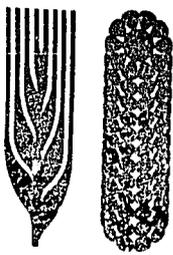


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1985 Annual Report

International Maize and Wheat Improvement Center

CIMMYT

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Trustees for 1985

Eduardo Pesqueira Olea
President, CIMMYT Assembly
Secretary of Agriculture and
Water Resources
Mexico

Virgilio Barco
Chairman, Board of Trustees
Consultant
Colombia

Ramón Claverán Alonso¹
Vice-Chairman, Board of Trustees
Director General, National Institute
of Agricultural Research
Mexico

Doris Howes Calloway
Provost, University of
California, Berkeley
USA

Walter P. Falcon
Director, Food Research Institute
Stanford University
USA

Robert D. Havener²
Director General, CIMMYT
Mexico

Phaitoun Ingkasuwat
Professor, Kasetsart University
Thailand

H.K. Jain
Senior Research Fellow
International Service for National
Agricultural Research,
The Netherlands

W.A.C. Mathieson
Consultant
United Kingdom

James R. McWilliam
Director, Australian Center for
International Agricultural Research
Australia

Joseph Menyonga
International Coordinator
Organization of African Unity
Semi-Arid Food Grain Research
and Development (SAFGRAD)
Burkina Faso

Jesús Moncada de la Fuente³
Chief Executive
National Institute of Forestry,
Agriculture and Livestock Research
Mexico

Stachys N. Muturi
Director of Agriculture
Ministry of Agriculture
Kenya

Lucio G. Reca
Secretary of Agriculture and Livestock
Argentina

Omond M. Solandt
Consultant
Canada

Guy Vallaeys
Advisor to the Director General
Centre de Coopération Internationale
en Recherche Agronomique pour le
Développement (CIRAD)
France

Donald L. Winkelmann⁴
Director General, CIMMYT
Mexico

Tomio Yoshida
Professor of Soil Science
University of Tsukuba
Japan

Zhuang Qiaosheng
Institute of Crop Breeding and
Cultivation
Chinese Academy of Agricultural
Sciences
People's Republic of China

¹ Ex-officio position. Resigned August, 1985

² Ex-officio position. Resigned January, 1985

³ Ex-officio position. Effective August, 1985

⁴ Ex-officio position. Effective September, 1985

Principal Staff for 1985

Office of the Director General

Donald L. Winkelmann, USA,
Director General¹
Robert D. Havener, USA,
Director General**
Robert D. Osler, USA,
Deputy Director General and
Treasurer²
W. Clive James, Canada,
Deputy Director General—Research
Gregorio Martinez V., Mexico,
Government and Public Affairs Officer
Norman E. Borlaug, USA,
Consultant

General Administration

Richard L. Clifford, USA,
Financial Officer
Homer M. Hepworth, USA,
Training Coordinator
José Ramírez S., Mexico,
Administrative Officer
Hugo Alvarez V., Mexico,
Purchasing Officer
Javier Eissa O., Mexico,
Administrative Computer Specialist
Susana Eng, Mexico,
Supervisor of Accounting Services
José Luis Fonseca, Mexico,
Head, Government Documents
Carlos García P., Mexico,
Head, Food and Housing
Yolanda Guerrero L., Mexico,
Assistant Supervisor of Personnel
Services
Gilberto Lugo A., Mexico,
Head, Building Maintenance

Maize Program

Ronald P. Cantrell, USA,
Director
R.L. Paliwal, India,
Associate Director
James B. Barnett, USA,
Training Officer
Magni S. Bjarnason, Iceland,
Breeder, Quality Protein Maize
James A. Deutsch, USA,
Breeder, Advanced Unit
Gregory Edmeades, New Zealand,
Physiologist
David C. Jewell, Australia,
Wide Crosses
James E. Lothrop, USA,
Breeder, Highland Maize
John A. Mihm, USA,
Entomologist
Hiep Ngoc Pham, USA,
International Testing
Bobby L. Renfro, USA,
Pathologist
Suketoshi Taba, Japan,
Germplasm Bank

Surinder K. Vasal, India,
Breeder, Hybrid Program
Alejandro D. Violic, Chile,
Training Officer
Stephen R. Waddington, UK,
Training Officer

Visiting Research Fellows

Vernon Gracen, USA,
Insect Resistance*
H. Garrison Wilkes, USA,
Germplasm Bank*
Bryan Wescott, UK,
Biometrician*

Associate Scientists

Dana L. Eaton, USA*
Tajul Islam, Bangladesh

Pre- and Postdoctoral Fellows

Narceo B. Bajet, Philippines*
David L. Beck, USA*
Dirk L. Benson, USA
José Luis F. Crossa, Uruguay
A. Michael Foster, UK
Jens Hock, Fed. Rep. of Germany*
H. Renee Lafitte, USA*
Susanne Welz, Fed. Rep. of
Germany**

Andean Region

Gonzalo Granados R., Mexico
(based in Colombia)
Shivaji Pandey, India
(based in Colombia)

Asian Region

Carlos de León G., Mexico
(based in Thailand)
Richard N. Wedderburn, Barbados
(based in Thailand)

Mexico, Central America and Caribbean Region

Momcilo Babic, Yugoslavia**
(based in Mexico)
Hugo Cordova, El Salvador
(based in Mexico)
Federico Kocher, Switzerland
(based in Mexico)
Alejandro Ortega C., Mexico
(based in Mexico)
Willy L. Villena D., Bolivia
(based in Mexico)

East African Region

Bantayehu Gelaw, Ethiopia
(based in Kenya)
A.F.E. Palmer, UK
(based in Kenya)
Joel K. Ransom, USA
(based in Kenya)

North Africa/Mideast Region

Wayne L. Haag, USA
(based in Turkey)

CIMMYT/IITA African Maize Program

Yoel Efron, USA
(based in Nigeria)
Ching-Yan Tang, Hong Kong*
(based in Nigeria)
Richard W. Ward, USA*
(based in Zimbabwe)

Ghana

Francisco R. Arias M., El Salvador*
Michael D. Read, USA
Michael Pratt, Canada**

Pakistan

E. John Stevens, New Zealand*

Wheat Program

Byrd C. Curtis, USA,
Director
Arthur R. Klatt, USA,
Associate Director
Maximino Alcalá S., Mexico,
Head, International Nurseries
Arnoldo Amaya C., Mexico,
Head, Wheat Industrial Quality
Laboratory
Girma Bekele, Ethiopia,
Pathologist
Pedro Brajcich G., Mexico,
Head, Durum Wheat Program
Peter A. Burnett, New Zealand,
Pathologist
Gerbrand Kingma, The Netherlands,
Head, Wheat Training
Edwin B. Knapp, USA,
Training Officer
A. Mujeeb Kazi, USA,
Head, Wide Crosses Program
Vjolfgang H. Pfeiffer, Fed. Rep. of
Germany, Bread Wheat Breeder
J. Michael Prescott, USA,
Head, Seed Health
Sanjaya Rajaram, India,
Head, Bread Wheat Program
Ricardo Rodríguez R., Mexico,
Head, Special Germplasm
Development
Eugene E. Saari, USA,
Pathologist
Kenneth D. Sayre, USA,
Agronomist*
H. Ayla Sencer, Turkey,
Head, Wheat Germplasm Bank
George Varughese, India,
Head, Triticale Program
Reynaldo L. Villareal, Philippines,
Training Officer

Associate Scientists

L.T. van Beuningen, The Netherlands
(based in Chile, Southern Cone
Region)

Neal A. Bredin, Canada
Daniel Danial, The Netherlands
(based in Kenya, East African
Region)

Lucy Gilchrist S., Chile*
Mahmood O. Osmanzai, Afghanistan
Ravi P. Singh, India
Marco Van den Berg, The Netherlands
Elizabeth J. Warham, UK
Masao Yoshida, Japan

Pre- and Postdoctoral Fellows

Osman S. Abdalla, Sudan
Thomas C. Barker, USA*
John Bowman, USA**
Walter de Milliano, The Netherlands**
Javier Peña B., Mexico
Tony B. Ramey, USA*
Robert Raab, USA
Lesley A. Sitch, UK*
John Stapleton, Ireland*

Andean Region of South America

Paul N. Fox, Australia
(based in Ecuador)
Patrick C. Wall, Ireland
(based in Ecuador)

Southern Cone Region of South America

Man Mohan Kohli, India
(based in Chile)
Matthew A. McMahon, Ireland
(based in Chile)

North and West African and Iberian Peninsula Region

Santiago Fuentes F., Mexico
(based in Portugal)

East African Region

Douglas G. Tanner, Canada
(based in Kenya)
Enrique Torres, Colombia
(based in Kenya)

ICARDA Region

Guillermo Ortiz Ferrara, Mexico
(based in Syria)
M. Miloudi Nachit, Fed. Rep. of
Germany
(based in Syria)

South Asia

H. Jesse Dubin, USA
(based in Nepal)

Southeast Asia

Christoph E. Mann, Fed. Rep. of
Germany (based in Thailand)

David A. Saunders, Australia
(based in Thailand)

Bangladesh

Larry D. Butler, USA
Mengu Mehmet Guler, Turkey

Pakistan

Peter R. Hobbs, UK

Peru

Gregorio Vázquez G., Mexico

Turkey

Hans-Joachim Braun, Fed. Rep. of
Germany
Bent Skovmand, Denmark

Economics Program

Robert B. Tripp, USA,
Training Officer³
James L. Longmire, Australia,
Economist

Associate Scientists

Gustavo E. Sain, Argentina
(based in Mexico)

Postdoctoral Fellows

Paul W. Heisey, USA*
(based in Pakistan)
Rigoberto Stewart, Costa Rica

Mexico, Central American and Caribbean Region

Alberic C. Hibon, France
(based in Mexico)
Juan Carlos Martínez S., Argentina
(based in Mexico)
Michael Yates, USA
(based in Haiti)

Asian Region

Derek R. Byerlee, Australia
(based in Pakistan)
Larry Harrington, USA
(based in Thailand)

Eastern and Southern African Region

Ponniah Anandajayasekaram, Sri
Lanka (based in Kenya)
Michael P. Collinson, UK
(based in Kenya)
Allan R.C. Low, UK
(based in Swaziland)

Laboratories

Evangelina Villegas M., Mexico,
Head, General Laboratories
Enrique I. Ortega M., Mexico,
Associate Scientist
Reynald Bauer Z., Fed. Rep. of
Germany, Laboratory Supervisor

Experiment Stations

John A. Stewart, UK,
Head of Stations and Executive
Officer
Armando S. Tasistro S., Uruguay,
Assistant Head
Hannibal A. Muhtar, Lebanon,
Training Officer
Roberto Varela S., Mexico,
(on study leave)
Ricardo Marques L., Mexico,
Field Superintendent, El Batan Station
Reyes Vega R., Mexico,
Wheat Field Superintendent, CIANO
Station
José A. Miranda, Mexico,
Field Superintendent, Toluca Station
Jorge Sarquis R., Mexico,
Field Superintendent, Tlaltizapan
Station
Daniel Villa H., Mexico,
Workshop Head

Data Processing Services

Carlos A. Gonzalez P., Uruguay,
Head, Data Processing
Russel Cormier, Canada,
Computer Specialist
Julio Cesar Ovalle, Mexico,
Operations Supervisor
Jesús Vargas G., Mexico,
Systems Manager

Information Services

Christopher R. Dowswell, USA,
Head, Information Services**
Tiffin D. Harris, USA,
Science Writer/Editor and Publications
Coordinator
Thomas Luba, USA,
Associate A/V Specialist—Training
Materials**
Victoria Lynch, USA,
Associate Editor—Training
Materials**
Nathan C. Russell, USA,
Science Writer/Editor*
Edith Hesse de Polanco, Austria,
Head, Scientific Information Unit
Linda G. Ainsworth, USA,
Head, Visitor Services

¹ Appointed Director General
September 1, 1985; former Director of
the CIMMYT Economics Program

² Acting Director General,
February 1-August 31, 1985

³ Acting Director of the Economics
Program beginning September 1, 1985

* Staff appointed during 1985

** Staff resigned during 1985

1985 Management Report

CIMMYT's year featured both change and a reaffirmation of long-standing goals and working relationships. Changes occurred in virtually all aspects and at all levels of the Center: in its facilities, its research agenda, and in its personnel. While in some cases these changes denote a reorientation of the Center's priorities and activities (see A Review of CIMMYT Programs), all reflect CIMMYT's continuing commitment to the changing needs of its primary clientele, the national agricultural research programs of the developing world.

A major personnel change occurred when, on September 1, CIMMYT's Board of Trustees appointed Donald L. Winkelmann (USA) as the Center's fourth Director General. Dr. Winkelmann replaces Robert D. Havener, who left CIMMYT as of

January 31, 1985, to assume leadership of Winrock International Institute for Agricultural Development. During the interim, Robert D. Osler, CIMMYT Deputy Director General and Treasurer, served effectively as the Center's Acting Director General, with the Board of Trustees and the entire CIMMYT staff most appreciative of his efforts.

Changes in the Board of Trustees

During 1985, three distinguished individuals joined the CIMMYT Board of Trustees:

Jesús Moncada de la Fuente (Mexico), Executive Director of Mexico's National Institute of Forestry, Agriculture and Livestock Research (INIFAP), replaced Ramón Claverán Alonso. Dr. Moncada has a long-established relationship with

CIMMYT, having worked from 1957 to 1959 in the Mexican Government/Rockefeller Foundation Office of Special Studies, a parent of CIMMYT and of Mexico's National Institute for Agricultural Research (INIA). He subsequently served INIA in a number of capacities, first as a researcher, then as Director of its Northeast Research Center (1965-77), and then as Deputy Director General for Program Operations (1977-81). In August of 1981, he became Director General of INIA and, in 1983, Coordinator of Integration of Agriculture, Livestock and Forestry Research, Secretary of Agriculture and Water Resources (SARH). He held this position just prior to becoming Chief Executive of INIFAP newly created by SARH to integrate research on agriculture, livestock, and forestry.

Joseph Menyonga (Burkina Faso), the International Coordinator of the Semi-Arid Food Grain Research and Development Program (SAFGRAD), Organization of African Unity. Prior to assuming his current position, Dr. Menyonga served as Administrative Secretary-General of the Association for Advancement of Agricultural Sciences in Africa (1981-83), and before that as Chief of the Agricultural Research Centre at Ekona, Cameroon (1976-80). He rose to the latter position after serving as Director of the Institute of Perennial Crops, Ekona (1974-76), and Director of the National Agricultural Research Centre, Ekona (1972-74).

Donald L. Winkelmann (USA) became a member of the Board on September 1, 1985, with his appointment as CIMMYT's Director General. Dr. Winkelmann began his professional career in research and teaching at Iowa State University (ISU) in 1962. From 1966 to 1971 he led an ISU team helping to develop graduate work in economics at Mexico's National School of Agriculture at Chapingo. In 1971, Dr. Winkelmann joined CIMMYT as the leader of its Economics Program, and



Donald L. Winkelmann, Director General of CIMMYT

became a member of the Center's Directing Staff in 1978. Under his leadership, and in close cooperation with national programs, the staff of the Economics Program developed key concepts and procedures to guide interdisciplinary research teams engaged in on-farm research. These procedures have been widely adopted by national agricultural research programs and are making significant contributions to the organization of production-oriented research in the developing world.

Financial Summary

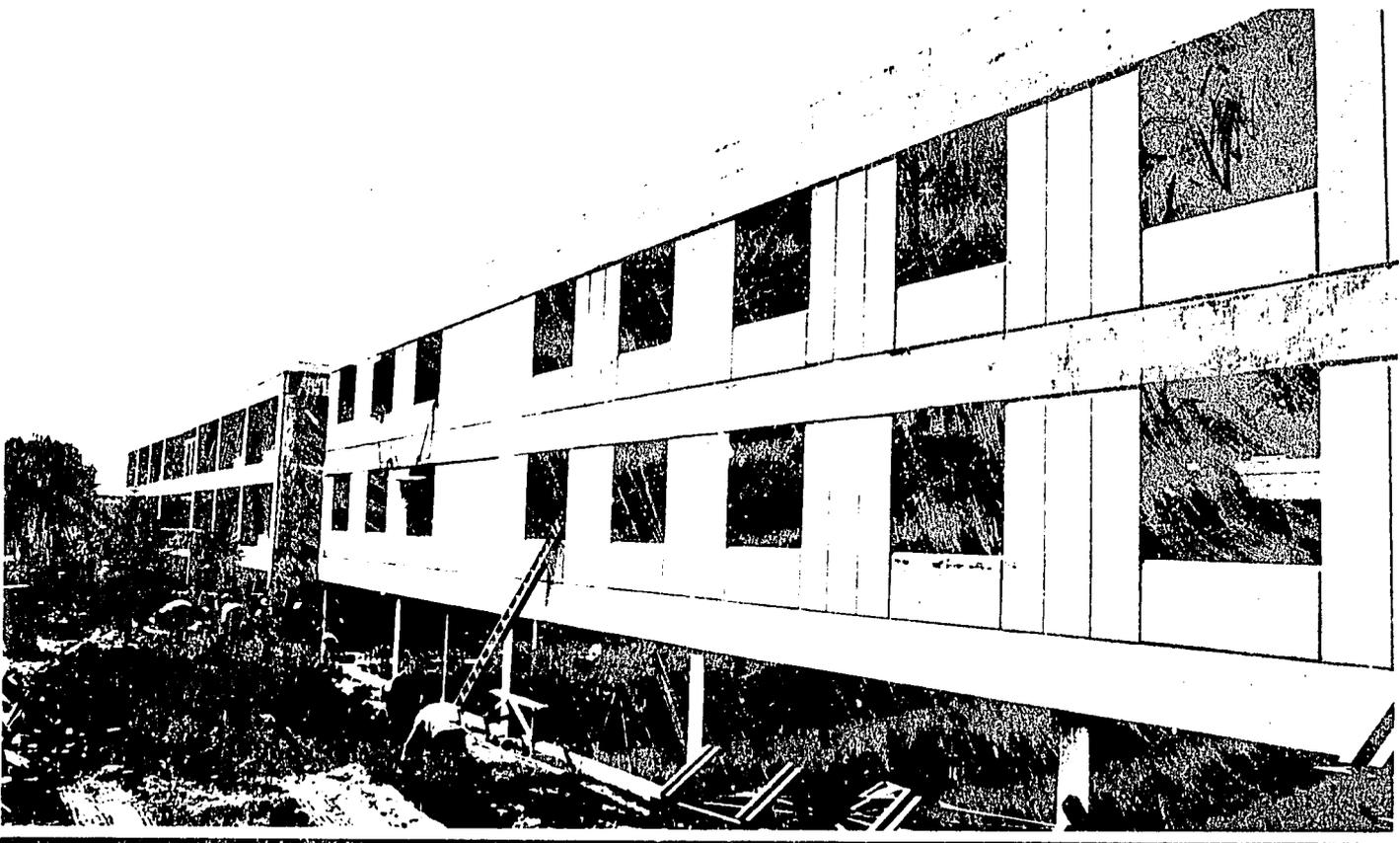
CIMMYT's financial performance during the year was once again satisfactory. Total revenues increased considerably for the second consecutive year, with the bulk of the increase again coming from extra-core (non-CGIAR) donations. Funds from CGIAR donors increased

slightly and, in a reversal of a recent trend, unrestricted donations increased significantly. Though no new CGIAR donors contributed to CIMMYT's programs, a number of them were able to increase their contributions significantly over their 1984 levels. This increase, combined with a weakening of the dollar late in the year (which affected some donations made in other currencies), contributed to the rise in unrestricted contributions.

In recent years, the distribution of funds among core restricted, core unrestricted, and extra-core has shifted, reflecting the increase in extra-core contributions. In 1985, close to 25% of CIMMYT's activities were sponsored by extra-core donors. This is an increase over previous years and is partly due to the capital construction program (the training, conference and information center) sponsored by the

Japanese Shipbuilding Industry Program and the government of Japan. It also is the result of a number of programs that were initiated last year coming fully on line in 1985. These extra-core programs supplement the core research and training programs in important ways: by increasing the knowledge base about specific environments, by providing closer links to national programs, and by increasing opportunities for training. Their financial effect is to provide leverage to the funds invested in the core research and training programs.

CIMMYT's externally audited financial statement is presented later in this report, showing the institution's financial condition at year end and the effects of financial flows during the year. A number of indicators demonstrate CIMMYT's financial vitality, and our continuing efforts to



CIMMYT's new training, conference, and information center

meet program goals and objectives. Cash on hand and short-term investments, for example, at the end of 1985 were significantly higher than at the end of 1984, offering a measure of financial stability for 1986. Total assets increased by over 20%, manifested by an improved cash position and additions to capital stock.

Program expenditures also increased. Those on research were up by 9%, with the largest increase coming in the maize program, where expenditures on headquarters research, regional programs and institutional support were all higher. In particular, efforts in maize germplasm conservation and development—reported last year as an area receiving greater resources—were increased with the addition of new staff and the utilization of the newly remodeled germplasm bank.

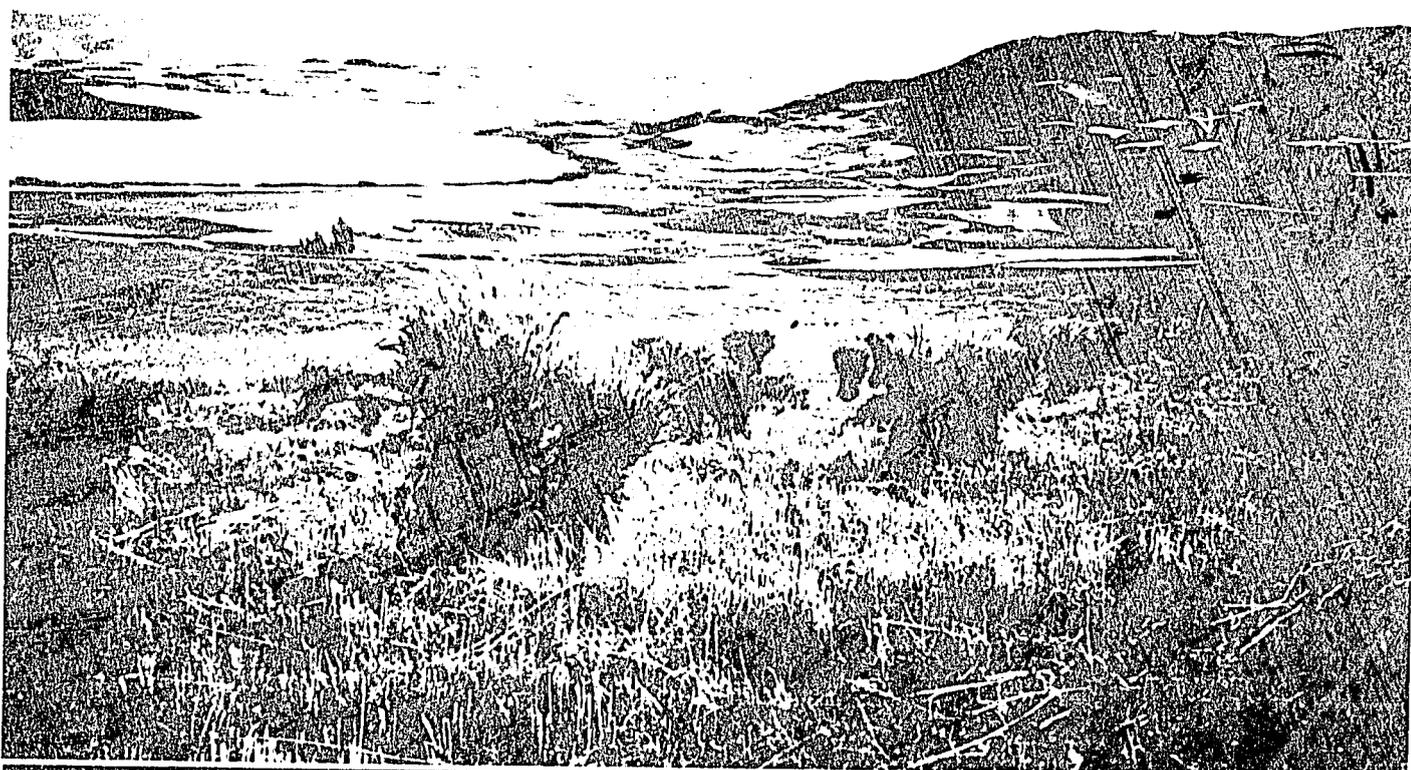
Conference and training activities increased by 5% over their 1984 level. With the completion of the training, conference and information center (in the fall of 1986), CIMMYT will be well positioned to increase the range of training opportunities, contributing to the base of human capital in national crop research programs.

Finally, inflation and exchange rates continued to play an important role in CIMMYT's management. In Mexico, the peso devalued during the year while annual inflation was above 60%. As in past years, CIMMYT has registered foreign currency translation losses on peso-denominated assets and this has been treated in the financial records in accordance with accepted accounting practices. The US dollar weakened towards the end of the year, giving rise to some optimism on this

front for 1986. Dealing with these external financial forces while seeking to maintain program effectiveness and continuity are important and essential management tasks; they promise to remain so in the foreseeable future.

Responding to Changing Needs

CIMMYT has a nearly unparalleled record of service and success in helping to improve Third World agriculture. Critical to understanding this success is our emphasis on "helping." Much of CIMMYT's success during the past 20 years has come through its close association with national agricultural research programs in the developing world. While the Center played an important role in helping to bring new germplasm and new techniques to farmers, local needs



As national crop research institutes increasingly seek to assist resource-poor farmers, CIMMYT is responding by devoting more of its research resources to addressing the challenges presented by marginal production environments.

were met by local institutions, by research and extension at the national level. It is appropriate to reaffirm here that CIMMYT remains committed to this fundamental working relationship, recognizing that, as in the past, future success in agricultural development rests largely on the continuing efforts of our national program colleagues.

For all the change in developing country agriculture, the process remains incomplete. There are millions of farmers who have yet to enjoy the benefits accruing from the efficient use of improved varieties and agronomic practices. The reasons for this lag are many and comprise the pressing agricultural development issues of our day. For its part, CIMMYT will address these issues in the context of improving the productivity of the resources committed to maize and wheat. In particular, we will continue striving for greater efficiency in the allocation of research resources, both within the Center and in our consultation with national research programs. CIMMYT also will continue to take a longer-term view of agricultural development issues, and will remain sensitive to the relevant research needs identified by donor countries and institutions.

Marginal production environments— During the last five years, CIMMYT's research agenda has given ever more weight to the challenges presented by the more marginal production environments: those areas characterized by such limiting factors as a high incidence of disease, drought, acid soils, or excessive heat or cold. Millions of resource-poor farmers work in these unforgiving environments, and national research programs increasingly seek to assist them in their efforts. In response, CIMMYT is now devoting more of its research resources to the development of germplasm and to understanding the production practices appropriate to these environments.



CIMMYT has long favored investments in developing the research capabilities of national program staff, and training remains an integral part of the Center's mission.

This is not to say that the more favored production environments of the Third World are being neglected in the research process. Quite to the contrary, CIMMYT is convinced of the need to maintain the gains already realized on these lands, that additional improvements in yield and output are both possible and, in the longer term, necessary. We therefore continue to devote a significant portion of our research resources to germplasm for these environments. Yet we believe that there are great opportunities for improving the productivity of resources deployed on marginal lands. Thus, the Center is seeking to build on the broad adaptation inherent in much of its germplasm, incorporating desirable traits into selected subsets of

experimental materials and, in this way, developing materials more useful to national programs.

New initiatives—In line with our desire to remain responsive to the changing needs of national research institutes, CIMMYT periodically evaluates its activities and, where appropriate, implements new programs. Two such initiatives serve to illustrate this point. In mid-1985, CIMMYT and the International Institute of Tropical Agriculture (IITA) joined forces with the University of Zimbabwe (Harare) to accelerate the development of improved maize germplasm for mid-altitude environments in eastern and southern Africa. Existing temperate and lowland materials are not well suited

for the roughly six million hectares in Africa that comprise these environments, and national programs in the region are seeking to develop improved germplasm to meet the needs of the millions of farmers who earn their living on these lands.

Along similar lines, there are millions of hectares in the developing world devoted to (or suitable for) the production of winter wheat, yet to date relatively little research has been targeted for these areas. In mid-1985, CIMMYT began working with Turkey, Oregon State University (USA), and several other USA universities in the southern Great Plains to develop an international cooperative winter wheat research program. A number of



CIMMYT shares the concern of others for preserving the genetic diversity of maize and wheat and, with financial assistance from the government of Japan and the International Board of Plant Genetic Resources (IBPGR, Rome), the Center has recently improved its germplasm bank facilities.

national programs in developing countries have expressed a desire to participate in the germplasm exchange and research aspects of this effort.

This sort of collaborative research leads to a strengthening of the all-important bonds between CIMMYT and national programs, and contributes to the growth and development of an international network of agricultural scientists addressing common problems. For these reasons, and of course for the products forthcoming from the research, CIMMYT places a high value on such cooperation.

Germplasm conservation—CIMMYT is aware of the concern over erosion of the germplasm base in maize and wheat, which can occur as improved varieties displace the heterogeneous traditional varieties. We share this concern for preserving the genetic diversity of our crops, and have responded by 1) improving our maize and wheat germplasm bank facilities, 2) accepting our role as a long-term custodian of maize germplasm, and 3) exploring with the International Board of Plant Genetics Resources (IBPGR, Rome) the specific role we should assume in the conservation of wheat germplasm, given the existence of other institutions around the world already dedicated to this objective. Moreover, we continue to strive for more effective ways to share with national programs the collections under our care.

Contributing to human research capital—As indicated earlier, CIMMYT owes much of its success to agricultural researchers and institutions in developing countries. We have long favored investments in developing the

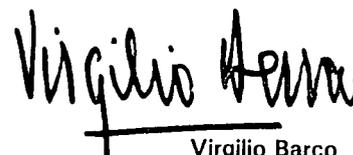
research capabilities of national program staff, and have pursued this objective in a number of ways: 1) by developing comprehensive, applied in-service training courses that address a range of pertinent topics, 2) through in-country training on a "special needs" basis, 3) with regional short courses focusing on training needs that transcend national boundaries, 4) through the efforts of our regional and bilateral program staff, who spend much of their time working side-by-side with colleagues in national programs, and 5) by sponsoring especially promising young scientists in their pursuit of advanced degrees.

CIMMYT remains convinced of the importance and efficacy of these efforts, and will continue to give them a high priority. We are anticipating the completion of a new training, conference and information center, which will greatly expand our headquarters training facilities and hence our ability to conduct in-service training. As well, we will be able to offer new opportunities to more experienced national program staff, such as to mid-career researchers who wish to refresh selected skills through research and writing. In a similar fashion, these improved facilities will enable us to host international scientific conferences in a more effective fashion and to enhance the delivery of essential information to in-service trainees and national program colleagues around the world.

A look to the future—CIMMYT's remarkable history is characterized by success born of individual effort and extensive international cooperation. The Center has grown and changed dramatically since its inception in 1966

and, as its twentieth anniversary approaches, CIMMYT remains a vital organization playing a key role in addressing development issues in the Third World.

Within these issues reside many challenges and opportunities, both for CIMMYT and for the national programs with which we collaborate. We will increasingly determine our response to these issues according to resource productivity criteria. We recognize that CIMMYT cannot hope to achieve success on all fronts simultaneously, and we therefore seek to establish our priorities well. And in the choice of priorities, we will work closely with national research programs to ensure that our research agenda reflects their changing needs, along with the perspectives of donors and of other agricultural research centers of excellence.


Virgilio Barco
Chairman, Board of Trustees


Donald L. Winkelmann
Director General

A Review of CIMMYT Programs

The Global Wheat and Maize Situation

Worldwide production of wheat stood at 522 million metric tons (MT) in 1985 (with 203 MT in developing countries), having grown remarkably (by 205 MT) since 1970. Roughly half of this additional wheat is produced in developing countries, and much of the other half is exported to the Third World, where wheat consumption has increased by about 70% during the last decade. Burgeoning populations, growing urbanization, and rising income levels are the key factors driving the rapid increase in wheat consumption in the developing world. Nearly one-third of the 50 MT of wheat imported in 1983-84 by developing countries went to those that traditionally produce wheat (primarily Middle Eastern and North African nations); but an increasing share—now about 20 MT or 40% of all developing countries wheat imports—went to tropical countries where wheat is not a traditional crop.

Maize, with a global harvest of 449 MT in 1984, ranked second to wheat (with hulled rice third) among the world's cereal crops. Worldwide, about 66% of all maize is used for feeding livestock, 25% for human consumption, and 9% for industrial purposes and as seed. In 1984, developing countries produced 170 million tons of maize, with roughly 50% destined for human consumption, 43% for livestock feed, and the remainder for industrial and seed purposes. Maize is a particularly

important crop for food in sub-Saharan Africa, Mexico, Central America and the Caribbean, and in the Andean countries. In recent years, the demand for maize as a feed grain has grown rapidly in the Third World, especially in the newly industrialized and oil-exporting middle-income countries. A considerable portion of this new demand has been met through maize imports (approximately 20 MT in 1980-82), which have increased six-fold in the Third World since the early 1970s.

CIMMYT Products and Services

Recent trends in global wheat and maize consumption, production, and trade reinforce the demand for CIMMYT's five main products and services:

- Improved germplasm adapted to the major production environments of the developing world, especially the less-favored environments;
- Cost-effective procedures for research on crop improvement and crop management;
- Trained developing country agricultural scientists;
- Consultation with national maize and wheat research programs;
- Scientific information about maize, wheat, and triticale.

These products and services are developed and delivered by way of a complex and interrelated mosaic of research, training, and information activities taking place in Mexico and in collaboration with more than 100 national programs around the world.

What follows constitutes a brief profile of CIMMYT's organization and its activities. More in-depth reporting of the Center's research can be found in

the *CIMMYT Research Highlights* series and in the more than 125 technical reports and information bulletins published during the last five years.

The Center's Organization

CIMMYT has three major programs: Maize, Wheat, and Economics. These programs are responsible for their own research and training agendas, both in Mexico and in their regional and bilateral (national) programs in Africa, Asia, the Middle East, and Latin America. The crop and economics programs receive assistance from several research support units and from general administrative and information services staff.

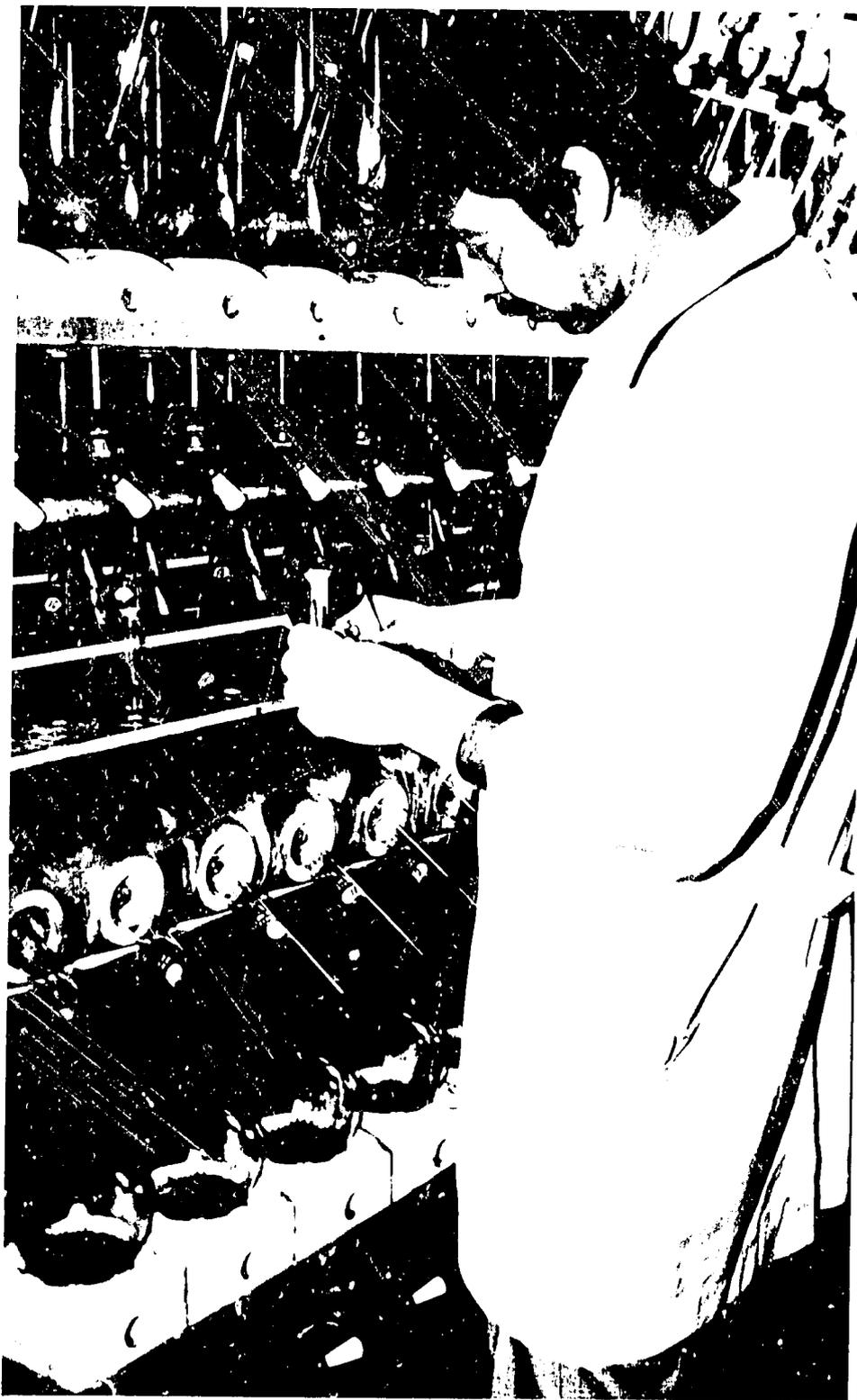
Laboratories—Laboratory staff support crop program research by undertaking protein quantity and quality, oil content, and other evaluations (mainly of maize), milling and baking evaluations (mainly of small grains), and soil and plant tissue analyses. Another important laboratory activity is the screening of seedlings for tolerance to aluminum toxicity. In addition, a seed health unit provides pathology support to both the Wheat and Maize Programs and manages CIMMYT's pathology-related greenhouse and laboratory operations.

Experiment stations—The staff of this support unit is responsible for managing the land, equipment operations, and field labor used by the crop research programs at five principal research stations in Mexico. Four of these stations—El Batán, Poza Rica, Tlaltizapan, and Toluca—are managed directly by CIMMYT. The fifth station, CIANO (located in northwest Mexico near Ciudad Obregón, Sonora), is owned and operated by INIFAP, Mexico's newly integrated national research institute for agriculture, livestock, and forestry. As the Center's

research agenda has broadened to address the problems of more marginal production environments, INIFAP has provided CIMMYT with access to more than a dozen other research sites in Mexico. Logistical support and access to hundreds of additional research sites are provided by collaborating national research programs throughout the developing world.

Data processing services—This unit provides computing and statistical support to all programs. It has grown rapidly in recent years as CIMMYT has sought to improve and streamline its management of research data and administrative information systems. During 1985, an extensive program of research staff training was initiated to help implement the Center's interactive, multi-user computer system.

Information Services—The Center's Information Services personnel assist scientific staff in two primary ways: 1) by helping them communicate the results of their research to colleagues the world over and 2) by helping them to keep current with relevant research done elsewhere. The publications and training materials produced by CIMMYT reflect the research agendas of the Maize, Wheat, and Economics Programs, completing the research process through the publication of results (see Appendix V). These publications are distributed using a mailing list of some 6,400 individuals, institutions, and libraries. In addition, a special project in the dissemination of scientific information (jointly funded by the International Development Research Centre, Canada, and CIMMYT) is developing more efficient ways to deliver relevant information to CIMMYT's cooperators, as well as to help the Center's scientific staff keep abreast of developments in their respective fields.



Laboratory staff undertake a diverse range of investigations, such as measuring the amount of nitrogen in maize plant tissue using the Kjeldahl procedure (shown here).



The Maize Program renewed its efforts in 1985 to develop improved hard endosperm germplasm for highland areas. Ron Cantrell (right), Director of the Maize Program, inspects a stand of highland maize with maize training officer Alejandro Violic (center) and highland maize breeder Jim Lothrop (left).

Maize Research

The Program's research and training activities are carried out by 15 international staff posted at headquarters and by 16 maize specialists assigned to six regional program posts: Mexico, Central America and the Caribbean; the Andean countries; eastern and southern Africa; West Africa; Asia; and the Middle East and North Africa. In addition, three maize specialists are working in national research programs in Ghana and Pakistan.

During 1984-85, CIMMYT maize staff and others held discussions regarding the current and future structure of the program, particularly those aspects having to do with germplasm development. This review process has already led to modifications described in the following sections, and other changes are being considered in 1986.

The aim of these adjustments is to achieve greater efficiency in supplying improved germplasm to national research programs in developing countries. As an important first step toward that objective, the Program began a detailed study of broad maize production areas (termed "mega-environments"). Information such as the time to maturity of maize, the grain type preferred, the availability of moisture, and the extent and severity of maize diseases and insect pests is being compiled by regional staff and their colleagues in national programs. Once all of this information has been collected and organized by region, the Program will have a much clearer picture of germplasm needs throughout the developing world and will thus be able to set breeding priorities with greater accuracy.

The results of the mega-environment study will be widely distributed among national maize programs and will offer them many of the same benefits CIMMYT expects to derive from the study. A more precise delineation of maize-growing environments will put

national researchers in a position to make better decisions about the allocation of scarce resources, about seed shipments and requests for trials from CIMMYT, and about the potential for direct cooperation with other national programs.

Germplasm Bank

The genetic diversity conserved in CIMMYT's maize germplasm bank (with more than 10,000 accessions collected largely in Latin America) is highly important to the Center's Maize Improvement Program. In the past the main functions of the bank have been to maintain landraces of maize and to supply useful materials for maize improvement research. For example, CIMMYT supplied seed of 895 bank accessions to research collaborators in 12 countries during 1985.

Although the distribution of seed will continue to be an important bank function, the Program now envisions a broader role for this unit, one that involves more active stewardship over its genetic resources. This broader role was brought within reach by supplemental funding, which permitted two important improvements in the bank's facilities. The first, completed in 1985, was to modify one of the cold storage rooms, so that the temperature can be maintained at -15°C . This improvement is expected to more than double the lifetime of the seed and thus reduce the frequency of regenerations from 20 years under previous storage conditions to as much as 100 years. The greater interval between regenerations, each of which causes some genetic drift, will keep the total change in the genetic composition of the accessions to a minimum.

The second improvement, still underway, is to develop and implement a computerized data management system. A catalog of CIMMYT's holdings with passport data, to be completed possibly in 1986, will provide easier access to the germplasm

for users around the world. Other projected activities of the bank are to evaluate the collections, with the aim of minimizing duplication of certain accessions, and to support research on the landraces and wild relatives of maize.

Gene Pools and Populations

During 1985 the Maize Program worked with 67 gene pools and populations. The 37 pools serve as genetic reservoirs, each having been formed of materials from many sources that are similar in adaptation, maturity, grain color, and grain texture. From this best fraction, the Program has developed 32 refined populations. Each of these fits within a particular mega-environment that has its own pest complex and is characterized by a certain climatic condition (tropical, subtropical, or temperate), elevation

(lowland or highland), maturity period (early, intermediate, or late), and consumer preference for grain color (yellow or white) and kernel type (flint, dent, or floury).

Two significant developments have come about recently in the handling or composition of the maize germplasm. A late-maturing gene pool has been created for the Amazon Basin, and greater emphasis is being placed (particularly in the pools) on improvement of husk cover, which is an important defense against damage by insect pests, diseases, and birds.

International Maize Testing

International testing is an integral part of the Maize Program's population improvement system and is the mechanism by which superior germplasm is distributed to national

researchers. In 1985, 728 maize trials were shipped to cooperators in 74 countries (see Appendix I).

The trials are of three types: International Progeny Testing Trials (IPTTs), Experimental Variety Trials (EVTs), and Elite Variety Trials (ELVTs). Each of the IPTTs consists of 250 full-sib families selected from a particular population and is conducted at six locations around the world. Based upon results recorded by national scientists on the performance of those families, experimental varieties are formed at CIMMYT and later tested at 30-50 locations in the EVT. The best performers in those trials are evaluated at 60-80 locations in ELVTs.

Over the past decade, more than 850 experimental varieties have been developed and tested. From this



CIMMYT's maize international testing program provides the mechanism by which improved germplasm is distributed worldwide to national program researchers. Hiep Pham (right), head of the testing program, describes to visitors the workings of the international network.

material scientists in 43 national programs have developed and released 147 improved varieties and hybrids.

Because most developing country maize is especially vulnerable to disease and insect attack and to the vagaries of the weather, it is extremely important that improved varieties offer, not only high yield potential, but yield stability under diverse growing conditions. CIMMYT scientists expend considerable effort on stability by developing resistance or tolerance to diseases, insect pests, and physical stresses.

To measure the effectiveness of those efforts, the Maize Program must reliably compare its germplasm with the materials farmers already have. Toward that end, a cooperative study was undertaken in 1985 with the Plant Breeding Institute at Cambridge, United Kingdom, in which a statistician spent six months at CIMMYT headquarters analyzing recent data generated by the maize international testing program. In the course of the study, a new method was developed for analyzing critical interactions and identifying high-yielding genotypes that give stable yields over a range of environments.

Highland Germplasm Development

CIMMYT's best maize germplasm is adapted to the lowland tropics. New efforts were begun this year to provide improved materials for other environments that have not received as much attention. One of those areas is the highlands, defined as being above 1,800 meters elevation, with mean temperatures during the growing season of 11° to 19°C and night temperatures of less than 10°C, and comprising some 4.5 million hectares in the developing world.

The Maize Program has not worked as continually in developing germplasm for highland areas that require flints or dents as it has in the improvement of the soft, large-kernel flinty genotypes preferred in much of the Andean region. Several improved varieties of

that type were developed under a seven-year cooperative project involving CIMMYT and the national maize program of Ecuador.

Since the work on flinty maize has now come to fruition and is being continued by Ecuadorian scientists, the Maize Program renewed its efforts in 1985 to develop improved germplasm for regions where hard endosperm maize is preferred, which constitute by far the majority of the developing world's highland area. Four highland pools and four populations were reactivated (they had previously been worked until 1979) to serve as source materials. In addition, a special pool is being developed for transitional areas found in eastern and southern Africa, which are not true highland environments but still require germplasm different from that adapted to intermediate elevations.

Germplasm for the Midaltitude Areas of Africa

Another mega-environment that has been relatively neglected in germplasm improvement work is the midaltitude area between 800 and 1600 meters above sea level. Neither temperate nor lowland tropical maize germplasm is adequately adapted to its unique climatic and disease conditions.

In 1985 CIMMYT and the International Institute of Tropical Agriculture (IITA) entered into a joint project with scientists from the University of Zimbabwe at Harare to accelerate the development and adoption of improved midaltitude germplasm in eastern and southern Africa, where there are about 6 million hectares of such maize. Two maize scientists—a CIMMYT breeder and an IITA entomologist—have been assigned to the project, land and offices have been leased from the University, and greenhouse and laboratory facilities are under construction.

In cooperation with the University's Faculty of Agriculture, CIMMYT/IITA project staff will develop more effective maize improvement

procedures, make available new training opportunities for national programs in the region, and, most important, produce improved breeding populations, open-pollinated varieties, and inbred lines. The immediate breeding objectives will be to develop materials that are disease resistant (ear rots, *H. turcicum*, maize streak virus, and *Puccinia sorghi*), insect resistant, and well adapted to a long, cool growing season, and that have high yield potential, yield stability, and good agronomic characters. More distant objectives include the development of germplasm with tolerance to drought and other environmental stresses.

Development of Disease Resistance

The new work on highland and midaltitude maize are part of the larger effort in the Program to pinpoint germplasm needs with greater precision and to meet them more effectively. Another part of that effort, which will be greatly aided by the results of the mega-environments study described on page 12, is to develop genetic resistance to the major disease problems in the developing world. Although the Program has already devoted considerable time and resources to this work, a more exact idea of the scope and severity of maize diseases is required.

In Mexico the aim of current disease work is to develop resistance to ear and stalk rots and leaf blights and rusts. To combat diseases that are not of economic importance in Mexico, the Program has entered into cooperative projects with various national and international institutions. Three of these are coordinated by Program regional specialists.

In Thailand regional staff are cooperating with Asian programs in developing resistance to downy mildew. Recently, CIMMYT staff have concentrated on improving the resistance of three populations (22, 28, and 31) that are well adapted to production conditions in Asia. The greatest progress has been made with Population 28, a tropical, late-maturing

yellow dent material that has shown good and stable downy mildew resistance across Asia and at locations in other regions where this disease is a problem. It is expected that superior varieties developed from this population will soon be released by national programs.

In another cooperative project, CIMMYT and IITA are working with several West African national programs to develop resistance to maize streak virus. This is being achieved by adding streak resistance to La Posta (Population 43), from which five experimental varieties are being formed, and through the conversion to streak resistance of superior experimental varieties from other promising CIMMYT populations. In 1985 the most advanced of these conversions were tested in parts of tropical Africa.

Work on corn stunt virus resistance was reorganized this year as a cooperative project with the national maize programs of El Salvador and the Dominican Republic. Previous research had led to the development and release in several countries of the stunt-resistant variety Santa Rosa 8073, which was selected in Nicaragua. Under the current arrangement, two full-season dent populations are being improved in each country involved: white-grain materials in El Salvador and yellow ones in the Dominican Republic. Researchers are selecting primarily for stunt virus and ear rot resistance, higher grain yield, better husk cover, and reduced plant and ear height.

Development of Insect Resistance

Research on insect resistance, like that on diseases, is a key component of the Maize Program's overall effort to improve the yield stability of its germplasm. One important prerequisite of effective insect-resistance work, a continuous supply of millions of insect larvae, is being fulfilled by the insect-rearing laboratory at CIMMYT headquarters. In 1985 the laboratory produced enough insect larvae for

artificially infesting and screening the majority of the pools and populations for their reactions to the most prevalent and important insects found in Mexico.

Although progress has been slow, researchers have made significant advances in their work on fall armyworm and certain classes of borers. To accelerate progress two special pools with multiple-insect resistance were created this year from CIMMYT's most resistant germplasm. These will be worked intensively to develop superior sources of resistance. Some of the recent work on insect

resistance is being conducted in cooperation with various US universities.

Research on Stress Tolerance

One urgent need is for germplasm with greater tolerance to environmental stresses such as drought. This problem is a major contributor to yield instability in much of the developing world, where maize is mostly grown under rainfed conditions, particularly in sub-Saharan Africa.

Although the materials coming out of the international testing program are showing better tolerance to this stress,



Research on insect resistance is a key component of the Maize Program's efforts to improve yield stability. Shown here, artificial infestation with fall armyworm larvae.

much remains to be done. Drought tolerance work begun in the 1970s with the population Tuxpeño-1 was continued this year, and several new projects were initiated as well. For example, a wide range of materials are being examined to determine which pools and populations have the highest levels of stress tolerance. In the process new screening techniques are being developed. One involves selection against barrenness at high density and for prolificacy (more than one ear per plant) at low density.

Agronomically superior materials selected through this process will be progeny tested under two stress levels (severe and slight) to identify materials that exhibit genotype x stress level interactions. In addition, source pools for unique stress tolerance will be developed using materials from the germplasm bank, other breeding programs, and local landraces.

Considerable attention is also being devoted to stress tolerance in the regional programs. For example, staff of the Andean program, based in Cali, Colombia, have initiated work on resistance to aluminum toxicity; they are currently collecting materials for resistance screening.

Wide Cross Research

The Maize Program's major efforts to improve yield stability are being carried forward through more or less conventional techniques. However, the Program also continues to explore the less conventional option of wide crosses. The aim of this work is to determine the feasibility of gaining genes from wild genera related to maize for improving its disease and insect resistance and tolerance to drought and waterlogging. The most notable success to date has been achieved with crosses between maize and *Tripsacum*.

Hybrid Development

The Maize Program has, until recently emphasized open-pollinated varieties almost exclusively in its germplasm development work, primarily because most developing countries lack the systems needed for production and distribution of hybrid seed. A second factor has been that hybrids are inevitably more costly than open-pollinated varieties and a third that hybrids show little yield advantage under the production circumstances of resource-poor farmers.

Maize production conditions in the Third World are by no means static, though. In parts of some developing countries, conditions have been improved, raising the potential for efficient use of high-yielding, uniform hybrids and improved agronomic practices. Although the development of open-pollinated varieties will remain a central feature of CIMMYT's maize improvement work, the Center initiated a new hybrid development program during 1985. This was done in response to a growing number of requests from national researchers for cooperation and assistance in hybrid work.

The program will cater in numerous ways to the needs of national researchers. One will be to compile and distribute information about the inbreeding depression and heterotic patterns of the Maize Program's gene pools and populations. Others will be to improve the combining ability of certain populations and to make early generation inbreds available to national programs.

Much of the hybrid program's resources will be devoted to the so-called "nonconventional" hybrids. Little information has been published on the development of family, top-cross, and varietal hybrids. Yet, they can be produced more cheaply than conventional hybrids and are therefore more appropriate for some national programs, especially those that have only recently initiated hybrid development efforts.



In the developing world, most maize is grown under rainfed conditions, and drought is a major contributor to unstable yields. Tolerance to drought therefore continues as a priority breeding objective, and new screening techniques are being developed. Here, physiologist Greg Edmeades measures the canopy temperature of materials under moisture stress.

Since the initiation of the new hybrid program, eight diallel crosses have been made and distributed for testing in Mexico, the USA, Nigeria, Zimbabwe, Guatemala, El Salvador, Colombia, and Thailand. Work was also begun on the screening of inbred lines, which will serve as source materials in the formation of nonconventional as well as conventional hybrids.

Nutritional Quality Improvement

As with every other aspect of the Maize Program's breeding activities, careful consideration was given this year to the past achievements and future direction of the work on quality protein maize (QPM). Through some 15

years of multidisciplinary research, the Program has developed a range of hard-endosperm materials carrying the opaque-2 gene, which improves protein quality in maize. In some regions these are on a par with normal germplasm in yield and kernel type, the two chief characteristics in which the original opaque-2 materials were deficient. The considerable scientific achievement of this project has been to break the apparently indissoluble bonds between the opaque-2 gene and a number of serious problems (such as an unacceptable, chalky grain type) through the accumulation of myriads of modifier genes.

That achievement has heightened interest in QPM materials, and these are now being handled by some 20 national maize programs around the world. Two have released varieties based on this germplasm. Much of the Maize Program's future research on QPM will be aimed at further increasing the utility of the germplasm to national researchers. For example, one key objective will be to identify areas where QPM has potential for benefitting human and animal nutrition and to improve a few QPM materials intensively in those areas, with emphasis on resistance to diseases and other stresses and on the stability of the modifier genes for endosperm hardness.



In 1985, the Maize Program initiated a hybrid development program, in response to a growing number of requests from national researchers for cooperation and assistance in hybrid work.

Wheat Research

CIMMYT's Wheat Program conducts research on bread wheat, durum wheat, and triticale. The Program has 16 international staff members at headquarters focusing on a range of crop research and training activities. Fourteen wheat specialists also are assigned to 6 regional programs, and 5 others are assigned to 4 national research programs: 2 in Bangladesh, 1 in Pakistan, 1 in Peru, and 1 in Turkey.

During the past few years, the Wheat Program has shifted its research agenda toward developing germplasm capable of improved performance in more difficult production environments. This does not mean the Program is now neglecting the more favored environments; in fact, resolution of the problems being addressed for marginal lands will also convey higher productivity in favorable environments. The approach being taken is to 1) improve the resistance of CIMMYT germplasm to various diseases and insects, and 2) increase its tolerance to certain problem soils and to such environmental stresses as drought, heat, and cold. The Program also is currently reorganizing its agronomy research to help national programs develop cost-effective production practices for an array of environments.

International Testing

The Wheat Program, in close cooperation with national crop improvement programs around the world, has successfully developed a range of widely adapted germplasm appropriate for Third World production conditions. This has been accomplished using a "shuttle breeding" strategy in Mexico (two breeding cycles per year, each under very different environmental conditions), combined with extensive international multilocation testing. This testing is largely done by national program scientists, who grow and evaluate the nurseries according to standard procedures established by CIMMYT.



The Wheat Program has, during the past few years, shifted its research agenda toward developing germplasm intended for more difficult production environments. Byrd Curtis (left), Director of the Wheat Program, inspects the performance of CIMMYT materials in Ecuador with agronomist Pat Wall.

The purpose of the Program's international testing effort is basically three-fold: 1) to obtain performance data from numerous locations worldwide, thereby facilitating the development of broadly adapted germplasm; 2) to introduce new genetic variability--critical to progress in plant breeding--into national crop research programs; and 3) to help facilitate communication among thousands of wheat scientists around the globe.

With the Program's increasing emphasis on germplasm for marginal environments, greater site-specificity for testing and selection is required. To accomplish this, the Program has moved toward the enhancement of selected subsets of its germplasm base, has created smaller, more problem-specific nurseries for testing in known "hot spots" around the world, and increasingly relies on regional staff to help guide and implement germplasm development work. Collaborative arrangements for screening germplasm for specific traits also are being established with selected national programs which, by virtue of their location and/or environmental conditions, are able to address problems of particular interest. Examples include Thailand (screening for heat tolerance), China (fusarium resistance screening), and Brazil (aluminum tolerance screening).

The international testing network thus provides a foundation for the close working relationships between CIMMYT scientists and their national program counterparts, a partnership that has proven over time to be very productive. The testing network has facilitated the development and release by national programs of over 350 improved bread wheat cultivars, 50 improved durum wheats, and 56 triticale varieties.

In 1985 collaborating scientists in 96 countries requested 2,085 trials of bread wheat, durum wheat, and triticale (see Appendix II). In addition, as a service to ICARDA, CIMMYT prepared and distributed 284 sets of barley nurseries for testing in 62 countries.

Bread Wheat Improvement

The bread wheat program is the largest of CIMMYT's small grains improvement efforts, a priority that is in keeping

with the fact that about 65% of the developing world's wheat area is devoted to bread wheat. CIMMYT maintains a broad genetic base in its bread wheat germplasm for such traits as yield, wide adaptation, resistance to major diseases, and milling and baking quality. In addition, the germplasm base contains subsets of materials having especially desirable traits, such as resistance to "minor" diseases of wheat, and tolerance to such stresses



Sanjaya Rajaram, head of the bread wheat breeding program, has organized the program's research according to six major target environments. This enables him to build upon a broad base of widely adapted, high yielding, and disease resistant germplasm by breeding for the specific traits required in each environment.

as drought and acid soils. The breeding program is organized according to six major target environments, which helps greatly to focus the program's breeding efforts.

Yield and adaptation—Currently, the best CIMMYT bread wheat lines are progeny of spring x winter crosses and possess 5-10% higher yield potential and greater yield dependability when compared to the best pure spring habit semidwarf wheats. The wide adaptation of these progeny is also evident from the results of international trials. One cross in particular, Veery "S", has produced a number of high-yielding lines that have ranked first in the vast majority of yield trials conducted during the last five years of international testing.

Disease resistance—The bread wheat program continues to emphasize enhanced disease resistance in its research, particularly to the rusts (leaf, stem, and stripe), which remain the major disease threats to dependable yields in much of the developing world. The program's germplasm base generally has acceptable and stable resistance to stem and stripe rust, but stable leaf rust resistance has been elusive. Some of CIMMYT's bread wheat lines have demonstrated a "slow rusting" response to leaf rust pathogens; i.e., they are susceptible to infection, but the disease develops at such a slow rate that little reduction in yield occurs. Materials having this desirable trait are being used extensively in the crossing program.

Considerable attention is being given to improving resistance to the diseases caused by *Septoria* spp. and, more recently, to diseases caused by *Fusarium* and *Helminthosporium* spp. (both of which limit yields in southern China and other areas with warm and humid climates). CIMMYT is now collaborating with Chinese scientists to help develop materials with greater resistance to fusarium head scab, and some of the materials supplied by

China are showing excellent resistance to helminthosporium leaf blotch (*H. sativum*) as well.

Drought tolerance—Some spring x winter materials are showing improved tolerance to drought. Advanced lines are now being selected under reduced-moisture regimes, and the best of these lines are distributed through the international nursery program for additional testing. This research is a promising avenue of exploration; the yield performance of the newer lines selected under drought-stress conditions has increased markedly.

Tolerance to acid soils—A number of high-yielding bread wheat lines with tolerance to acid soils and with improved resistance to the diseases found in these environments are being developed through a cooperative shuttle breeding program with national scientists from Brazil. With adequate disease resistance, these lines should yield considerably more than the commercial varieties currently grown in Brazil's acidic soils. In 1985, an advanced line (Thornbird) developed from this collaborative work was released by Brazil as "Brazil 14."

"Tropical" wheats—The bread wheat program continues its research on the problems encountered in attempting to produce wheat in warmer, more tropical production environments. In addition to focusing on the development of greater resistance to certain diseases, this breeding effort is giving attention to improved tolerance to heat stress, which can adversely affect the tillering and grain-filling abilities of wheat grown in warmer environments.

Winter wheat research—In 1985, CIMMYT took preliminary steps toward addressing the need of a number of developing countries for improved winter wheat germplasm by placing a breeder with the Turkish national crop research program. Winter-habit wheats are grown on about 15% of the

developing world's wheat area. The objective is to develop an international collaborative winter wheat program based in Turkey and involving scientists from the host country, CIMMYT, and several U.S. universities. To supplement this new initiative, and in response to requests from the Chinese Academy of Agricultural Sciences, CIMMYT also began a small-scale shuttle breeding program (between Mexico and China) to develop improved winter wheat germplasm appropriate for conditions prevalent in northern and central China.

Durum Wheat Improvement

In the developing world, durum wheat covers some 10% of the total wheat area, and is an important crop (used for making pasta products and certain types of unleavened bread) in the Mediterranean Basin countries of North Africa and the Middle East, in Argentina, and in Chile. As in the bread wheat program, durum wheat breeding is organized according to target environments, and research focuses on yield, wide adaptation, disease resistance, agronomic type, and milling and baking quality.

Yield and adaptation—International yield nursery data indicate that CIMMYT's best durum materials are now equal to, or higher yielding than, the best bread wheat materials. Yields of up to 10 t/ha have been recorded at certain locations. Work to broaden the genetic base and increase the breadth of adaptation of high-yielding durum cultivars continued in 1985. Statistical analyses of past international yield trial data are being undertaken in an attempt to identify better selection criteria for increasing the yield stability of improved durums over a range of environments.

Drought is a significant yield-limiting factor in many durum wheat production environments, and cooperative research at ICARDA is

concentrating on the development of materials with greater drought tolerance. Crosses between the winter and spring germplasm pools also are being made to capitalize on genes found in winter durums for enhanced tolerance to drought and cold stress. Efforts are also being made to develop earlier maturing varieties with good yield potential and disease resistance. Such materials would be particularly advantageous in areas characterized by drought stress and/or a short growing season.

Disease resistance—The durum wheat program gives emphasis to improving disease resistance of its high-yielding genotypes. The program has successfully developed durum lines with high and stable levels of resistance to stripe rust, while better resistance to stem rust, septoria and fusarium diseases is still needed. In cooperation with Ethiopian research institutions, new sources of resistance to stem rust are being exploited to pyramid genes for higher and more stable resistance.

Agronomic type—Breeders are attempting to modify the head architecture in durum wheats in hopes that this will reduce the incidence of head-rotting diseases that affect durums in many areas. Considerable progress has also been made in developing durum types with solid stems for areas in North Africa where sawflys can cause serious damage to hollow-stem materials.

Milling and baking quality—There is a growing export potential for durum wheats with large sized grains, high test weights, and acceptable pigment and protein content. Some developing countries are potential exporters of durum wheat, and the Wheat Program's milling and baking laboratory is helping breeders develop durums that maintain high industrial quality characteristics during processing. As a result of this attention, numerous high-yielding lines with satisfactory quality characteristics have been made available to national programs.

Triticale Improvement

Triticale is a product of the successful hybridization of wheat and rye and, as a result of the rye component, has considerably higher yield potential than wheat in acidic soils, at high elevations, and in semiarid environments. International triticale yield nurseries, grown at over 100 locations worldwide for nearly two decades, have confirmed the crop's adaptation to a wide range of stress environments. The number of varietal releases by national programs (53 new varieties have been released since 1978) indicates a growing interest in triticale, both for food and forage/feed, but this apparent interest has yet to be translated into widespread use at the farm level. Triticale remains an important small grain crop in only a few countries, with roughly 750,000 hectares now in commercial production worldwide.



Pedro Brajcich, head of the durum wheat breeding program, is giving emphasis to several major breeding objectives, including improved disease resistance and broadening the genetic base of high yielding materials.



Rapid progress has been made in the development of improved triticales, but much of this progress rests on a somewhat narrow genetic base. To broaden this base, George Varughese (head of the triticale breeding program) is giving emphasis to the production of new "primary" triticales (initial crosses between rye and wheat).

"Complete" triticales—In particular, "complete" triticales (having a full complement of rye chromosomes) have a higher yield potential in stress environments than the more wheat-like "substituted" types (in which one or more wheat chromosomes substitute for those of rye). CIMMYT is therefore moving toward a preponderance (about 75%) of complete triticales in its triticale germplasm base. Since the completes tend to be taller and mature later than substituted types, the development of shorter and earlier maturing cultivars is important. Good genetic sources exist within the CIMMYT germplasm base for these characters. One advanced line in particular, recently named "Ardilla," is being used extensively in crosses to develop early maturing complete triticales.

"Primary" triticales—New primary triticales (initial crosses between rye and bread wheats or durum wheats) are being produced to widen the genetic base of CIMMYT's triticale germplasm. The best available bread wheat and triticale cultivars are being

crossed to incorporate additional genes into triticale for disease resistance, higher seed quality and test weights, earlier maturity, and adaptation to marginal environments.

Spring x winter crosses—The triticale program has embarked on a more active crossing program between spring and winter habit triticales, two distinct gene pools possessing considerable genetic variation; these pools have not been extensively crossed in the past. Many excellent winter triticales are coming from Poland, where improved ryes are being bred into triticales, and these winter materials are being used extensively in the CIMMYT program.

Test weights and preharvest sprouting—The major drawbacks in CIMMYT's triticale materials are still found in grain quality and in the tendency of the grain to sprout before harvest. Although it has been relatively easy to find triticales with high test weights when grown under favorable production conditions, these test

weights drop sharply as production environments become less favorable. Considerable progress has been made in recent years toward overcoming this problem. Recent data on test weights show a number of high-yielding triticale lines with more acceptable and stable test weights—within 10% of commercial bread wheat varieties.

Preharvest grain sprouting in triticale can be a serious problem in environments having high levels of rainfall and/or humidity at harvest. This in turn results in a rapid degradation of grain quality. Field and laboratory screening procedures are being used to identify genotypes with improved resistance to preharvest sprouting; while some progress has been made, greater resistance is still required.

Special germplasm development

To capitalize on potentially valuable germplasm that cannot be readily utilized in the conventional breeding programs, CIMMYT has a special research unit that attempts to transfer useful genes into lines having good agronomic characteristics. Approximately 50% of this unit's research efforts is devoted to bread wheat, 30% to triticale (and rye improvement), and 20% to durum wheat. Activities focus on the components of yield in bread wheat and durum wheat (spikelets per spike and grains per spikelet), improved protein content in advanced bread wheat lines, enhanced disease resistance in aluminum-tolerant materials, and new sources of resistance to leaf rust in bread wheat and to stem rust in durums. In addition, the unit conducts a small breeding program designed to develop improved rye germplasm for use in making new primary triticales.

Wheat Germplasm Bank

The wheat germplasm bank maintains working collections of breeding materials primarily to support the research of Wheat Program scientists and national program collaborators. In 1985, CIMMYT had approximately

60,000 total entries in its small grains bank, including 10,500 bread wheat, 4,500 durum wheat, 5,100 triticale, 4,900 barley, and 1,100 interspecific germplasm entries; the bank also contains some 33,700 entries from other germplasm banks around the world.

Each year, the bank rejuvenates a significant portion of its collection, and conducts germination viability tests with a large number of entries. Seed from 2,620 entries was supplied to national programs during 1985. Computerization of the information generated on the bank's collections continued in 1985. Finally, duplicates of nearly 19,000 entries were sent to the USDA National Seed Storage Laboratory (NSSL) in Fort Collins, Colorado, for long-term storage.

Seed Health—Pathology

Most pathology research is carried out by staff in the three crop programs. In addition, CIMMYT has a new seed health research unit serving both the wheat and maize programs, a regional small grains disease surveillance program and a special project focusing on barley yellow dwarf virus (see Extra-Core Grants). In 1985, seven special disease screening nurseries were distributed for international testing.

CIMMYT's seed health unit was established in 1984 to provide a more comprehensive and coordinated approach to seed health problems. The unit is responsible for all standard tests for seed-borne pathogens in germplasm destined for international distribution, development of improved methods of detection of seed-borne pathogens, testing for the efficacy of chemical seed treatments, and determination of improved seed treatment procedures. These activities are all conducted in close cooperation with Mexico's plant quarantine authority, Sanidad Vegetal.

A special research project within the seed health unit deals with Karnal bunt, a disease of wheat and triticale caused by the weakly pathogenic

fungus *Tilletia indica*. The disease, also known as "partial bunt," originated in the Karnal district of India and was first discovered in Mexico more than 15 years ago. It is confined to a small part of the wheat-growing area of northwest Mexico. At present, quarantine restrictions apply to seed movement from Karnal bunt-infected areas in Mexico to other parts of the country and to international destinations. These restrictions hinder the exchange of germplasm among crop research institutions and, as a temporary countermeasure, seed destined for international distribution is grown in an area free of Karnal bunt infection.

Cooperative Karnal bunt research projects with Mexican and U.S. plant pathology research services are underway at two locations in Mexico, two locations in the USA, and several locations in India, Pakistan, and Nepal. These research efforts are focused on the development of resistant germplasm, as well as effective and

safe chemical control methods. Additional research is examining the effect of Karnal bunt on seed quality for food and feed uses. While there are still questions as to how to control this disease, the current research program will ultimately provide the answers needed.

Wide Cross Research

Another area of research receiving attention in the Wheat Program involves the transfer of useful genes from related genera to wheat. Collaboration with other institutions and funds provided by the biotechnology consortium (see Extra-Core Grants) have facilitated CIMMYT's interaction with other research groups in areas of tissue culture (Colorado State University, CSIRC, Australia), basic genetics (PBI, Cambridge), cytogenetics (University of Missouri), and taxonomy and genetics of the wild relatives of wheat (University of Utah). Initial investigations on apomixis in wheat, based upon germplasm emanating from



CIMMYT's wide cross derivatives, were also launched during the year in collaboration with scientists from the University of Utah.

The focus of wheat wide cross research is to obtain better resistance to certain pathogens, such as *Helminthosporium sativum*, *Fusarium graminearum*, and *Tilletia indica*, and tolerance to such stresses as high concentrations of salt and aluminum, and to copper deficiencies. Most of the wide crosses made to date involve *Agropyron*, *Elymus*, and *Aegilops* species.

In 1985, 2,110 lines derived from crosses of bread wheat with either *Agropyron* or *Elymus* species were tested, and 70 lines selected from these combinations showed varying levels of resistance to *H. sativum*; efforts are underway to transfer this alien resistance to a wheat background. Also during 1985, 19 hybrid combinations were field tested for resistance to fusarium head scab (*F. graminearum*). Of the 279 resistant selections, 10 came from *Elymus* derivatives and 269 from *Agropyron* derivatives.

It is premature to report definitive results of research now underway to transfer new sources of resistance to Karnal bunt from *Aegilops* species, but the work is progressing at a satisfactory pace. The same may be said of efforts to develop wheats with increased tolerance to high concentrations of salt and aluminum, and to copper deficiencies.

Economics Research

In 1985, CIMMYT's Economics Program had 13 professionals involved in collaborative research and training activities at headquarters and in three regional programs: Mexico, Central America and the Caribbean; Eastern and Southern Africa; and South and Southeast Asia. In addition, one international staff member was assigned to a bilateral project in Haiti.

Economics staff have made a major contribution to the development of a conceptual framework for assessing the production circumstances of representative farmers in the Third

World. Cost-effective research procedures for ascertaining the biological and economic circumstances of farmers have been developed. These procedures are used to help understand the most important production problems and resource circumstances faced by the majority of farmers (in target research areas) and then to orient subsequent crop research toward appropriate improved technologies. On-farm research procedures, developed by the Economics staff in conjunction with CIMMYT and national program biological scientists, are now being used in many production research programs in the developing world.



CIMMYT economists are developing procedures for improving the efficiency of research resource allocation in national programs. Economist Derek Byerlee, now serving the Asian regional program and stationed in Pakistan, is an important contributor to this work.

CIMMYT economists are also involved in research related to the production and utilization of maize and wheat in the world economy. As well, a research project was initiated to develop techniques for estimating the real domestic costs for producing such commodities as maize and wheat. Data collection and trend analyses about the world maize and wheat economies represent continuing activities that are reported in a special publication series.

Technology Generation

From the outset, the Economics Program has sought to work with selected national programs in developing countries, demonstrating and institutionalizing on-farm research procedures. In 1985, more than a dozen collaborating national research institutes in Africa, Asia, Latin America, and the Caribbean were well on the way toward integrating on-farm research procedures into the process of technology generation.

Interest in on-farm research techniques has expanded rapidly among national programs and development assistance agencies. In such countries as Zambia, Malawi, Panama, Ecuador, and Honduras, on-farm research procedures are now well established within national research programs. The national programs of Pakistan, Mexico, Haiti, Zimbabwe, and Indonesia are testing these procedures as well and considering how to adapt them to their own institutional settings. This type of interchange between national programs and CIMMYT contributes both to the refinement of on-farm research procedures and to the development of institutional innovations that improve the effectiveness of national production research efforts.

Research Resource Allocation

Research organizations face the problem of allocating their resources among competing crops and regions. To improve the efficiency of decision

making on resource allocation in national programs, CIMMYT economists have undertaken to adapt a framework of domestic resource cost analysis to determine the farm- and national-level profitabilities of producing such crops as maize and wheat, relative to alternative crops. This type of research provides a means of linking research resource allocations to the environment in which researchers and farmers make decisions.

Economics staff, in cooperation with national program colleagues, were engaged in two studies in 1985 in Pakistan and Kenya. The Pakistan case looks at the choice of crops for research investment in one region, while the Kenyan case examines alternative scales of wheat technology. Field work was conducted in both countries during the year, and preliminary analyses were undertaken. In both cases, considerable care was taken to ensure that the relatively complex farming patterns were accurately depicted for economic analysis. Budgeting and other profitability analyses will provide information useful for guiding decisions on research resource allocation. The goal of these and similar studies is to accumulate sufficient experience to produce a manual that can be used by national program research personnel and other decision makers concerned with the efficient allocation of scarce research resources.

Assessing Aspects of Policy

A third set of research procedures are being developed that take advantage of farm-level research data to assess the adequacy of systems for delivering inputs, marketing products, disseminating information, and providing credit. With this methodology, estimations can be made of the direct losses incurred due to inadequate implementation of current policies affecting production support systems. The Program's goal is to derive cost-effective methods for undertaking this sort of research, and

to synthesize these procedures in manuals appropriate for use in national programs. Case studies are underway to provide background for the development of these procedures. As in the past, both CIMMYT staff and colleagues from national programs are involved in these studies.

Data Collection and Analysis

In recent years, the Economics Program has increased its data collection activities and analysis of the maize and wheat world economies. In 1981-82, CIMMYT initiated two new serial publications: *World Wheat Facts and Trends* and *World Maize Facts and Trends*. These reports assemble, on an alternate-year basis, pertinent data related to maize and wheat production, utilization, and trade and present this information in a readily digestible form for agricultural administrators, researchers, and policy makers. Each issue also discusses a theme of particular relevance.

In 1985, CIMMYT published *World Wheat Facts and Trends, Report III: A Discussion of Selected Wheat Marketing and Pricing Issues in Developing Countries*. In this issue, various aspects of wheat marketing and pricing in the Third World were explored. The study reviewed wheat marketing systems in 13 developed and developing countries. Comparisons of price differentials in each of these wheat markets emphasized that with economic growth, marketing functions take on greater importance for farmers. As well, technologies for grain transportation, storage, and processing need to be adapted to the circumstances of the particular countries. Alternative wheat pricing mechanisms reviewed in the report also highlighted advantages and disadvantages of the major methods currently employed in setting wheat prices, and identified the need for improved pricing arrangements for wheat in both developed and developing countries.

Training Activities

This year CIMMYT offered a diverse array of training opportunities in Mexico, within the regions, and in national programs (see Table 1). Eight full-time maize, wheat, economics, and experiment station training officers (plus a coordinator) were stationed at headquarters, and one full-time regional economics training officer was assigned to eastern and southern Africa. In addition, most other CIMMYT staff members devoted a portion of their time to training.

The primary roles of the training officers at headquarters are to 1) conduct in-service courses, 2) develop teaching materials, including instructional modules and formats for in-country courses, 3) assist outreach staff with in-country training activities, and 4) consult with national researchers on the organization of in-service training programs in their countries.

Table 1. Summary of CIMMYT training activities during 1985 in Mexico

Type of training	Participants	Countries
In-service		
Maize	50	27
Wheat	49	26
Experiment Stations	18	14
Laboratories	6	5
Visiting scientists		
Maize	36	20
Wheat	68	23
Economics	18	7
Research support	3	2
Pre- and postdoctoral fellows		
Maize	8	5
Wheat	9	6
Economics	2	2

In-service training courses were offered this year in maize and wheat production and improvement, experiment station management, and laboratory procedures for milling and baking evaluation, protein quality analysis, and insect-rearing techniques. Visiting scientists were brought to

Mexico for periods of one to six weeks to become familiar with CIMMYT research programs and to examine and select breeding materials. Several Ph.D candidates joined the crop improvement programs to conduct thesis research on such topics as insect and disease resistance, and postdoctoral fellows participated in the ongoing research activities of the crop programs, in addition to conducting special research projects of their own.

Outreach staff are of crucial importance in handling many aspects of these training programs. Their main roles are to 1) identify the training needs of cooperating institutions and coordinate CIMMYT's programs of assistance, 2) help shape the content of in-service courses offered in Mexico, 3) advise on the development of teaching materials and provide examples of research experiences for inclusion in training manuals, 4) organize and participate in in-country training courses, and 5) coordinate follow-up support of former trainees.

Outreach staff and other members of the Maize, Wheat, and Economics Programs participated with colleagues from national programs in more than a dozen in-country training courses (concerned largely with on-farm research methodologies) for more than 600 research workers. Many of these in-country courses have used an approach referred to as the "call system." Course participants come together for periods of one to two weeks at key stages in the research cycle (for example, to conduct on-farm surveys, evaluate trial results, and plan subsequent research) and during the periods between those "calls," resume their normal duties.

Though CIMMYT is clearly providing a diverse array of training opportunities, the larger part of its training resources have been devoted to the in-depth, hands-on courses conducted in Mexico.



In 1985 CIMMYT provided training in the use of a new type of tillage implement. CIMMYT staff members (left) are shown demonstrating the use of the implement to local researchers (right).

Since it is becoming increasingly obvious that through those courses the Center can reach only a fraction of the maize and wheat research workers in the developing world (see Appendices III and IV), changes are being made that will broaden the scope of the training activities. Among those changes are an expanded program of in-country training, especially in on-farm research, to be conducted in cooperation with national program staff; a greater number of senior visiting scientist fellowships at headquarters; increasing consultation and assistance to national programs that wish to develop their own in-service courses; and the development of a broader array of training manuals and self-paced instructional materials that can be used at CIMMYT and in developing countries.

Expansion in the training program has required some adjustments in its organization. For example, although each of the Center's research programs and support units will retain responsibility for their own training activities, a staff member was appointed to coordinate those aspects of training that are amenable to integration across programs. The training coordinator also advises CIMMYT staff on training-related matters both at headquarters and in the outreach programs.

The broader program of training activities will be facilitated by the new training, conference, and information building. Extra office space will be available for visiting scientists, and larger training areas will make it possible to offer a wider array of courses (in the use of microcomputers as research tools, for example). The new library will give trainees and visiting scientists greater access to scientific literature, and growth in information services should accelerate the development and use of self-paced instructional materials.

Conferences and Workshops

CIMMYT cosponsored a number of conferences this year both at headquarters and in various regional and national programs. At headquarters in-house reviews were conducted to consider all aspects of the Maize Program, the agronomy research of the Wheat Program, and all aspects of the Economics Program. In June the Center hosted a workshop attended by computer and data processing staff from sister international institutes and developing country national programs. Participants identified opportunities for joint software development and shared software applications. A workshop held in August on winter wheat was attended by 25 persons, including scientists from China, Yugoslavia, the USA, and ICARDA. In October CIMMYT made its conference and housing facilities available to the International Crops Research Institute for the Semi-Arid Tropics (ICRISAT) for a regional conference of Latin American sorghum researchers. A regional maize conference on production problems in eastern and southern Africa was held in Zambia during March, with maize researchers from 23 countries attending; a proceedings of this conference will be published by CIMMYT in 1986. A similar regional wheat workshop was sponsored in Kenya during September for national scientists from eastern, southern, and central Africa.

Regional and National Programs

Thirty-nine staff members are currently assigned to regional maize, wheat, and economics programs under core and extra-core funding arrangements (Table 2). These programs vary in their structure and activities according to the needs and concerns of the particular national programs they serve. Even so, all have essentially the same purpose: to reinforce the efforts of national researchers in improving

farmers' productivity. Moreover, regional staff provide a vital link between CIMMYT headquarters and national programs that helps ensure the suitability of the Center's products and services.

Table 2. Regional program staff assignments during 1985

Region	Maize	Wheat	Economics
Central America, Mexico, and the Caribbean	3 ^a	—	4 ^a
Andean countries of South America	3	2	—
Southern Cone countries of South America	—	2 ^b	—
North and West Africa	3 ^a	1	—
Middle East	1	3	—
Eastern and southern Africa	4 ^a	2 ^a	3 ^a
Asia	2	3 ^b	2
Total	16	14	9

a/ Includes extra-core funded position(s).
b/ Includes one position for tropical wheat research.

The varied work of every regional program is carried out by a team of two or three scientists, each of whom works within his own discipline in a complementary relation with other members of the team, while maintaining a broad interest in other aspects of research and production. Increasingly, one of the most important tasks of regional staff is to assist in research planning and management, a service they provide mainly through frequent and timely visits to researchers in national programs.

Much effort in the regional programs is devoted to germplasm development. One way in which regional staff

participate in that work is by helping national scientists monitor the various trials and nurseries distributed from CIMMYT headquarters. A number of regional program staff also prepare and distribute elite trials of superior materials (subselections from larger international trials or commercial varieties) as a means of supporting regional research networks.

The regional programs are also actively engaged in helping national scientists integrate production agronomy and on-farm work into national research systems. To achieve that end, regional staff demonstrate procedures for identifying research opportunities, help plan agronomic experiments and analyze the results, and assist in

developing technology demonstration and transfer programs. As part of this assistance, regional agronomists and economists organize in-country training courses on production-oriented research.

Much of the work of the regional programs is designed to promote regional cooperation as an efficient means by which groups of national programs with common interests can confront shared research problems. The regional specialists work toward this goal by performing networking functions, including the hosting of regional conferences and workshops, arrangement of travelling seminars for which national program scientists visit their colleagues in other countries, and

participating in national research planning meetings. In some regions, such as Central America and the Caribbean, CIMMYT staff have also helped develop more formalized regional research associations.

The Center had 11 international staff members assigned to bilateral national programs in Bangladesh, Ghana, Haiti, Mexico, Pakistan, Peru, and Turkey (see Extra-Core Grants). Those staff share many of the objectives and are involved in much the same types of activities as the regional specialists. The main difference between the two types of assignments is that CIMMYT scientists working in bilateral projects are full members of single national maize or wheat programs, are assigned to them for fixed terms, and concentrate on quite specific research and training activities within national research systems. The work of the regional specialists, in contrast, is not so narrowly focused, since they are concerned with many aspects of numerous national programs.

Maize Regional Programs

In addition to providing general assistance to national maize programs, some of the regional maize specialists were involved in special disease research projects: one concerned with downy mildew in Asia, another with the maize streak virus in West Africa, and a third with corn stunt in Central America.

Regional and related activities were stepped up considerably in eastern and southern Africa, where there is both an urgent need and much promise for improvement in national research capabilities. Toward that end, two additional staff members were assigned to the eastern and southern Africa regional program. Moreover, so as to better assist national programs in meeting the germplasm requirements of the region, CIMMYT and IITA set up a midaltitude research station this year at the University of Zimbabwe. There, as in West Africa, the two centers will engage in various germplasm



The success of CIMMYT's regional and bilateral programs rests largely on the work of national program researchers like Dr. Abdrabboh Ismail (right), assistant director of the Egyptian maize program, shown here taking notes on an on-farm variety trial.

development activities in cooperation with national researchers. Those activities will be guided by the CIMMYT germplasm development coordinator for sub-Saharan Africa.

Wheat Regional Programs

The Wheat Program operated six regional programs in 1985, including the joint CIMMYT/ICARDA Middle East/Western Asia program. During 1985, regional staff prepared and distributed a number of regional disease screening and surveillance nurseries, as well as regional yield trials. Two Andean zone bread wheat and barley screening nurseries, prepared in cooperation with Ecuador's national wheat research program, were distributed to a dozen Latin American countries in 1985. Regional screening nurseries were also prepared by the regional wheat staff assigned to the Southern Cone and eastern and southern Africa programs. In addition, staff assigned to East Africa assisted

the Kenyan national program in the operation of an extensive off-season nursery program as a service to other African and Asian national research programs.

Economics Regional Programs

The Economics Program currently has three regional programs in operation. In each, regional economists engage in collaborative research projects to demonstrate on-farm research techniques. The three staff members working in eastern and southern Africa are involved in cooperative research and training programs with national research institutes engaged in on-farm research. The regional staff in Central America and the Caribbean spent considerable time on training in Honduras, Mexico, and Panama. Regional staff in Asia also concentrated on training and were engaged in special studies related to the introduction of wheat into nontraditional production areas.

Consultation

The active consultation schedules of the CIMMYT staff (over 5,000 person-days in 73 developing countries in 1985) is a key dimension in keeping the Center's research and training programs well targeted to the needs of national programs. During 1985, scores of field trips were made by regional and headquarters staff to review materials from the international nurseries, advise on experiment station management issues and laboratory techniques, and to interact directly with staff of national crop research programs. Additionally, senior staff were frequently called upon during the year by national research leaders to advise on the organization of national maize and wheat research programs, as well as on significant production-related problems in which CIMMYT has expertise.



Regular and continuous consultation with national program researchers is essential for maintaining well-targeted research and training programs. Field trips to review international nursery materials, such as this one undertaken by Larry Butler (left), wheat breeder/pathologist stationed in Bangladesh, provide unique opportunities to interact directly with national program colleagues.

Extra-Core Grants

Extra-core programs are undertaken as a result of a direct relationship between CIMMYT and a donor. Though they fall outside of CIMMYT's core program sponsored by the CGIAR, they form an important part of CIMMYT's research and training efforts.

Extra-core programs are generally of four types:

- Direct assistance (posting of staff or provision of research equipment) to national or regional programs;
- Specialized or advanced-degree training;
- Collaborative research arrangements of a more basic or longer term nature; and
- Special exploratory research activities.

In assessing the relative merit of potential projects, the CIMMYT Board of Trustees has established certain guidelines with respect to extra-core grants:

- The objective must be within the mandate of CIMMYT;
- The action should not be a mere technical assistance contribution to a country or region, but have some potential to strengthen CIMMYT's overall research competence and add to the base of scientific knowledge;
- The project should have, wherever appropriate, a training component, which either enables CIMMYT staff to gain experience or enhances national capacity in the area of concern;
- Any administrative costs for CIMMYT should be fully identified and reimbursed by overhead or other means in the funding of the project; and

- There should be no implied continuing obligation on the part of CIMMYT; i.e., all potential staff repatriation, rehabilitation or ancillary costs on termination must be funded by the donor.

In 1985, extra-core grants amounted to US\$ 5,354,000, or 20% of total expenditures. Reports on major grants are included in the following pages. Several of these provide funds for posting staff to national research programs, and all provide important feedback to CIMMYT's research programs.

One on-going extra-core project not reported here but to be featured in the *CIMMYT Annual Report 1986* is the Center's new Training, Conference, and Information Center. Funded by the Japanese Shipbuilding Industry Foundation and the Government of Japan, the project was initiated in 1984 and is due to be completed in September 1986.



Maize

Project:	East Africa Cereal Program
Donor:	Canadian International Development Agency (CIDA)
Pledge:	CA\$ 993,000 US\$ 764,000 (est.)
Duration:	October 1984 - June 1988

Financial Summary

Expenses (US\$)	
Previous Years	\$ -0-
1985	\$ 227,000
Total to Date	\$ 227,000
Balance Available	\$ 537,000

Objectives

The project has as its principal objective increased maize production and productivity in seven countries that make up the East Africa region: Burundi, Ethiopia, Kenya, Rwanda, Somalia, Tanzania, and Uganda. The project seeks to accomplish that objective primarily through the transfer of improved maize production technology (agronomic practices and superior varieties). A companion project, also funded by CIDA as part of the same grant, seeks to increase small grains production and productivity in the region (see page 37 of this report).

Staffing

Two maize agronomists are assigned to the project and are based in Kenya. They work closely with scientists from national research programs in the region and with other CIMMYT scientists stationed in East Africa.

Project Description

Agronomic research—The agronomists are involved in initiating, implementing, and evaluating agronomic trials to derive, test, and validate packages of agronomic practices appropriate to farmers' circumstances in the region. On-farm research is the principal means by which those activities are carried out.

Agronomic production—The agronomists act as advisors to national programs and extension services that are applying new technologies and encouraging farmers to adopt them.

Agronomic training—A variety of training opportunities and fellowships are provided. One important type of training that will take place in the region concerns the methodology of on-farm research. Other activities in the region will include workshops on the development and implementation of recommended technologies. Training outside the region will be provided

primarily through in-service courses at CIMMYT in Mexico and degree-related programs at selected universities.

The expected beneficiaries of the project are farmers and national research institutions in the region. The project is one of several in eastern and southern Africa currently being implemented by CIMMYT. Focusing on agronomic issues in the region, the project is closely tied to the networking efforts in germplasm development, institutional collaboration and support, and agronomic research being carried out under the core program funded by the CGIAR.

Activities in 1985

Staff were posted to Kenya at midyear and spent time familiarizing themselves with the region. All countries except one were visited, and discussions were held with national program leaders on research and training needs and future collaboration.

In-country training was initiated in Ethiopia, Kenya, and Tanzania. One maize agronomist participated in the experimental phase of the on-farm research course in Zimbabwe.

A number of candidates for training in Mexico were tentatively identified in conjunction with national program leaders. These individuals most likely will begin their training in 1986.

Maize

Project: Central America and Caribbean Maize Seed Production

Donor: Swiss Development Cooperation

Pledge: US\$ 1,050,000

Duration: July 1983 - June 1986

Financial Summary

Expenses (US\$)

Previous Years	\$ 148,000
1985	\$ 218,000
Total to Date	\$ 366,000

Balance Available \$ 684,000

Objectives

The primary objective of the project, in which CIMMYT cooperates with the 13 governments of the Central American and Caribbean region, is to improve maize seed production, so that more effective and efficient use can be made of germplasm and technology now being generated through a companion project for maize improvement. That project is also funded by the Swiss Development Corporation as part of CIMMYT's core program.

Staffing

One CIMMYT staff member is assigned full time to the project. He is based in Mexico and travels extensively throughout the region.

Project Description

The seed production specialist is engaged in five major activities:

- Liaison with national seed production agencies;
- Development of mechanisms for forecasting seed demand and for generating supplies of superior varieties as they are developed by the maize improvement program;
- Assistance to breeders in developing expertise in the final steps of varietal development and description: a) selection of individual plants from an experimental variety that will be used in seed increase of the variety to be released, and b) varietal description for producer utilization and certification (stressing unique traits);
- Training in: a) breeder seed maintenance and production of basic seed and b) production of foundation and certified seed; and
- Assistance in procuring equipment and sponsorship of workshops in the region.

Activities in 1985

During the year staff assigned to the project continued to work with national seed programs. In Guatemala staff worked with national scientists to improve field operations for the efficient production of basic and foundation seed. In the Dominican Republic assistance was given in the quality control aspects of seed production. And in Haiti efforts were devoted to the organization of a seed unit, particularly for basic seed production. In addition, seed equipment was provided to national programs in El Salvador, Guatemala, Haiti, and Honduras.

At the regional level, project funds were made available for a seminar in the management and marketing of seed organized by the Regional Association of Seed Technologists (ARTES).

One national program scientist was sponsored for a special course in seed technology at Mississippi State University in the USA. Assistance was also given to a Guatemalan researcher in the preparation of a thesis on the descriptors of maize for use in the certification of seed.

Maize

Project:	Ghana Maize Program, Phase II
Donor:	Canadian International Development Agency (CIDA)
Pledge:	CA\$ 4,754,300 US\$ 3,803,000 (est.)
Duration:	October 1983 - September 1988

Financial Summary

Expenses (US\$)	
Previous Years	\$ 859,000
1985	\$ 660,000
Total to Date	\$ 1,519,000
Balance Available	\$ 2,284,000

Objectives

The project is phase II of an effort initiated in 1979. The overall objective is to increase maize production in Ghana by developing superior maize production technology and by strengthening the capabilities of staff involved in the current maize research program conducted by the Crops Research Institute. Project staff also conduct cowpea research, which is coordinated by the International Institute of Tropical Agriculture (IITA).

CIMMYT has agreed to staff the Grains Development Project for the first three years and to subcontract the cowpea research component to IITA.

Staffing

The project has one joint coordinator and one agronomist resident in Ghana for the three-year grant period. IITA provides 2.5 man-years of scientific expertise for work on legumes. The economics component is carried out by two Ghanaian economists under the direction of project staff and with assistance from CIMMYT economists.

Project Description

Three major activities are carried out under the grant:

- Breeding of high-yielding varieties adapted to the various ecological zones and crop uses in Ghana, which will be accomplished by selecting for:
 - i) increased grain yield and yield stability,
 - ii) improved resistance to lodging,
 - iii) improved disease and insect resistance, and
 - iv) improved protein quality maize for food and feed;
- On-farm research and demonstrations aimed at developing:
 - i) suitable agronomic practices for the various ecological zones of Ghana,
 - ii) cropping systems that include maize,
 - iii) appropriate technology for small-scale farmers, and
 - iv) extension information;
- Economics research in which informal and formal survey techniques and information obtained from on-farm trials and demonstrations are used to determine:
 - i) the place and importance of maize and cowpeas in existing farm activities,
 - ii) farmer circumstances that influence acceptance of new technology and the identification of recommendation domains,

- iii) the probable socioeconomic returns to farmers from recommended technologies, as compared with traditional technologies, and
- iv) policy-related studies on the structure of the public agricultural sector and trade-related issues.

Substantial graduate-level training is also provided under the grant (through Canadian and other foreign universities), and technical training is offered at CIMMYT's headquarters in Mexico. Funds are also available for purchase and maintenance of equipment needed by the research and extension programs.

As part of a national production program, the grant has a wide range of beneficiaries, including farmers, consumers, and the Crops Research Institute itself. The program is also tied to CIMMYT's core research on maize and maintains close ties with the West Africa regional maize program.

Activities in 1985

Breeding activities focused on the five maize types required in Ghana: 120-day white dent, 105-day white dent, 105-day yellow dent, 95-day yellow flint, and 95-day white dent. These have been constituted from the best available materials corresponding to the major varietal types needed in Ghana. Streak resistance is an important part of the population improvement program. Field trials of improved germplasm were planted during the year. These included both station variety trials conducted by the Crops Research Institute (CRI) and on-farm variety trials conducted by the Grains and Legumes Development Board (GLDB) and the Ministry of Agriculture (MOA). Three different variety trials were planted at various

stations to give an indication of performance in different ecological zones. On-farm trials of early-to-medium and medium-to-late maturing materials were conducted nationwide.

On-station agronomy research examined the use of crop residues and mulch, maize cassava intercropping, and weed control. Over 400 on-farm trials were carried out during the major growing season. These included both researcher- and farmer-managed plots and demonstration trials, in which a number of issues were examined, such as variety performance, fertilizer use, and maize intercropping with cassava and legumes.

In production economics research, project staff participated in an informal survey in the Volta Region. The survey had two purposes: 1) to gain more information on this important growing area for research planning and 2) to train local staff in informal-survey techniques.

The CRI joint coordinator received a six-month fellowship to work at CIMMYT in Mexico and returned to Ghana in June of 1985. Two Ghanaian scientists attended the maize in-service training course in Mexico, and one scientist from the GLDB visited CIMMYT as a visiting scientist for three weeks. Support for graduate students continued, with four scientists currently enrolled in upper level degree courses. One scientist completed his MSc and returned to the project.

A new grain drier was installed at the Crops Research Institute of Kwadaso to increase the grain drying capacity of the grains project. Humidifiers were also installed in the cold rooms to increase the longevity of stored seed.



Maize

Project: Pakistan Maize Program
Donor: United States Agency for International Development (USAID)
Pledge: Rps 8,597,029
US\$ 537,000 (est.)
Duration: October 1984 -
September 1988

Financial Summary

Expenses (US\$)	
Previous Years	\$ 109,000
1985	\$ 396,000
Total to Date	\$ 505,000
Balance Available	\$ 773,000

Objectives

This project, in which the wheat and economics programs also participate, is a continuation of an association with USAID and the Pakistan Agricultural Research Council that dates back to 1976. The overall objective of the project is to develop improved varieties and agricultural technologies for increasing production of wheat and maize in Pakistan. Specifically, the project seeks to:

- Continue efforts to produce high-yielding varieties of wheat and maize adapted to Pakistani conditions;
- Develop a detailed agroecological analysis that will permit the identification of wheat and maize zones in Pakistan;

- Establish larger and more accessible on-farm research and verification areas; and
- Increase the use of farming systems research methods.

Staffing

This component of the project is carried out by a maize agronomist.

Project Description

The maize agronomist is involved in six activities:

- Developing a 10-year plan for a program of germplasm evaluation and maintenance research and maize seed production;
- Conducting agroecological analysis for maize;
- Implementing diagnostic surveys;
- Monitoring trial plots;
- Designing and implementing an on-farm research program; and
- Assisting in training activities.

Activities in 1985

Project staff continued to emphasize the development of early maturing varieties with tolerance or resistance to major diseases and insect pests. Priorities for that work have been defined partly on the basis of information gathered in farm surveys during 1984-85. In addition, a program for developing cold and heat tolerance (employing a shuttle-breeding strategy) was begun to help meet the germplasm requirements of spring

maize production in the Punjab and of main-season production in the mid- to high-altitude northern areas of the country. Attention was also given to dual-purpose grain and fodder production, stay-green characteristics, and tolerance to higher plant densities.

Ten international trials and a range of other germplasm were received by Pakistani researchers from CIMMYT's International Maize Testing Program.

The effectiveness of on-farm research was improved considerably through the joint effort of maize researchers and socioeconomists to develop a management-oriented, holistic approach to maize improvement. This alliance was strengthened in some northern areas of the country as soil fertility researchers and extension workers joined forces with maize scientists and socioeconomists. An acute shortage of improved seed, however, is restricting the impact of the project.

Locally manufactured, tractor- and bullock-powered maize planting equipment is being developed in consultation with CIMMYT staff.

Four Pakistani researchers participated in maize in-service courses at Center headquarters. A number of in-country training opportunities were offered as well; these were mainly workshops and informal instructions given at research sites. A pre-season planning workshop, followed by a late-season travelling workshop, were particularly successful in the northern part of the country.

Wheat

Project: Barley Yellow Dwarf Virus

Donor: Italy

Pledge: US\$ 1,477,017

Duration: January 1984 -
December 1987

Financial Summary

Expenses (US\$)	
Previous Years	\$ -0-
1985	\$ 193,000
Total to Date	\$ 193,000

Balance Available \$ 1,284,017

Objectives

The project seeks to reduce losses caused by this widespread virus through the transfer of technology via CIMMYT from developed to developing country institutions. The principal objective is to identify sources of resistance to the virus from research currently being undertaken in several institutions and transfer this technology through a cooperative network to institutions throughout the world.

Staffing

The project draws on the time and skills of many people currently working in institutions around the world. Staff specifically funded under the project at CIMMYT include a virologist and an associate scientist.

Project Description

As a cooperative effort, the research program is undertaking a number of activities and channelling their results and outcomes through an information network. Efforts are focusing on seven areas:

- identifying resistant germplasm sources and breeding improved cultivars;
- conducting epidemiological studies on the dynamics of aphid vector movement and virus transmission;
- identifying virus strains;
- identifying aphid species known to transmit BYDV;
- conducting training of national program scientists;
- establishing and/or strengthening institutional relationships;
- organizing symposia and publishing proceedings.

Italian research institutions will work extensively on the project, conducting research on virus/vector/plant relationships, epidemiology, control measures, and aphid vectors.

Activities in 1985

Preliminary work was completed on the identity of aphid vectors in Mexico and the virus isolate they transmit. Several aphid vectors and two main isolates have so far been identified. Screening of germplasm for BYDV resistance is now in its second cycle in Mexico. Screening nurseries have also been prepared for distribution to selected hot spots throughout the world. Materials that perform well over a number of these hot spot sites will be made available for much wider distribution in future years as a regular part of CIMMYT's international nursery programs.

Four Italian research institutions are currently involved in collaborative work with CIMMYT under the project. National research programs in Brazil, Chile, Ecuador, and Zimbabwe also are contributing to the research efforts.

Training is expected to begin in 1986, with two scientists pursuing advanced degrees and others attending in-service courses at CIMMYT in Mexico.

Wheat

Project:	East Africa Cereal Program
Donor:	Canadian International Development Agency (CIDA)
Pledge:	CA\$ 1,760,000 US\$ 1,354,000 (est.)
Duration:	October 1984 - June 1988

Financial Summary

Expenses (US\$)	
Previous Years	\$ 47,000
1985	\$ 135,000
Total to Date	\$ 182,000
Balance Available	\$ 1,172,000

Objectives

The project has as its principal objective increased wheat and triticale production and productivity in the seven countries that comprise the CIMMYT East Africa region. These include Burundi, Ethiopia, Kenya, Rwanda, Somalia, Tanzania, and Uganda. The project seeks to transfer improved wheat production technology to the countries of eastern Africa, primarily through improved agronomic practices and varietal improvement. A companion project, also funded by CIDA as part of the same grant, seeks to increase maize production and productivity in the region (see page 31 of this report).

Staffing

One agronomist is assigned to the project and is based in Kenya. He works in close collaboration with

scientists from national research programs stationed in the region and with other CIMMYT scientists stationed in East Africa.

Project Description

Agronomic research—The agronomist is involved in initiating, implementing, and evaluating agronomic trials to derive, test, and validate packages of agronomic practices appropriate to farmers' circumstances in the region. On-farm research is the principal vehicle for carrying out these activities.

Agronomic production—The agronomist acts as an adviser to national programs and extension services to assist in applying new verified technology and to encourage farmers to adopt the methods.

Agronomic training—A variety of training opportunities and fellowships are provided. One important type of training that will take place in the region is in the methodology of on-farm research. Other activities in the region will include workshops related to the development and implementation of recommended technologies. Training outside the region primarily will be provided through in-service courses at CIMMYT in Mexico and degree-related programs at selected universities.

The expected beneficiaries of the project are farmers and national research institutions in the region. The project is one of several in the eastern and southern Africa region currently being implemented by CIMMYT. By focusing on agronomic issues in the

region, the project has an important tie to germplasm development and networking efforts, institutional collaboration and support, and general agronomic research, all carried out under the core program funded by the CGIAR.

Activities in 1985

The wheat agronomist has concentrated on the research and production programs of Kenya and Ethiopia, where over 90% of the region's small grains are produced. In Kenya, time was spent planning on-station and on-farm agronomic experiments for implementation in 1986. Variables to be investigated include tillage methods, herbicide mixtures, weed control, and fertilizer rates. The objective is to identify production methods for sustainable wheat production in marginal ecological zones. In Ethiopia, a major effort is planned to coordinate agronomic research in the country. A number of factors will be studied, such as double cropping, crop rotation, and the components of the complex farming system.

The agronomist participated in a number of workshops in the region, and in-country training also took place. In Ethiopia, about 110 scientists participated in the farming systems research workshop jointly supported by International Agricultural Research, CIMMYT and International Livestock Center for Africa. Papers were presented on the design, implementation, and institutionalization of farming systems research. In-service trainees were also identified, two from Ethiopia and one from Kenya. They will attend courses at CIMMYT in Mexico in 1986.

Wheat

Project:	Pakistan Wheat Program
Donor:	United States Agency for International Development (USAID)
Pledge:	Rps 12,206,835 US\$ 763,000 (est.)
Duration:	October 1984 - September 1988

Financial Summary

Expenses (US\$)	
Previous Years	\$ 66,000
1985	\$ 388,000
Total to Date	\$ 454,000
Balance Available	\$ 1,387,000

Objectives

This project, in which the maize and economics programs also participate, is a continuation of an association with USAID and the Pakistan Agricultural Research Council that dates back to 1979. The overall objective of the project is to develop improved varieties and agricultural technologies for the increased production of wheat and maize in Pakistan. Specifically, the project seeks to:

- continue efforts to produce high-yielding varieties of wheat and maize adapted to Pakistani conditions;
- develop a detailed agroecological analysis that will permit the identification of wheat and maize zones in Pakistan;
- establish larger and more accessible on-farm research and verification areas;
- increase the use of farming systems research methods.

Staffing

This component of the project utilizes the services of a wheat agronomist.

Project Description

The wheat agronomist is involved in six areas:

- developing a 10-year plan for a germplasm evaluation and genetic materials maintenance research program for wheat and for wheat seed production;
- developing an agroecological analysis for wheat;
- implementing diagnostic surveys;
- planning, coordinating, and implementing an agronomy research program at provincial agricultural research stations, at the National Agricultural Research Center (NARC), and on farmers' fields;
- planning and coordinating international and national yield trials and screening for wheat, barley, and triticale.
- assisting in training activities.

Activities in 1985

On-farm agronomy research in the rainfed areas of northern Punjab, in the rice-wheat irrigated areas of Punjab, and in the irrigated maize-wheat areas of the Northwest Frontier Province (NWFP) continued to receive most of the project staff's attention. In addition, work began on evaluating the situation in the cotton-wheat areas of Multan District in southern Punjab. In this effort, a multidisciplinary team of biological and social scientists are working together to determine research opportunities and identify economic recommendations for each area.

In the rainfed wheat areas, 24 on-farm research sites were chosen for the placement of tillage, variety, fertilizer, and weed control trials. The tillage research confirmed that deep primary tillage with a moldboard plow is an important factor for increasing wheat production in these areas; i.e., soil compaction and reduced rooting were identified as major yield-limiting factors. Pak 81 (Veery 5) and S19 (Junco 'S') were the best varieties for the rainfed areas, and both phosphorus and nitrogen were needed to obtain the most economic returns from fertilizer use, specially in a dry year.

Seventy-one international nurseries were sent by CIMMYT to Pakistan in 1984-85, of which 43 were bread wheat, 13 durum wheat, 9 triticale, and 6 barley. These were distributed among, grown, and evaluated by eight provincial and national research stations within the country. Data from these experiments were returned to CIMMYT for more extensive analysis.

More than 250 national uniform yield trials, consisting of the best lines from the provincial and national breeders, were assembled and redistributed throughout Pakistan for testing. The trials were grown both on-station and on farmers' fields, in locations representative of the many agroecological zones of the country. The data from these trials provide the basis for the release of varieties in Pakistan.

In 1985, four Pakistani scientists participated in the CIMMYT in-service training program in Mexico, and three others went to CIMMYT as visiting scientists. Forty people joined the annual travelling wheat seminar, which was divided into two tours: the first occurred during mid-March in the southern areas, and the second took place during early April in the northern areas. An annual wheat conference was held in August, with many wheat scientists from around the country presenting papers. Outside consultants helped to conduct in-country training courses on the use of MSTAT (a computer software package), on diagnostic surveys, and on mechanized seeders and combines with 28, 15, and 10 trainees, respectively.

Computers were provided to several of the cooperating units and training was given for data analysis and word processing. The CIMMYT office was computerized for word processing, accounting, data bases, and statistics. Equipment was purchased for Karnal bunt research, as were other small items needed to strengthen existing provincial and federal research programs.

Wheat

Project:	Bangladesh Wheat Program
Donor:	Canadian International Development Agency (CIDA)
Pledge:	CA\$ 4,680,000 US\$ 3,744,000 (est.)
Duration:	April 1982 - April 1987

Financial Summary

Expenses (US\$)	
Previous Years	\$ 1,199,000
1985	\$ 396,000
Total to Date	\$ 1,595,000

Balance Available \$ 2,149,000

Objectives

The overall objectives of the project are to increase wheat production in Bangladesh by developing superior wheat varieties and improved production technologies, and to help strengthen and support the research and production staff currently assigned to the wheat research program of the Bangladesh Agricultural Research Institute (BARI).

Staffing

The project calls for eight man-years of longer term technical advisers and 30 man-months of short-term consultants. One CIMMYT staff member residing in Bangladesh, a breeder/pathologist, is designated the joint coordinator for the program. A second person, an agronomist, was assigned to the project in 1983.

Project Description

The project includes three primary components:

- Technical assistance: CIMMYT staff assigned to the project devote their time to wheat breeding and

cropping systems research. Breeding work is oriented toward increased grain yields and yield stability, development of varieties for various ecological zones, and improved disease and insect resistance. Cropping systems research includes fertilizer trials, soil testing, improved water and soils management, and integrated pest management.

- Training: Included in the project are 430 man-months of training (192 man-months for PhD candidates, 108 man-months for MSc candidates, 120 man-months for in-service trainees at CIMMYT, and 10 man-months for visiting scientists, also at CIMMYT).
- Equipment: Some US\$500,000 are set aside in the project for the purchase of field and laboratory equipment appropriate for use by the BARI wheat program.

The project is designed to help provide training and other educational opportunities and equipment to the BARI wheat staff and to help continue the flow of appropriate wheat varieties and technology to farmers in Bangladesh. The project also has a direct relationship with core program wheat research efforts aimed at developing early maturing varieties with tolerance to heat stress and improved resistance to helminthosporium leaf spotting diseases.

Activities in 1985

Germplasm development programs proposed at the initiation of the project continued; their objective is to produce germplasm for late or favorable dates of planting and for dryland or irrigated conditions. The system has

successfully streamlined the selection process by eliminating unsuitable material soon after introduction and has provided a solid data base from which firm recommendations for release of varieties can be made. During the year, the data base was expanded by conducting stability analyses of yields against environments on all lines.

Crop management studies were conducted on: 1) fertilizer requirements of wheat-*aus* rice rotations; 2) minimum tillage requirements for wheat land preparation; 3) performance of selected varieties/advanced lines at six dates of seeding; 4) seed rate requirements; and 5) favorable seeding patterns.

Three in-country, farmer training programs were carried out in 1985. Travelling seminars were conducted for groups of farmers and selected extension officers, in which participants were introduced to the wheat research program and visited on-farm varietal demonstrations and experiments.

Seed storage demonstrations were also given to approximately 500 farmers. Both of these programs were conducted in three districts in 1985 and will be expanded to six in 1986. A third training program for farmers participating in on-farm trials was also conducted. This gave instruction on plot management.

Two scientific officers attended short-term training in Mexico in 1985. Three other Bangladeshi scientists entered postgraduate degree training programs, using the last of the postgraduate scholarships provided for under the terms of the project.

Wheat

Project:	Peru National Cereals Program
Donors:	Peruvian National Institute for Agricultural Research and Production (INIPA) and World Bank
Pledge:	US\$ 308,000
Duration:	August 1983 - December 1985

Financial Summary

Expenses (US\$)	
Previous Years	\$ 188,000
1985	\$ 115,000
Total to Date	\$ 303,000
Balance Available	\$ 5,000

Objectives

The project is designed to help INIPA strengthen its cereals research program through:

- Consulting with national cereals research coordinators in program planning and research implementation, including the development of research facilities and manpower; and
- Assisting program leaders to develop a national in-service training program and to assist in the selection of candidates for advanced training outside Peru.

Staffing

The project is staffed by one CIMMYT staff member resident in Peru who serves as joint coordinator of the national cereals program during the two-year grant period (the project is being considered for an extension in 1986). CIMMYT staff assigned to the Andean regional wheat and maize programs also provide support to the national cereals program of Peru.

Project Description

The CIMMYT staff member assigned to this program focuses his attention on small grains research. Activities are centered on: 1) crop improvement research to develop higher yielding, more yield dependable small grains; 2) on-farm research to develop more appropriate production recommendations; 3) foundation seed multiplication; and 4) training in research procedures.

Activities in 1985

Germplasm development and improvement continued during 1985. Several bread wheat, durum wheat, triticale, and barley lines with wide adaptability and high yields were identified. From the most promising lines, 19 bread wheats, 13 durum wheats, 14 triticales and 9 barleys were selected for seed multiplication.

Fifty-two international nurseries were also distributed during the year to sites near Cusco, Huancayo, Cajamarca, La Molina, Ayacucho, Huaraz, and Puno.

A number of crop management studies were conducted, analyzing fertilizer responses, weed control techniques, and seed density. Agronomic data obtained from these and other experiments are being reviewed for inclusion in a reference booklet for extension specialists.

Training and institutional support activities were also undertaken in 1985. Field days were sponsored in two areas of the country in conjunction with INIPA. Three Peruvian scientists were nominated for in-service training courses in CIMMYT for the 1986 cycle. Operational support in the form of equipment, transport, publications, and labor expenses was also provided.



Wheat

Project:	Wheat Improvement in Turkey
Donor:	United Nations Development Programme (UNDP)
Pledge:	US\$ 263,000
Duration:	December 1983 - March 1986

Financial Summary

Expenses (US\$)	
Previous Years	\$ 132,000
1985	\$ 109,000
Total to Date	\$ 241,000
Balance Available	\$ 22,000

Objectives

The project seeks to strengthen small grains cereals research in Turkey. Specifically, the project aims to attain the following immediate objectives:

- Establishment of a germplasm exchange and distribution system that will allow Turkey to benefit from improved germplasm with superior characteristics;
- Development of improved varieties that are suitable for particular wheat-growing zones in Turkey;
- Increased understanding of the role and control of small grain diseases in production; and

- Initiation of a national in-service training program to ensure the long-term sustainability of the national cereals research program.

Staffing

The project is staffed by one wheat breeder/pathologist resident in Turkey for the two-year grant period.

Project Description

The project is establishing a program of germplasm and information exchange between Turkey, CIMMYT, Oregon State University (USA), and other major wheat-producing countries. An important aspect of this exchange program is the exploitation of winter x spring crosses.

The project also aims to develop spring and winter habit wheats for the various priority zones in Turkey. Greater production would be possible if varieties specifically adapted to the various zones were developed. Priority zones include the area along the southern coast of Turkey, the southeast portion of the country, and eastern Turkey.

Three visiting scientist training fellowships, each of three weeks duration, are available to national program winter cereals scientists. The objectives of this training are to acquire additional knowledge in the organization and management of a cereals improvement program, and to learn about the CIMMYT breeding material. Also, one trainee per year will be able to attend CIMMYT's in-service training program in Mexico.

Activities in 1985

Germplasm development work continued in accordance with the objectives of the project. In several of the Turkish research institutes, a modified-bulk selection/breeding system was introduced to increase selection efficiency. The germplasm program in the eastern regions of the country was also strengthened with the introduction of both domestic and foreign germplasm. An international winter wheat screening nursery (IWWSN) was prepared at a Turkish research institute with material from Turkish, US, and Bulgarian research programs. Twenty-five nursery sets were prepared and sent to the major winter wheat-producing countries of the world.

Institutional collaboration also received support under the grant. Two Turkish wheat breeders spent time at the CIANO experiment station near Ciudad Obregon in Sonora, Mexico, and a third scientist participated in the Winter Wheat Workshop held at CIMMYT in August 1985. Other Turkish scientists received project support for study tours of Yugoslavia and Hungary.

One Turkish scientist was sponsored to attend the in-service training course in experiment station management held at CIMMYT. This was a joint fellowship provided by the CIMMYT maize and wheat programs.

Wheat

Project: Introduction of Alien Genes in Wheat through Conventional and Biotechnology Approaches

Donors: Australia, United Nations Development Programme (UNDP), and Rockefeller Foundation

Pledges: Australia: A\$ 140,000
UNDP: US\$ 39,000
Rockefeller Foundation: US\$ 50,000

Duration: Australia, multi-year; UNDP and Rockefeller Foundation, negotiated annually

Financial Summary

Expenses (US\$)	
Previous years	\$ 10,000
1985	\$ 94,000
Total to Date	\$ 104,000

Balance Available	\$ 99,000
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Objectives

The objectives of the Wheat Wide Cross Program are to incorporate resistance to *Helminthosporium sativum*, *Fusarium graminearum* and *Novossia indica* (Karnal bunt) and stress tolerance (salt, drought, heat, aluminum, and copper) from related genera into wheat. Sources of resistance/tolerance have been identified within *Aegilops*, *Agropyron*, *Elymus*, *Haynaldia* and *Secale* species. Gene transfer is made by the hybridization of wheat with the alien species; the hybrid is then advanced by further crosses with wheat. Field and greenhouse selections are used to identify potential sources of resistance/tolerance and to detect successful transfers.

Staffing

One post-doctoral fellow is sponsored by the project. A second CIMMYT staff member, a cytologist, is funded from core (i.e., CGIAR) sources.

Project Description

The areas of work covered by the grant include:

- Intergeneric hybrid production of early backcross generations in the greenhouse;
- Embryo culture/rescue is carried out on all hybrid and backcross I generations to maximize the rate of survival of the progeny;
- Somatic and meiotic cytological analyses are carried out on the early generation progeny to confirm hybrid status and to study the loss or retention of the alien chromosomes during the early generations. The somatic analytical techniques involve both routine chromosome counting and chromosome banding for the identification of individual alien chromosomes.
- Interspecific hybridization using species more closely related to wheat, such as *Triticum boeoticum* and *T. dicoccoides*. This is a new area of interest, with similar objectives to the ongoing intergeneric hybridization program;
- Field screening of early progenies (from backcross II onwards) and advanced progenies for *Helminthosporium sativum*, *Fusarium graminearum*, and *Puccinia recondita* f.sp. *tritici* (leaf rust) resistance and salt tolerance;
- The use of electrophoresis as a method of determining the extent of wheat-alien translocations that have occurred in the advanced progeny and to characterize the chromosomes involved;
- Liaison of tissue culture activities with collaborating institutes;
- Overseeing the production of primary triticales for the triticale program.

Activities in 1985

Activities this year focused on the production of new hybrids and early generation progenies using new advanced wheat genotypes from the CIMMYT wheat breeding programs. Hybrids were produced with 13 of the 22 *Aegilops* species previously identified as potential sources of resistance to helminthosporium and Karnal bunt diseases, and of tolerance to aluminum. A number of durum hybrids were produced with 15 new alien species. This augmented the number of alien species that have been successfully hybridized with durum wheat to 24 in total. These hybrids will be advanced for ultimate use by the CIMMYT durum wheat program. Acting on a need expressed by the durum program, work was initiated toward the production of durum germplasm containing the 1B/1R translocation. In addition, the transfer of the 5A/5RL translocation carrying a gene conferring copper uptake efficiency was initiated and advanced to the F₁ top and F₂ generations. The translocation used in this work was transferred from a Chinese Spring 5A/5RL line, obtained from T.E. Miller, Plant Breeding Institute, Cambridge, England.

In the 1985-86 winter cycle, 9005 early and advanced progenies were planted. These included 538 lines selected for fusarium resistance, 409 lines selected for helminthosporium resistance, and 1034 leaf rust-resistant lines.

An electrophoresis facility was initiated for use in determining the extent and characterization of the wheat-alien translocations that have occurred in wide cross program advanced progenies. The equipment was purchased in 1984-85, and the facility became operational in December 1985.

Economics

Project:	Pakistan Economics Program
Donor:	United States Agency for International Development (USAID)
Pledge:	US\$ 300,000 Rps 2,561,000 (US\$ 160,000 est.)
Duration:	October 1984 - September 1988

Financial Summary

Expenses (US\$)	
Previous Years	\$ -0-
1985	\$ 75,000
Total to Date	\$ 75,000
Balance Available	\$ 385,000

Objectives

This project, in which the maize and wheat programs also participate, is a continuation of an association with USAID and the Pakistan Agricultural Research Council (PARC) that dates back to 1976. The economics portion of the grant was begun in 1984. The overall objective of the project is to develop improved varieties and agricultural technologies for the increased production of wheat and maize in Pakistan.

Staffing

This component of the grant supports the activities of a CIMMYT staff member specializing in on-farm research. In addition, a second agricultural economist (working under core funds in the CIMMYT Asian

regional program and stationed in Pakistan) devotes about 50% of his time to project related activities.

Project Description

The on-farm research specialist is involved primarily in the design, implementation, and evaluation of an expanded on-farm research and verification program for the nationally coordinated wheat and maize programs. He participates in a number of activities, such as diagnostic surveys, the design of on-farm trials, the development of on-farm research methodologies, and in-training courses and workshops.

The agricultural economist works on methodological issues in on-farm research and resource allocation, and also participates in diagnostic surveys and training courses.

Activities in 1985

Collaborative efforts were undertaken with various agricultural economic research units in Pakistan in an effort to develop and enhance on-farm research capacities. A number of surveys were conducted throughout the country focusing on wheat production practices, farming systems, and cropping patterns. In the latter case, this also has important implications for the allocation of research sources. In maize, assistance was provided in site selection and implementation of the planned on-farm experiments in Swat and Mansehra.

In-country training took place with field staff in formal survey techniques, spread sheet analysis, and survey data analysis.



Economics

Project:	Haiti Economics Program, Phase II
Donor:	Canadian International Development Agency (CIDA)
Pledge:	CA\$ 778,395 US\$ 564,000 (est.)
Duration:	January 1985 - December 1988

Financial Summary

Expenses (US\$)	
Previous Years	\$ -0-
1985	\$ 85,000
Total to Date	\$ 85,000

Balance Available	\$ 479,000
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Objectives

The primary objective of the project is to facilitate the development and diffusion of technologies appropriate to the biological and socioeconomic circumstances of representative Haitian farmers growing maize through the training of Haitian researchers in on-farm research techniques.

Staffing

One CIMMYT staff member is assigned to the project, and additional staff input is provided at no cost to the

project by the CIMMYT maize agronomist and the CIMMYT economist working in the Central American and Caribbean regional program. This latter program is classified as core restricted and is funded by the Swiss Development Corporation.

Project Description

The components of the project include:

- Informal surveys of farmers' circumstances;
- On-farm trials and demonstrations of production technologies; and
- Training of Haitian researchers in on-farm research techniques.

The project is an important adjunct to CIMMYT's core Economics Program. Haiti, with its low levels of income, labor-intensive farming, and underfunded research service, offers a demanding environment for testing CIMMYT's procedures in on-farm research. The project benefits the Haitian national program and local maize producers. On a much larger scale, other national programs will benefit from the development of more effective mechanisms for bringing together biological and social science research.

Activities in 1985

During June, 23 national program scientists attended a seminar on on-farm research. Representatives of every major agricultural research/development project in Haiti and five district authorities were in attendance. Project funds were also used to help provide practical training to a group of university students in such areas as seed production and the analysis of experiments in farmers' fields. Also, one national scientist entered an advanced degree program in the United States.

On-farm research received considerable attention throughout the year. Experiments on conservation tillage were carried out in farmers' fields, and the preliminary analyses are encouraging. There appear to be no significant differences in land preparation treatments between conventional and conservation tillage, with the added benefit, though, of lower variable costs under the latter. Other on-farm research issues that are currently being explored include fertilizer use and grain storage.

In the area of germplasm improvement, work continued on adapting CIMMYT variety La Maquina 7827 to local conditions.

Economics

Project:	On-Farm Research in Eastern and Southern Africa
Donor:	United States Agency for International Development (USAID)
Pledge:	US\$ 1,213,000
Duration:	June 1982 - December 1985

Financial Summary

Expenses (US\$)	
Previous Years	\$ 687,000
1985	\$ 524,000
Total to Date	\$ 1,211,000
Balance Available	\$ 2,000

Objectives

The project seeks to provide the expertise in on-farm research required by a number of national agricultural research and extension institutions and USAID agricultural project management teams in eastern and southern Africa. The project concentrates on four major objectives, all relating to on-farm research:

- Direct collaboration with national programs;
- Training;
- Network development; and
- Institutionalizing the on-farm research concept.

Staffing

Two CIMMYT economists are assigned to the project. One is based in Swaziland and is responsible for collaborating with USAID-sponsored teams in Botswana, Lesotho, Malawi, and Swaziland. The second is based in Kenya and concentrates on training and collaborating with USAID programs in the northern part of this region.

Project Description

Major activities include:

- **Training:** The project has implemented a series of in-country training programs using a format introduced by the CIMMYT economics staff. Training is carried out through a series of "calls" in which research trainees convene at an on-farm research area at various stages in a crop cycle. This is a learning-by-doing process involving farm-level surveys, and on-farm research trials and technology demonstrations.
- **Direct cooperation with national programs:** At the request of national programs and their USAID collaborators, CIMMYT staff participate in adaptive on-farm research surveys to assess farmer circumstances, evaluate possible new technological components to enhance farmer productivity, and design and implement appropriate on-farm trials.
- **Regional seminars and publications:** The aim is to facilitate discussion and information exchange among the various programs so that the accumulated experience can be shared.

- **Development of research results relevant to policy formulation:** This serves not only as the final step in the on-farm research process but also helps to integrate on-farm research into national research and extension programs. It is an important part of the institutionalization of on-farm research.

Benefits from this project come in the form of greater productivity in the agricultural sectors of the countries involved. This increased productivity itself will be the result of more effective agricultural research. In providing this expertise in on-farm research, the CIMMYT economics program also benefits from the knowledge acquired and seeks to transfer these lessons to other areas of the world.

Activities in 1985

Training continued to receive emphasis under the grant. Two regional training workshops were held during the year in collaboration with the University of Zimbabwe, Department of Land Management. There were some 32 participants for the sessions, which taught the planning, implementation, management, and evaluation of on-farm experiments. In-country training was also important. Kenya, Malawi, and Tanzania were all locations of on-going courses under the "call" system. CIMMYT staff also participated in a number of orientation sessions in Malawi and the Sudan. These were designed to introduce on-farm research with a farming systems perspective to national program scientists.

Issues 19, 20, and 21 of the Farming Systems Newsletter were distributed during the year. A "networkshop" was also held in Botswana. It was attended by farming systems economists from ten countries in the region and covered such topics as the use of economic analysis and micro-computers in on-farm research. A meeting of senior agricultural administrators was held at year end to assess progress and needs in on-farm research with a systems perspective. The program for the networkshops was developed around suggestions from research and extension administrators from the region. The achievements of on-farm research and the problems in its

implementation in seven countries were reviewed. Other topics covered included institutionalization, research/extension linkage, planning and policy coordination, programming on-farm research teams, training, and networking. For 1986, a number of additional themes for possible networkshops emerged: 1) review of a field program in OFR; 2) on-farm experiments with case studies of planning, management, and evaluation; 3) crop/animal interactions in the farming systems of the region; and 4) micro-computers and data analysis for agronomists in on-farm research.

The two CIMMYT staff assigned to the project also spent time collaborating with national programs. They visited the countries in the region a number of times and worked with national scientists in virtually every aspect of on-farm research. In doing this, they drew frequently on the advice and participation of other CIMMYT staff based both in the region and in Mexico.

Finally, during 1985, Phase II of this grant was successfully renegotiated. The second phase will run from 1986-90 and will permit the assignment of two new staff—an agronomist and an economist—to the project.



Information Services

Project: Information Service on Wheat and Other Small Grains

Donor: International Development Research Centre (IDRC), Canada

Pledge: CA\$ 387,075
US\$ 295,000 (est.)

Duration: June 1984 - June 1987

Financial Summary

Expenses (US\$)

Previous Years	\$ 11,000
1985	\$ 86,000
Total to Date	\$ 97,000

Balance Available \$ 198,000

Objectives

The project seeks to establish an information and documentation service for the benefit of researchers focusing on wheat and other small grains in the developing world. This objective will be met through the following activities:

- Establish a Scientific Information Unit (SIU) and integrate the CIMMYT library within it;
- Improve CIMMYT's capacity to respond to scientific questions from developing-country researchers;
- Deliver bibliographic services (CAB, AGRIS) to up to 700 individuals and institutions in developing countries. (The provision of the AGRIS journal of wheat, triticale, and barley is already covered by IDRC project No.3-P-83-0254, which began operation in January, 1984);
- Develop a document-delivery service controlled by the progressive implementation of a coupon scheme;

- Develop a local data base on CIMMYT-generated and other relevant "gray" literature; and
- Produce state-of-the-art reviews.

Staffing

Project funds support three positions: a senior scientific information officer, a junior programmer and a secretary. All other positions, e.g., the existing library staff and a database operator, are funded by CIMMYT.

Project Description

CIMMYT provides free of charge two bibliographic services (CAB, AGRIS) on wheat and other small grains to up to 700 collaborating scientists and institutions in the developing world. More than 15,000 references will be cited annually in these two bibliographic journals.

CIMMYT also offers recipients a document delivery service for the complete articles listed in the two bibliographic journals. On a limited basis, these documents will be provided free of charge.

Increased access to online databases for literature searches will also be provided to CIMMYT staff and key collaborators.

CIMMYT is to become an AGRIS input center for its own publications. A local data base is to be developed to access unique CIMMYT-generated information as well as the "gray" literature received from other research collaborators.

State-of-the-art reviews on key research topics will be prepared by visiting scientists wholly dedicated to this purpose. CIMMYT scientists will cooperate with the visiting scientists in the consolidation of available information, and the SIU will provide logistical support for these exercises.

The SIU also is to establish a distribution center (using microfiche technology) on a pilot basis at a

regional program office to provide hard copies of selected articles included in scientific literature collections on file at the office.

Activities in 1985

Bibliographic service—IDRC provided funds for the production of "Wheat, Barley and Triticale Bibliography," with data extracted from the AGRIS database. Ready-for-print bromides are sent to CIMMYT for printing in Mexico and bimonthly issues are dispatched to a selected subset of developing country libraries and collaborators from CIMMYT's global mailing list. For the second consecutive year, CIMMYT's Wheat Program financed 600 annual subscriptions of "Wheat, Barley and Triticale Abstracts," co-published with CAB. Bimonthly issues are dispatched from the United Kingdom to the same subset of addresses as the AGRIS journal.

A similar bibliographic service, not covered in the IDRC project, was also implemented for the Maize Program with 500 annual subscriptions of "Maize Abstracts," co-published with CAB.

Document delivery service—As part of the IDRC project, CIMMYT has instituted a limited free-of-charge document delivery service for the recipients of the wheat, barley, and triticale journals. This service is based upon the progressive implementation of a coupon system in which each coupon (printed in English and Spanish) entitles the recipient to request two full-text manuscripts from the SIU. Coupons are mailed with letters focusing on various service-related questions. After sending out the fourth round of coupons, approximately 330 requests for full-text documents have been returned to CIMMYT. Fifty percent of the requested documents were available at CIMMYT or another Mexican library and could be

dispatched in less than five days; the remainder had to be requested from outside sources, with a success rate of 25%.

Online literature searches—Online access to DIALOG (Palo Alto, California), AGRIS (Vienna), QUESTEL (France), and Mexican databases has been implemented. CIMMYT researchers made extensive use of these newly available online literature search facilities, requesting approximately 250 searches during 1985. Lists of all search topics were circulated to CIMMYT staff and results were provided on request.

CIMMYT has become an AGRIS input center, submitting indexed references together with abstracts of its own publications on magnetic tape to the AGRIS database. The same processed references were also distributed to other relevant agricultural database to make them retrievable for a wider audience.

In-house database management—IDRC provided the funds for the purchase of the database management package System 1032. A bibliographic database has been developed that includes materials available from CIMMYT. CIMMYT's global mailing list system is being converted to System 1032 and will allow for a more efficient handling of journal and coupon mailing.

State-of-the-art-reviews—The IDRC grant provides funds to support senior visiting scientists who work with selected CIMMYT staff to prepare state-of-the-art reviews. The first such review has been initiated under the leadership of an Emeritus Professor of plant breeding. He is working with several CIMMYT wheat pathologists to assess changes in epidemiological zones around the world during the past 10 years. Using results from the Regional Disease Trap Nursery (RDTN), the origin and spread of rust pathogens from one zone to another in these major small-grains production regions are being mapped. Such mapping can help provide an early warning system that can give plant breeders and seed industries 3-5 years of advance notice about potentially dangerous races of rust.

Library strengthening—Apart from the new task of providing efficient bibliographic and document delivery services to developing country collaborators, the SIU seeks to become a more significant part of CIMMYT's research process. Awareness of new modes of information retrieval must be created, user needs must be evaluated continuously, and library staff must be trained to access a wider range of services. CIMMYT's collection of serial publications is now periodically evaluated to ensure that it reflects the

needs of the SIU's major clients, namely resident and outreach staff, trainees, and also the beneficiaries of the bibliographic and document delivery services. Special efforts are being made to increase the number of titles based on exchange agreements and donations and to strengthen collaboration with Mexican agricultural libraries. Monthly acquisition lists were prepared and circulated to resident and outreach offices. In 1985, in-house training courses for the VAX system and outside retrieval courses were attended by several SIU staff. Two AGRIS training courses taught by teachers from FAO Rome were organized by the SIU, and 25 Mexican librarians and information officers were also invited to participate.

Further useful experience was gained during the IDRC-sponsored participation of the senior scientific officer at the VII World Congress of the International Association of Agricultural Librarians and Documentalists in Ottawa. Several pending library management issues were discussed during a one-week library consultancy in late November. Microfiche equipment was purchased with IDRC funds, and the microfiching of CIMMYT documents on a regular basis will begin in 1986.

Appendices

Appendix I Distribution of Maize Program international trials, 1983-85

	1983 Trials	1984 Trials	1985 Trials		1983 Trials	1984 Trials	1985 Trials
				Sub-Saharan Africa (cont'd)			
Central America, Mexico, and Caribbean	201	195	164	Gabon	2	3	—
Bahamas	—	—	—	Gambia	2	2	5
Barbados	—	—	—	Ghana	2	4	3
Belize	3	—	—	Guinea	10	7	—
Costa Rica	31	11	11	Guinea-Bissau	4	4	1
Cuba	2	—	9	Ivory Coast	5	7	1
Dominican Republic	10	7	8	Kenya	39	21	26
El Salvador	10	9	3	Liberia	—	2	—
Grenada	—	—	1	Madagascar	—	—	3
Guatemala	17	17	6	Malawi	1	13	1
Haiti	4	—	—	Mali	23	8	6
Honduras	20	12	14	Mozambique	—	2	5
Jamaica	2	2	12	Nigeria	4	5	2
Mexico	68	71	55	Rep. South Africa	—	2	—
Nicaragua	6	35	12	Reunion	—	10	—
Panama	26	25	25	Rwanda	—	1	—
St. Kitts	—	6	6	Senegal	8	23	19
Trinidad	2	—	2	Sierra Leone	33	16	6
				Somalia	9	6	3
South America	114	130	123	Sudan	—	6	9
Argentina	18	11	23	Swaziland	6	6	8
Bolivia	13	19	27	Tanzania	11	—	7
Brazil	39	38	18	Togo	12	15	—
Chile	1	1	3	Transkei	—	—	—
Colombia	8	7	6	Uganda	5	6	3
Ecuador	—	1	5	Zaire	12	17	4
Paraguay	—	8	5	Zambia	6	7	6
Peru	16	22	21	Zimbabwe	15	9	18
Surinam	3	—	2				
Uruguay	1	1	3	Asia	186	184	193
Venezuela	15	22	10	Afghanistan	1	—	—
Mediterranean/Mideast	24	27	40	Bangladesh	8	14	4
Algeria	—	—	—	Burma	9	—	14
Egypt	2	6	9	China	—	18	19
Iran	—	—	4	India	28	9	5
Iraq	—	2	—	Indonesia	6	12	14
Jordan	—	—	6	Korea, South	1	1	1
Libya	—	—	3	Malaysia	7	2	—
Mauritania	—	—	4	Nepal	7	1	10
Morocco	—	7	6	Pakistan	17	17	14
Qatar	2	—	2	Philippines	43	48	51
Saudi Arabia	13	—	—	Sri Lanka	6	4	7
Syria	—	1	—	Thailand	45	34	44
Turkey	—	4	2	Vietnam	8	24	10
Yemen A.R.	7	7	4				
				Other	50	15	14
Sub-Saharan Africa	252	229	194	France	—	4	9
Angola	3	2	6	Germany, Fed. Rep.	—	—	—
Benin	6	—	—	Greece	2	2	2
Burkina Faso	12	12	22	New Guinea	12	—	—
Burundi	12	—	9	Spain	—	1	—
Cameroon	6	6	6	Tahiti	—	—	—
Cape Verde	4	5	3	USA	11	8	3
Central African Republic	—	2	—				
Congo	—	—	—	Total Trials	827	780	728
Ethiopia	—	—	12	Total Countries	68	72	74

Appendix II
Distribution of Wheat Program international nurseries, 1985

	Bread Wheat	Durum	Triti- cale	Barley	Germ. Dev.	Special Nur.		Bread Wheat	Durum	Triti- cale	Barley	Germ. Dev.	Special Nur.
Latin America	183	69	78	34	29	70	Asia	181	48	51	64	26	70
Argentina	28	19	9	--	4	8	Afghanistan	2	2	--	--	--	2
Bolivia	21	8	4	1	1	4	Bangladesh	15	1	2	--	--	5
Brazil	49	3	28	9	12	31	Bhutan	4	2	--	2	1	--
Chile	19	11	10	3	5	8	Burma	5	--	2	2	--	2
Colombia	7	--	2	3	2	3	China	55	12	13	30	6	30
Costa Rica	3	--	--	1	--	1	India	16	10	6	2	6	4
Ecuador	10	2	5	1	2	3	Indonesia	6	2	1	--	--	1
Guatemala	7	3	3	2	--	2	Japan	1	--	--	1	--	--
Guyana	--	--	1	--	--	--	Korea, South	2	2	2	3	--	1
Mexico	13	9	9	8	3	1	Nepal	8	2	2	--	1	5
Paraguay	6	--	--	--	--	2	Pakistan	28	8	10	11	9	11
Peru	16	14	7	3	--	6	Philippines	12	1	3	1	--	3
Uruguay	4	--	--	3	--	1	Sri Lanka	2	--	--	--	--	1
							Taiwan	5	--	2	2	--	1
							Thailand	20	6	8	10	3	--
Africa	235	115	72	66	28	84	Oceania	37	10	14	7	1	17
Algeria	17	14	6	6	2	6	Australia	30	4	8	4	1	9
Angola	2	--	2	--	--	1	New Zealand	7	6	5	2	--	8
Burkina Faso	2	--	--	--	--	1	New Caledonia	--	--	1	1	--	--
Cameroon	8	1	1	1	1	2							
Congo	7	--	--	--	--	--	Europe	103	113	88	61	34	60
Egypt	18	19	9	9	4	7	Albania	5	6	4	3	2	1
Ethiopia	11	10	3	7	4	6	Austria	--	4	1	1	1	--
Gabon	--	--	1	--	--	--	Belgium	--	--	--	--	1	--
Kenya	16	7	6	4	1	4	Bulgaria	--	6	--	--	4	3
Libya	22	11	1	2	1	3	Czechoslovakia	4	--	--	2	3	1
Malawi	5	4	3	3	2	2	England	3	--	4	2	2	2
Mali	2	--	--	--	--	--	Finland	--	--	--	1	--	--
Morocco	13	13	3	3	--	8	France	5	5	6	2	2	4
Mozambique	8	4	4	2	--	2	Germany, E. Dem.	1	--	3	3	2	1
Nigeria	5	--	1	1	--	2	Germany, W. Fed.	--	6	2	3	--	--
Rwanda	4	--	2	--	--	1	Greece	7	6	5	4	2	3
Senegal	3	--	--	--	--	1	Hungary	--	4	4	3	--	1
Somalia	3	--	--	--	--	1	Ireland	4	--	--	3	--	--
S. Africa	17	9	6	6	4	8	Italy	8	16	5	6	1	6
Sudan	10	4	3	1	--	3	Netherlands	1	--	1	--	1	2
Swaziland	2	--	--	--	--	1	Norway	4	--	2	3	--	--
Tanzania	15	3	6	6	4	6	Poland	4	--	7	1	--	--
Tunisia	18	14	7	8	3	6	Portugal	12	19	6	3	2	7
Uganda	4	1	2	1	--	3	Rumania	3	1	5	--	3	3
Zaire	6	--	--	--	--	2	Spain	24	28	23	16	2	17
Zambia	11	--	5	--	1	4	Sweden	2	1	3	--	--	--
Zimbabwe	6	1	1	6	1	4	Switzerland	2	1	1	--	1	1
							USSR	3	4	--	--	--	1
							Yugoslavia	11	6	6	5	5	7
Middle East	95	64	33	38	16	44	North America	2	0	3	14	5	7
Cyprus	5	4	3	2	1	2	Canada	--	--	3	6	--	1
Iran	8	2	3	6	--	5	USA	2	--	--	8	5	6
Iraq	--	--	--	--	--	2							
Israel	13	8	3	--	5	3	Total Nurseries	836	419	339	284	139	352
Jordan	7	8	4	3	1	3	Total Countries	84	58	70	62	49	78
Lebanon	3	3	--	2	--	2							
Qatar	3	--	2	2	--	--							
Saudi Arabia	4	--	--	1	--	3							
Syria	21	14	6	5	6	7							
Turkey	29	25	12	17	3	13							
Yemen, A.R.	2	--	--	--	--	--							
Yemen, Dem.	--	--	--	--	--	2							

Appendix III
Origin of maize in-service trainees, 1971-85

	1971-85	1985		1971-85	1985
Central America,			Asia (cont'd)		
Mexico and Caribbean	253	22	Nepal	26	2
Belize	6	—	Pakistan	46	2
Costa Rica	19	4	Philippines	30	3
Cuba	4	1	Thailand	50	1
Dominica	1	—	Vietnam	8	2
Dominican Republic	20	2			
El Salvador	28	2	North Africa and		
Grenada	1	—	and Mideast		
Guatemala	28	5	Algeria	1	—
Guyana	1	—	Egypt	29	4
Haiti	18	—	Iran	1	—
Honduras	33	3	Syria	2	—
Jamaica	1	—	Tunisia	3	—
Mexico	51	5	Turkey	19	2
Nicaragua	25	—	Yemen A.R.	3	—
Panama	17	—			
			Sub-Saharan Africa		
South America	113	6	Benin	2	—
Argentina	12	1	Botswana	2	—
Bolivia	12	—	Burundi	1	1
Brazil	4	—	Cameroon	4	—
Colombia	15	—	Cape Verde	1	—
Chile	2	—	Congo	1	—
Ecuador	24	1	Ethiopia	8	—
Paraguay	3	—	Ghana	34	2
Peru	33	4	Guinea-Bissau	3	—
Venezuela	8	—	Ivory Coast	5	—
			Kenya	14	1
Asia	215	15	Lesotho	1	—
Afghanistan	6	—	Mali	1	—
Bangladesh	13	—	Malawi	8	2
Burma	1	—	Mozambique	3	—
China	1	1	Nigeria	15	—
India	10	—	Rwanda	2	—
Indonesia	12	4	Senegal	3	—
Japan	7	—	Somalia	5	2
Korea	2	—	Swaziland	1	—
Malaysia	3	—	Tanzania	57	2
			Transkei	1	—
			Uganda	4	1
			Zaire	32	—
			Zambia	10	1
			Other Countries		
				4	1
			Total Training Fellows	861	62
			Total Countries	74	27

Appendix IV
Origin of wheat in-service trainees, 1966-85

	1966-85	1985		1966-85	1985
Latin America	241	21	Sub-Saharan Africa	103	2
Argentina	16	—	Burundi	1	—
Bolivia	25	1	Cameroon	5	—
Brazil	21	1	Chad	1	—
Chile	13	—	Ethiopia	20	—
Colombia	8	—	Kenya	14	1
Dominican Republic	3	—	Lesotho	2	—
Ecuador	27	3	Madagascar	2	—
Guatemala	14	1	Malagasy	1	—
Guyana	2	—	Malawi	3	—
Honduras	1	—	Mali	3	—
Mexico	62	9	Mozambique	1	—
Panama	1	—	Nigeria	18	—
Paraguay	9	1	Rwanda	2	—
Peru	38	5	Senegal	2	—
Uruguay	1	—	Somalia	1	—
			Tanzania	14	1
North Africa			Transkei	1	—
and Mideast	225	9	Uganda	1	—
Algeria	54	—	Zaire	2	—
Cyprus	2	—	Zambia	7	—
Egypt	16	1	Zimbabwe	2	—
Iran	10	1			
Iraq	5	—	Asia	231	21
Jordan	7	—	Afghanistan	13	—
Lebanon	4	—	Bangladesh	51	2
Libya	4	—	Burma	2	—
Morocco	23	1	China	3	3
Saudi Arabia	2	—	India	19	1
Sudan	4	1	Indonesia	2	2
Syria	9	1	Korea	19	1
Tunisia	28	—	Nepal	24	3
Turkey	54	4	Pakistan	70	4
Yemen	3	—	Philippines	14	3
			Sri Lanka	2	—
			Thailand	11	2
			Vietnam	1	—
			Other Countries	30	2
			France	1	—
			Hungary	2	—
			Norway	1	—
			Poland	5	—
			Portugal	5	1
			Rumania	2	—
			Spain	6	1
			USA	4	—
			USSR	4	—
			Total Training Fellows	830	55
			Total Countries	73	26

Appendix V

Publications released by CIMMYT in 1985

	Language	Pages	Pressrun
Administration			
CIMMYT Annual Report 1984	English	72	3,000
	Spanish	72	3,000
CIMMYT Research Highlights 1984	English	116	4,000
	Spanish	112	3,000
CIMMYT Mid-Term Budget 1986	English	36	750
Patronato of Sonora (CIMMYT Today 16)	English	12	6,000
	Spanish	12	4,000
Strengthening Agricultural Research in Latin America and the Caribbean: A Proceedings of the IDB Conference	Spanish	196	2,000
	English	180	1,000
Training at CIMMYT	English	32	2,500
	Spanish	32	2,000
Maize			
1980-81 CIMMYT Maize Improvement Report	English	104	2,000
Maize International Testing, 1983 Final Report	English	360	750
Maize International Testing, 1984 Preliminary Report	English	316	750
Managing Trials and Reporting Data for CIMMYT's International Maize Testing Program	English	24	1,500
	Spanish	28	1,000
Development, Maintenance, and Seed Multiplication of Open-Pollinated Maize Varieties	Spanish	20	3,000
Chemical Methods Used in CIMMYT	Spanish	40	1,500
Wheat			
1983 Annual Report on Wheat Improvement	English	213	3,500
1982-83 International Spring Wheat Yield Nursery (ISWYN)	English	98	750
1982-83 Elite Spring Wheat Yield Trial (ESWYT)	English	52	750
1982-83 International Bread Wheat Screening Nursery (IBWSN)	English	58	750
1982-83 International Durum Yield Nursery (IDYN)	English	60	750
1982-83 Elite Durum Yield Trial (EDYT)	English	44	750
1982-83 International Durum Screening Nursery (IDSN)	English	108	750
1982-83 International Triticale Yield Nursery (ITYN)	English	84	750
1982-83 International Triticale Screening Nursery (ITSN)	English	58	750
1982-83 International Barley Yield Trial (IBYT)	English	48	750
1982-83 International Barley Observation Nursery (IBON)	English	42	750
1982-83 International Septoria Observation Nursery (ISEPTON)	English	26	750
Instructions for Managing and Reporting Results for the CIMMYT Wheat Program International Nurseries	English	24	3,000
Rust Scoring Guide	English	12	10,000
	Spanish	12	5,000
	French	12	3,000

Appendix V (Cont'd)

	Language	Pages	Pressrun
Identification of Rust	English	1	5,000
Diseases on Wheat (Poster)	Spanish	1	3,000
	French	1	2,000
Wheats for More Tropical Environments: A Proceedings of the International Symposium	English	380	5,000
Wheat in the Third World	Spanish	184	1,500
Spring Triticale: Names; Parentage; Pedigrees; Origin	English	42	4,000
Economics			
1985 CIMMYT World Wheat Facts and Trends, Report Three: A Discussion of Selected Wheat Marketing and Pricing Issues in Developing Countries	English	46	7,000
<i>Working paper series:</i>			
Comparative Advantage and Policy Incentives of Wheat Production in Ecuador	English	124	700
	Spanish	140	500
The Concept of Recommendation Domains	French	42	500
Maize Food and Feed Consumption in the Developing World	English	86	700
The Rate and Sequence of Adoption of Improved Cereal Technologies: The Case of Rainfed Barley in the Mexican Altiplano	Spanish	62	500
Copublication of Bibliographic Journals			
Wheat, Barley, and Triticale Bibliography—Vol. 1, No. 1 (AGRIS)	English	87	750
Wheat, Barley and Triticale Bibliography—Vol. 1, No. 2 (AGRIS)	English	89	750
Wheat, Barley and Triticale Bibliography—Vol. 1, No. 3 (AGRIS)	English	81	750
Wheat, Barley and Triticale Bibliography—Vol. 1, No. 4 (AGRIS)	English	67	750
Wheat, Barley and Triticale Bibliography—Vol. 1, No. 5 (AGRIS)	English	115	750
Wheat, Barley and Triticale Abstracts—Vol. 2, No. 1 (CAB)	English	92	550
Wheat, Barley and Triticale Abstracts—Vol. 2, No. 2 (CAB)	English	86	550
Wheat, Barley and Triticale Abstracts—Vol. 2, No. 3 (CAB)	English	111	550
Wheat, Barley and Triticale Abstracts—Vol. 2, No. 4 (CAB)	English	113	550
Wheat, Barley and Triticale Abstracts—Vol. 2, No. 5 (CAB)	English	109	550
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Maize Abstracts—Vol. 1, No. 1 (CAB)	English	58	550
Maize Abstracts—Vol. 1, No. 2 (CAB)	English	72	550
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México, D.F., February 26, 1986

To the Board of Trustees of
Centro Internacional de Mejoramiento
de Maíz y Trigo, A.C.

In our opinion, the accompanying statements of condition and the related statements of activity and of changes in financial position on a cash basis, expressed in United States dollars, present fairly the financial position of Centro Internacional de Mejoramiento de Maíz y Trigo, A.C. (CIMMYT) at December 31, 1985 and 1984, and the results of its operations and the changes in its financial position for the years then ended, in conformity with accounting principles generally accepted in the United States of America for not-for-profit organizations consistently applied. Our examinations of these statements were made in accordance with generally accepted auditing standards and accordingly included such tests of the accounting records and such other auditing procedures as we considered necessary in the circumstances.

Our examinations were made primarily for the purpose of forming our opinion on the financial statements taken as a whole. We also examined the additional information presented on Exhibits 1 to 4, expressed in United States dollars, by similar auditing procedures. In our opinion, this additional information is stated fairly in all material respects in relation to the financial statements taken as a whole. Although not necessary for a fair presentation of financial position, results of operations and changes in financial position, this information is presented as additional data.

PRICE WATERHOUSE


C.P. Oscar Córdoba

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Comparative Statement of Condition

Centro Internacional de Mejoramiento de Maíz y Trigo, A.C.

Assets	Currency: U.S. Dlls. (000's)	
	As of December 31	
	1985	1984
Current Assets:		
Cash on Hand and in Banks	399	791
Short-Term Investments (Note 2)	5,288	2,857
	5,687	3,658
Accounts Receivable (Note 6)		
Donors	1,130	1,437
Others	744	429
	1,874	1,866
Inventories	88	213
Total Current Assets	7,649	5,737
Fixed Assets (Note 2):		
Vehicles	3,245	2,906
Furniture, Fixtures and Equipment	5,323	4,169
Buildings	7,257	6,356
Land	464	464
Other Fixed Assets	369	369
Total Fixed Assets	16,658	14,264
Other Assets		
Work in Progress	-	9
Guarantee Deposits	1	1
Total Other Assets	1	10
Total Assets	24,308	20,011

The attached notes numbered 1 to 6 form an integral part of these Financial Statements.

Liabilities, Capital Grants, Unexpended Funds and Reserves

	As of December 31	
	1985	1984
Current Liabilities:		
Payments in Advance—Donors (Note 6)	4,509	1,549
Vouchers Payable	1,793	2,705
Seniority Premiums and Accrued Benefits (Note 2)	245	112
Accrued Taxes	212	272
Accrued Miscellaneous Expenses	2	2
Total Current Liabilities	6,761	4,640
Capital Grants, Unexpended Funds and Reserves		
Capital		
Fully Expended on Fixed Assets (Note 2)	16,658	14,264
Operating Funds (Note 4)	1,540	1,540
	18,198	15,804
Unexpended Funds		
Core Unrestricted	812	812
Core Restricted	19	19
Extra Core and Cooperative Projects	(48)	(48)
Auxiliary Services	159	65
Translation Effect (Note 3)	(1,685)	(1,373)
	(743)	(525)
Trustees Reserve	92	92
Total Capital Grants, Unexpended Funds and Reserves	17,547	15,371
Total Liabilities and Capital	24,308	20,011

The attached notes numbered 1 to 6 form an integral part of these Financial Statements.

Comparative Statement of Activity

Centro Internacional de Mejoramiento de Maíz y Trigo, A.C.

Revenue and Expenses	Currency: U.S. Dlls. (000's)	
	Year ended December 31	
	1985	1984
Revenue (Note 5)		
Grants	25,621	23,705
Administrative Fees	1,139	1,096
Sale of Crops	38	22
Interest on Short-Term Investments	309	508
Auxiliary Services	665	629
Other Income	1	2
Total Revenue	27,773	25,962
Expenses (Note 5)		
Research Programs	17,063	16,501
Conferences and Training	3,659	3,482
Information Services	905	789
General Administration	1,857	1,504
Plant Operations	1,463	1,475
Capital Acquisitions	986	607
Auxiliary Services	571	637
Indirect Costs	1,139	1,096
Seniority Premiums	36	50
Total Expenses	27,679	26,141
Excess (Deficit) of Revenue over Expenses before Translation Effect	94	(179)
Translation Effect for the Year (Note 3)	(312)	(303)
Net Deficit of Revenue over Expenses	(218)	(482)
Unexpended Funds, Opening Balance	(525)	(43)
Closing Balance Unexpended Funds as per Statement of Condition	(743)	(525)

The attached notes numbered 1 to 6 form an integral part of these Financial Statements.

Comparative Statement of Changes in Financial Position on a Cash Basis

Centro Internacional de Mejoramiento de Maíz y Trigo, A.C.

Currency: U.S. Dlls. (000's)

	Year ended December 31	
	1985	1984
Sources of Cash		
Revenue	27,773	25,962
Capitalization of Fixed Assets Purchased during the Year		
Core Unrestricted Grants	1,411	1,094
Extra Core Grants	983	—
Translation Effect of the year-Net	(312)	(303)
	29,855	26,753
Accounts receivable-Donors	307	681
Inventories	125	—
Payments in advance-Donors	2,960	128
Accrued taxes	—	127
Seniority premiums and accrued benefits (Note 2)	133	35
Other assets	9	—
	33,389	27,724
Application of Cash		
Expenses	27,679	26,141
Purchases of fixed assets		
Core Unrestricted Grants	1,411	1,094
Extra Core Grants	983	—
Accounts Receivable-Others	315	98
Inventories	—	107
Vouchers payable	912	428
Accrued miscellaneous expenses	—	5
Accrued taxes	60	—
Other assets	—	9
	31,360	27,882
Increase (Decrease) in Cash and in Short-Term Investments	2,029	(158)
Cash and Short-Term Investments at beginning of year	3,658	3,816
Cash and Short-Term Investments at end of year	5,687	3,658

The attached notes numbered 1 to 6 form an integral part of these Financial Statements.

Notes to the Financial Statement

Centro Internacional de Mejoramiento de Maíz y Trigo, A.C.

December 31, 1985 and 1984

U.S. Dollars

Note 1 — Statement of Purpose.

The Centro Internacional de Mejoramiento de Maíz y Trigo, A.C. (CIMMYT) is a private, autonomous, not-for-profit, scientific and educational institution chartered under Mexican law to engage in the improvement of maize and wheat production everywhere in the world, with emphasis on developing countries.

Note 2 — Summary of significant accounting policies.

CIMMYT follows accounting policies recommended by the Secretariat of the Consultative Group on International Agricultural Research (CGIAR), an international association sponsored by the World Bank, the Food and Agriculture Organization of the United Nations, and the United Nations Development Programme. These policies are in accordance with accounting practices generally accepted in the United States of America for not-for-profit organizations and are summarized below:

a. CIMMYT uses the accrual method of accounting for transactions and its books of account are kept in U.S. dollars. Transactions in other currencies (mainly Mexican pesos) are recorded at the rates of exchange prevailing on the dates they are entered into and settled. Assets and liabilities denominated in such currencies are translated into U.S. dollars applying Statement No. 52 of the Financial Accounting Standards Board of The United States of America (FAS 52). In accordance with that statement CIMMYT has adopted the U.S. dollar as its "functional currency"

in consideration that the Mexican economy has been hyper-inflationary, i.e. with a cumulative inflation rate for the three last years greater than 100 percent as measured by the National Consumer Price Index published by Banco de Mexico.

b. Purchase orders issued prior to December 15 are treated as operating expenses of the year in question and are shown on the statement of condition under vouchers payable. This is in accordance with guidelines issued by the Secretariat of the Consultative Group on International Agricultural Research (CGIAR).

c. During periods of cash surplus CIMMYT makes short-term investments in marketable securities. Those denominated in dollars are transacted in the U.S. money market. Interest is credited to income when the security matures or is sold. The security is recorded at cost, which approximates market, and any gain or loss from its sale is recorded at that time. Investments in pesos are held in a short-term interest-bearing account in a Mexican bank or in government securities. Interest is credited to income as accrued.

d. Inventories are stated at cost (first-in, first-out method), which is not in excess of market.

e. Fixed Assets are stated at acquisition cost. Up to 1971 all purchases of property and equipment were recorded as expenses. In 1972 the CGIAR requested that the International Agricultural Research Centers change to the "write off, then capitalize" method of recording purchases of property and equipment. Accordingly, all property and equipment purchased under capital grants as from January 1, 1972, was recorded as an asset and credited to

capital grants. Prior to 1980 replacements of capital items were recorded as expenditures of the related programs, and did not enter in any way to form part of CIMMYT's capital grants, shown on the statement of condition. In 1980, this policy was revised to conform with the accounting policies of the CGIAR. Under this set of guidelines, the incremental value of a capital replacement item, i.e., the amount by which the historical cost of the replacement item is greater (less) than the historical cost of the item being replaced, is credited (debited) to capital grants fully expended on fixed assets. In this way, the statement of condition reflects the historical cost of the fixed assets actually in use.

CIMMYT's buildings at certain locations in Mexico are constructed on land owned by the Mexican government, and will be donated to the government when CIMMYT ceases operations in Mexico.

f. Depreciation — In accordance with the "write off, then capitalize" method, no depreciation is provided since the assets have already been written off at the time of purchase.

g. Seniority premiums, to which employees are entitled upon termination of employment after fifteen years of service, are recognized as expenses as such premiums accrue. The estimate of the accrued benefit determined on the basis of an actuarial study as of the year end amounted to U.S.\$143,000 in 1985 (U.S.\$197,000 in 1984) and CIMMYT has recorded a liability of U.S.\$126,000 in 1985 (U.S.\$112,000 in 1984). The charge to income for the year amounted to U.S.\$36,000 in 1985 (U.S.\$50,000 in 1984) including amortization of past service cost over 10 years.

Other compensation based on length of service, to which employees may be entitled in the event of dismissal or death, in accordance with the Mexican Federal Labor Law, is charged to income in the year in which it becomes payable.

Since 1985, CIMMYT has recorded an accrual of unutilized leave time by staff. This amounted to \$119,000.

h. Income Recognition: Core unrestricted grants are given annually and are charged to accounts receivable when the amount of the donation becomes known. The receivable is cancelled when the funds are received. Any uncollected portion of the pledge applicable to the current year remains charged to accounts receivable and forms part of the institution's income in that year. If the pledge is later judged to be uncollectible it is written off against income of the year in which it is cancelled.

Pledges in currencies other than U.S. Dollars are recorded at their equivalent at the date of deposit.

Core restricted and extra core pledges, which are often for more than one year, are treated somewhat differently. In these cases the amount recognized as a receivable is equal to the expenses incurred under the grant. The uncollected portion of the pledge is not recognized as a receivable and consequently does not contribute to income. Only when expenses are incurred under the grant is an account receivable created and income recorded. This treatment matches revenues and expenses in accordance with the level of activities carried out under the grant.

This accounting policy permits CIMMYT to distinguish between income and amounts pledged in core restricted and extra core grants. This is necessary since these grants often cover more than one year's activities or contain carry-forward provisions in cases of underexpenditure. Recognizing the total pledge in a given year as income could result in an overstatement of income. Core unrestricted grants do not require this treatment since they are given annually and the amount pledged represents income that year.

Note 3 — Mexican Peso Transactions. The foreign exchange system existing in Mexico as of July 1985, permits the parallel existence of controlled and free exchange rates handled through exchange brokerage houses with rates in the latter case set on the basis of supply and demand.

At December 31, 1985 CIMMYT had Mexican peso assets and liabilities amounting to Ps 63,949,000 (Ps 147,605,000 in 1984) and Ps 139,341,000 (Ps 117,044,000 in 1984), which were included in the statement of condition at their U.S. dollar equivalents resulting from applying the year-end rate of Ps 448.00 per dollar.

In 1985 the value of the Mexican peso compared to the dollar fell from Ps 209.22 to Ps 448.00 to the dollar (Ps 160.47 to Ps 209.22 in 1984). This devaluation gave rise to a translation loss aggregating U.S. \$312,000 (U.S. \$303,000 in 1984). In accordance with FAS 52, where the firm is judged to be operating in a hyper-inflationary environment and the dollar is judged to be the functional currency, the translation effect in each year is charged to current income.

At February 26, 1986 date of issuance of the Financial Statements, the brokerage houses exchange rates with the U.S. dollar were Ps. 468 (buy) and Ps. 473 (sell).

Note 4 — Operating funds.

The CGIAR permits CIMMYT (and all other international agricultural research centers funded through it) to maintain, as part of the center's capital accounts, operating funds equal to thirty days of its core operating budget. In 1985 and 1984 there was no increase in operating funds.

Note 5 — Revenue and expenses:

A. Revenue. CIMMYT's revenues are grouped into six categories:

i) Grants. These are funds received from donors and are used to support two types of programs at CIMMYT: core and extra core. Core programs must fall within the mandate of the center and be approved by the Board of Trustees. These must also be approved by the members of the CGIAR, who then provide funding. The CGIAR membership includes governments, government aid agencies, international and regional development banks, and private philanthropic foundations (see Exhibit 2). Core programs are divided into two groups: unrestricted and restricted. Unrestricted grants come with only one requirement: that the funds be used to support core activities. Restricted grants also support core activities but they must be used for an activity mutually agreed upon by CIMMYT and the donor.

Extra core programs must also fall within CIMMYT's mandate and also must be approved by the Board of Trustees. They fall outside of any direct funding through the CGIAR and may be considered related but distinct sets of activities from the core program. In general they are of four types: 1) direct assistance (i.e. posting of staff) to national programs; and 2) training at CIMMYT for persons from a specific country, and 3) collaborative research arrangements with other institutions; and 4) special exploratory research activities. Coordination of this type of funding is done between CIMMYT and the donor.

ii) Administrative Fees. These fees are charged on restricted and extra core grants. They permit CIMMYT to offset the cost of administering these grants, which by design only fund specific research activities. In 1985 and 1984 this fee was generally 15% though for some on-campus activities it was 25%.

iii) Sale of Crops. CIMMYT operates four experiment stations throughout Mexico. Grain and other produce not required for continuance of the research programs is sold from time to time depending on their availability and quality, and revenues received are registered as income of the period.

iv) Interest on Short-Term Investments. Surplus cash is invested in short-term interest bearing securities, and any interest earned is recorded as income. Similarly interest expense arising from short-term borrowings to cover cash deficit positions is charged to this account.

v) Auxiliary Services. These comprise revenues from the following areas within CIMMYT: Cafeteria, Laundry, Guest House, Dormitories and Staff Residences. As a whole, they are intended to be self-supporting.

vi) Other Income. This is a grouping of miscellaneous revenues received from the sale of surplus items such as used tires and other small pieces of equipment no longer needed by CIMMYT.

B. Expenses. The breakdown of CIMMYT's expenses as shown in its statement of activity is largely self-explanatory. Included under Research Programs, the largest single expenditure, are the expenses of the Maize, Wheat, Economics, Experiment Stations, Laboratories and Data Processing units. In 1985 and 1984 their expenses were as follows:

(000's)	1985	1984
Maize	6,313	5,664
Wheat	6,678	6,742
Economics	1,334	1,265
Experiment Stations	1,530	1,452
Laboratories	386	385
Data Processing	693	636
Others	129	357
Total	17,063	16,501

Note 6 – Accounts receivable – and (Payments in Advance)

Donors: In 1985 and 1984 these were comprised as follows:

Others: In 1985 and 1984 these comprised the following:

Accounts Receivable—Donors (000's)	1985	1984	(000's)	1985	1984
Canadian International Development Agency	191	92	Loans to Senior Staff	253	256
European Economic Community	129	169	Personal Charges to		
Germany, The Federal Republic of	18	—	Employees	(26)	(82)
International Crops Research Institute for the Semi-Arid Tropics	26	—	Official Expenses		
International Institute of Tropical Agriculture	26	—	Advances	462	218
International Center for Agricultural Research for Dryland Areas	49	10	Employee Credit Union	(28)	(52)
Instituto Nacional de Investigación y Promoción Agropecuaria Peru/World Bank	54	27	Miscellaneous Debtors	83	89
OPEC Fund for International Development	30	138	Total	744	429
The Ford Foundation	—	52			
The Netherlands, Government of	39	—	A program of loans to senior staff, mainly to provide partial financing for house purchases, was initiated in 1982. These carry an interest rate of prime plus 1.75%.		
United Nations Development Programme	152	457			
United States Agency for International Development	362	395			
World Bank	—	52			
Other Donors	54	45			
Sub Total: Accounts Receivable - Donors	1,130	1,437			
Payments in Advance—Donors					
Australia, Government of	(99)	(74)			
Canadian International Development Agency	(509)	—			
Germany, The Federal Republic of	(35)	(105)			
International Development Research Centre	(25)	(136)			
International Crops Research Institute for the Semi Arid-Tropics	—	(11)			
Italy, Government of	(712)	(337)			
The Japan Shipbuilding Industry Foundation and Government of Japan	(785)	(283)			
Norwegian Agency for International Development	—	(31)			
Switzerland, Government of	(1,406)	(455)			
The Ford Foundation	(24)	—			
The Netherlands, Government of	—	(96)			
United States Agency for International Development	(13)	—			
United Nations Development Programme	(70)	—			
World Bank	(750)	—			
Other Donors	(81)	(21)			
Sub Total: Payments in Advance—Donors	(4,509)	(1,549)			
Net Status of Donors Payments	(3,379)	(112)			

Detailed Statement of Activity

For the Period January 1 to December 31, 1985

Centro Internacional de Mejoramiento de Maíz y Trigo, A.C.

Exhibit 1

Currency: U.S. Dlls. (000's)

	Core Unrestricted	Core Restricted	Extra Core & Cooperative	Auxiliary Services	Total
Revenue (Note 5)					
Grants	15,570	4,697	5,354		25,621
Administrative Fees	1,139				1,139
Sale of Crops	38				38
Interest on Short-Term Investments	309				309
Auxiliary Services				665	665
Other Income	1				1
Total Revenue	17,057	4,697	5,354	665	27,773
Expenses (Note 5)					
Research Programs	11,031	2,930	3,102		17,063
Conferences and Training	1,669	1,137	853		3,659
Information Services	905				905
General Administration	1,857				1,857
Plant Operations	1,463				1,463
Capital Acquisitions	96		890		986
Auxiliary Services				571	571
Indirect Costs		630	509		1,139
Seniority Premiums	36				36
Total Expenses	17,057	4,697	5,354	571	27,679
Excess of Revenue over Expenses before translation effect	--	--	--	94	94
Translation Effect for the year	(312)	--	--	--	(312)
Net (Deficit) excess of revenue over expenses	(312)	--	--	94	(218)

Detail of Sources of Income from Grants

For the Period January 1 to December 31, 1985

Centro Internacional de Mejoramiento de Maíz y Trigo, A.C.

Exhibit 2

	Currency: U.S. Dols. (000's)			
	Unrestricted	Restricted	Extra Core & Cooperative	Total
Australia, Government of	518		15	533
Canadian International Development Agency	1,211		1,506	2,717
China, People's Republic of	50			50
Denmark, Government of	256			256
European Economic Community		525		525
France, Government of		285		285
Germany, The Federal Republic of	461	176	32	669
Inter-American Development Bank	2,992			2,992
International Center for Agricultural Research for Dryland Areas			39	39
International Crops Research Institute for The Semi-Arid Tropics			246	246
International Development Research Centre		95	104	199
International Institute of Tropical Agriculture			96	96
Instituto Nacional de Investigación y Promoción Agropecuaria Peru/World Bank			115	115
India, Government of	60			60
Ireland, Government of		66		66
Italy, Government of			193	193
Japan, Government of		964		964
Mexico, Government of	762		94	856
OPEC Fund for International Development		175		175
Philippines, Government of	50			50
Saudi Arabia, Government of	300			300
Spain, Government of	100			100
Switzerland, Government of		609	218	827
Norwegian Agency for International Development	113	55		168
The Ford Foundation	100	68	36	204
The Japan Shipbuilding Industry Foundation, and Government of Japan			889	889
The Netherlands, Government of		223		223
The Rockefeller Foundation		100	50	150
The United Kingdom, Government of	597			597
United Nations Development Programme		1,356	138	1,494
United States Agency for International Development	6,000		1,536	7,536
World Bank	2,000			2,000
Miscellaneous Training and Research Grants			47	47
Total Income from Grants	15,570	4,697	5,354	25,621

Core-Restricted Pledges and Expenses

For the Period January 1 to December 31, 1985.

Centro Internacional de Mejoramiento de Maíz y Trigo, A.C.

Exhibit 3

Currency: U.S. Dlls. (G00's)

	Grant Period (1) (mo/day/yr)	Grant Pledged(1)	Prior Years	Expenses This Year	Total
Government of France					
Collaborative Research -Maize	01/01/85-12/31/85			100	100
Bread Wheat	01/01/85-12/31/85			41	41
Triticale	01/01/85-12/31/85			28	28
Economics	01/01/85-12/31/85			116	116
Total		285(2)	N/A	285	285
Government of Japan					
Wheat Disease Surveillance	01/01/85-12/21/85			191	191
Wheat and Maize Plant Protection	01/01/85-12/31/85			443	443
Wheat Southern Cone	01/01/85-12/31/85			330	330
Total		964(3)	N/A	964	964
OPEC Fund for International Development					
Maize West Africa Phase II	07/01/84-06/30/85	225	111	114	225
Maize West Africa Phase III	07/01/85-06/30/86	125	N/A	61	61
Total		350	111	175	286
Government of Switzerland					
Central America & Caribbean-Maize	01/01/85-12/31/86			366	366
Central America and Caribbean-Economics	01/01/85-12/31/86			243	243
Total		1,764	N/A	609	609
Government of the Netherlands					
Wheat and Maize Training	01/01/85-12/31/85	88(4)	N/A	88	88
Computer Programmer	01/06/83-05/31/86	421	117	135	252
Total		509	117	223	340
United Nations Development Programme					
International Maize Testing Program and Selected Training Activities	01/01/85-12/31/89	5,022	N/A	868	868
Tropical Wheat	07/01/82-06/30/87	2,415	931	488	1,419
Total		7,437	931	1,356	2,287
(1) For information purposes only	(5) Equivalent to ECU	2,000,000	N/A	= Not applicable	
(2) Equivalent to FF 1,900,000	(6) Equivalent to IFL	55,000			
(3) Equivalent to YEN 235,400,000	(7) Equivalent to NOK	650,000			
(4) Equivalent to DFL 300,000	(8) Equivalent to CA	197,000			

Exhibit 3 (Cont'd)

Currency: U.S. Dlls. (000's)

	Grant Period (1) (mo/day/yr)	Grant Pledged(1)	Prior Years	Expenses This Year	Total
European Economic Community					
Andean Regional Wheat and Maize	03/12/83-12/31/86	1,955(5)	1,068	525	1,593
Government of Ireland					
Training Wheat	01/01/85-12/31/85	66(6)	N/A	66	66
The Rockefeller Foundation					
Training Wheat and Maize	01/01/85-12/31/85	100	N/A	100	100
Norwegian Agency for International Development					
Training Wheat and Maize	01/01/84-12/31/85	82(7)	27	55	82
The Ford Foundation					
East Africa	09/24/81-12/31/85	256	175	68	243
Government of Federal Republic of Germany					
Wheat Improvement Program	07/01/83-09/30/85	291	113	176	289
International Development Research Centre					
Data Processing	11/02/84-11/02/86	160(8)	10	95	105
Total Core-Restricted			2,552	4,697	7,249

- (1) For information purposes only
- (2) Equivalent to FF 1,900,000
- (3) Equivalent to YEN 235,400,000
- (4) Equivalent to DFL 300,000

- (5) Equivalent to ECU 2,000,000
- (6) Equivalent to IRL 55,000
- (7) Equivalent to NOK 650,000
- (8) Equivalent to CA 197,000

N/A = Not applicable

Extra-Core Pledges and Expenses

For the Period January 1 to December 31, 1985.

Centro Internacional de Mejoramiento de Maíz y Trigo, A.C.

Exhibit 4

Currency: U.S. Dlls. (000's)

	Grant Period (1) (mo/day/yr)	Grant Pledged(1)	Prior Years	Expenses This Year	Total
The Ford Foundation					
Economics and Training Algeria	09/01/79-12/31/85	680	634	36	670
United States Agency for International Development					
Pakistan Agricultural Research Council					
Wheat, Maize and Economics	10/01/84-09/30/88	3,579(3)	175	859	1,034
Barley Yellow Dwarf Virus	06/01/85-05/31/86	30	N/A	30	30
Miscellaneous Training	(2)	N/A	N/A	61	61
Africa On-Farm Research	06/01/82-12/31/85	1,213	687	524	1,211
Agronomic Wheat Production	08/01/85-11/30/85	25	—	12	12
Winter Wheat Conferences	08/01/85-11/30/85	50	—	50	50
Total		4,897	862	1,536	2,398
United Nations Development Programme					
T.C.D.C. Training	(2)	N/A	30	—	30
Turkey Wheat	12/31/83-03/01/86	263	132	109	241
Total		263	162	109	271
Canadian International Development Agency					
Triticale Research and Training	04/01/78-12/31/86	286(4)	270	3	273
Haiti-Economics	01/01/85-12/31/88	564(5)	N/A	85	85
East Africa Cereal Program	10/01/84-02/31/88	2,118(6)	47	362	409
Ghana Maize Phase II	10/01/83-09/30/88	3,803(7)	859	660	1,519
Bangladesh-Wheat	04/01/82-04/30/87	3,744(8)	1,199	396	1,595
Total		10,515	2,375	1,506	3,881
Government of Switzerland					
Central America and Caribbean Seed Production					
	07/01/83-06/30/86	1,050	148	218	366
Instituto Nacional de Investigación y Promoción Agropecuaria Peru/World Bank					
Wheat	08/01/83-12/31/85	308	188	115	303
Government of Federal Republic of Germany					
Maize Improvement Program	01/01/83-05/15/86	129	59	32	91
(1) For information purposes only		(8) Equivalent to CA	4,680,000		
(2) Grant period not applicable donor pays tuition for each trainee sponsored		(9) Equivalent to CA	65,888		
(3) Includes RPs 23,364,864 equivalent US. 1,460,304		(10) Equivalent to CA	387,075		
(4) Equivalent to CA 338,944		(11) Equivalent to CA	196,750		
(5) Equivalent to CA 778,395		(12) Equivalent to AD	140,000		
(6) Equivalent to CA 2,753,000		N/A	= Not applicable		
(7) Equivalent to CA 4,754,300		(—)	Indicates zero or insignificant amount		

Exhibit 4 (Cont'd)

Currency: U.S. Dlls. (000's)

	Grant Period (1) (mo/day/yr)	Grant Pledged(1)	Prior Years	Expenses This Year	Total
Government of Italy					
Barley Yellow Dwarf	01/11/84-10/31/87	1,477	—	193	193
Government of Mexico					
Research	01/01/85-12/31/85	N/A	N/A	94	94
The Japan Shipbuilding Industry Foundation, and Government of Japan					
Training Building	11/01/84-12/31/86	1,600	14	889	903
International Development Research Centre					
Bibliographic Service on Wheat & Small Grains	01/01/84-12/31/86	53(9)	3	5	8
Information Services on Wheat & Small Grains	06/29/84-06/30/87	295(10)	11	86	97
Data Base Management	11/02/84-11/02/86	160(11)	5	13	18
Total		508	19	104	123
Biotechnology Consortium					
Rockefeller Foundation	01/05/85-01/05/86	50	N/A	50	50
Government of Australia	01/09/84-01/09/86	114(12)	N/A	15	15
United Nations Development Programme	09/10/84-09/09/85	39	10	29	39
Total		203	10	94	104
International Institute of Tropical Agriculture					
SAFGRAD	01/01/85-12/31/85	N/A	N/A	96	96
Miscellaneous Training Grants	(2)	N/A	N/A	47	47
Cooperative Projects					
ICARDA — Barley Project	12/01/84-12/31/85	—	10	39	49
ICRISAT — Sorghum Project	01/01/81-12/31/85	1,130	671	246	917
Total		1,130	681	285	966
Total Extra Core			5,152	5,354	10,506

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