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1984 INTERNATIONAL CENTERS' WEEK REPORT

INTERNATIONAL MAIZE AND WHEAT IMPROVEMENT CENTER (CIMMYT)

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INTRODUCTION

It is a pleasure to present CIMMYT's International Centers' Week Report to members of the CGIAR, invited guests, and observers. In this report, I shall highlight recent trends in maize and wheat production, show how these trends are shaping CIMMYT's program of work, inform the Group of various management developments, and allude to the budget and manpower requirements we believe are needed to fulfill our mandate.

RECENT TRENDS IN WHEAT AND MAIZE PRODUCTION

Over the last two decades, the highest cereal production growth rates in the developing world have been achieved in wheat and maize. These crops have registered production gains of 4.7 and 3.95 percent, respectively, well ahead of population growth. ~~Although~~ CIMMYT is not responsible, *per se*, for increasing developing country cereal production. This is principally the task of national research and production organizations, but we do consider these productivity expansions to be an important measure by which to guide our work and to judge its value.

Wheat Production Trends

The developing country area planted to HYV wheat varieties has continued to expand, from 29 million hectares in 1977, to an estimated 45 million hectares today, approximately 45 percent of the total Third World area devoted to wheat production. Much of the expansion in recent years has been in non-traditional wheat-producing areas. The widespread adoption of HYV wheats in Bangladesh is perhaps the most spectacular example. This non-traditional wheat-producing country achieved a 12-fold increase in production, from 89,000 tons in 1973 to over one million tons in 1983. Today, 97 percent of the 600,000 ha national wheat area is seeded to high-yielding semidwarf wheat varieties.

In the space of two decades, average wheat yield levels in the developing world have doubled and per capita production has increased by 73 percent. If we attribute only 200 kg per hectare in additional production to the "variety effect" alone, the 45 million hectares in developing countries now growing high-yielding wheat varieties are adding 9 million tons annually to production.

Maize Production Trends

The production story in maize is also gaining in significance. At the aggregate level, per capita maize production in the developing world has increased by 36 percent over the past two decades, spurred in large part by the significant production gains achieved in China, Thailand and Argentina. While the impact of improved maize varieties and hybrids derived from CIMMYT germplasm is only beginning to show up in national production figures, we estimate that at least three million hectares in the developing world are now planted to these materials. The yield gain made by these

improved varieties and hybrids is conservatively adding at least 600,000 tons annually.

Where Are We Today on the Production Front?

Although the overall maize and wheat production scenarios in the developing world are quite favorable, the regional production stories are highly variable. In wheat, per capita production has increased throughout Asia but it has declined in North and sub-Saharan Africa, the Middle East and in Latin America. In maize, per capita production has increased dramatically in Latin America and in developing Asia, decreased slightly in the Middle East and declined drastically in Sub-Sahara Africa.

CIMMYT RESEARCH PRIORITIES

CIMMYT's research agenda for the 1980s places major emphasis on the generation of new technological components that can increase yield dependability in less-favored rainfed environments. While we cannot neglect the more-favored environments, where substantial yield improvements are still achievable and necessary, it appears to us that the major unexploited production gains must be made through the application of new technologies--which are economically viable and sustainable--to the more marginal cereal crop environments of the developing world.

Wheat Research

In the wheat program, a number of research thrusts are under way at CIMMYT to increase the yield dependability of wheat grown under various stress situations. Only a few of these efforts will be highlighted today.

Drought Tolerance--More than one-third of the total area in the developing countries consists of semiarid environments in which periodic drought is a primary constraint on crop production. The development of wheat varieties with an enhanced ability to withstand greater moisture stress would benefit a very substantial area of crop land worldwide. Some of these lines, such as Veery which I will talk more about later, produce up to 3 tons per hectare under droughty conditions yet also have a yield potential exceeding 11 tons per hectare under optimal growing conditions.

Earlier Maturing Wheats--Another important research effort involves the development of a broader range of earlier maturing wheat varieties. These materials are paticularly advantageous where there is a short growing season available for wheat cultivation or where farmers seek to intensify their cropping systems, such as the rice/wheat rotations increasingly practiced in South and Southeast Asia. CIMMYT has several hundred wheat and triticale lines with maturity similar to the popular short-season Indian variety, Sonalika, and with improved yield potential and disease resistance.

Tolerance to Mineral Toxicities--It is estimated that up to one billion hectares have acidic soils with high levels of soluble aluminum that are either undeveloped for agriculture, or, where cultivated, have very low productivity. Through a cooperative program with Brazilian institutions, a number of high-yielding bread wheat lines have been developed with tolerance to the higher levels of free aluminum often found in these acidic soils and with improved resistance to many of the diseases found in these warmer environments. With adequate disease control, these varieties yield up to twice as much as the earlier varieties grown under these stress conditions.

Fuller Exploitation of Genetic Variability--CIMMYT's work with spring x winter crosses is producing new varieties with higher yield potential, better disease resistance, and improved environmental tolerance as well as other desirable traits. A new group of spring x winter lines, commonly called Veery selections, are now setting yield records in many parts of the world, and over a surprisingly wide range of environments. In the 1982-83 international spring wheat yield nursery grown at 40 locations worldwide, a Veery selection yielded 17 percent better than Pavon 76, formerly one of CIMMYT's highest yielding spring wheat varieties. Veery also outyielded the best local check varieties (usually a HYV) at 70 percent of the individual locations, an indication of its very broad adaptation.

Introduction of Alien Genes--CIMMYT's first major involvement in wide crosses was with triticale. Our continuing work on triticale is motivated by two major considerations. One is the observed capacity of triticale to perform better than wheat under a number of environmental stress conditions. These include areas with acid soils, cool highland temperatures, and certain heavy disease-stress situations. In such environments, triticales often outyield normal wheat materials by as much as 100 percent or more. The second major factor, which may be of critical importance in raising yield potential, is the greater total dry matter production of triticale compared with wheat. A further partitioning of this biomass into grain could push triticale to a higher genetic yield potential than wheat under most production conditions.

Research to cross domesticated species of wheat with related wild species and grasses is a very promising research avenue that may lead to the development of varieties with greater yield potential and dependability in a number of important marginal areas. We have identified a number of wild species

with greater resistance to certain diseases and insects and tolerance to salinity, temperature, and moisture stresses than we have found to date in the cultivated germplasm of the major crop species. Successful introgression of desirable genes from these related species could lead to crop varieties with greater tolerance to these environmental stresses.

Maize Research

CIMMYT's maize improvement research attempts to serve the germplasm requirements of a wide range of production circumstances and consumer preferences. We endeavor to develop broadly adapted materials with high yield potential as well as enhanced stability of yield under various environmental situations.

Hybrid Development--Given the circumstances of many maize farmers in the developing world and because of weaknesses in seed production and distribution systems, CIMMYT has traditionally emphasized a population improvement program and the development of open-pollinated varieties as the end product of our maize improvement research. In recent years, however, many collaborating national research programs have expressed an interest in the development of hybrids as well as open-pollinated varieties. Therefore, we have decided to increase substantially our efforts to assist those national programs pursuing a hybrid development strategy. Studies are under way to document more fully the heterotic patterns of different materials from our maize gene pools and populations. Our training programs will also now contain a segment on the efficient development of hybrid maize varieties.

Grain Efficiency--A historical problem with lowland tropical maize has been its tall stature, large amount of foliage,

large tassel size, and hence, relatively low grain-to-stover ratio. Most of CIMMYT's original tropical and subtropical germplasm sources were over three meters tall with a grain-to-stover ratio of 30:70. Today, the height of most CIMMYT maize materials is in the 1.75 to 2.5 meters range and grain now accounts for 40-50 percent of the total dry matter production. These shorter, more grain-efficient and manageable genotypes can be grown in higher density plant stands and respond to proper levels of soil fertility with higher grain production per unit of time and area. Several of CIMMYT's best materials are approaching the grain-to-stover ratios of the best U.S. corn belt and northern European materials.

Early Maturity--Considerable demand exists in developing countries for earlier-maturing varieties to fit into more intensive production cycles, mixed cropping situations or in areas where moisture is too limited to sustain longer-season varieties. Low yield potential, as well as greater disease and insect problems, have long been associated with early maturity. CIMMYT has made considerable progress in overcoming these limitations and today has an increasing number of early-maturing populations with relatively good yield potential and adequate disease resistance. Today, these experimental varieties are among the most requested maize materials in the international testing program.

Disease Resistance--Generally good research progress is being achieved on the maize disease resistance front. Efforts are continuing to maintain and improve the generally good resistance levels found in our germplasm to foliar diseases and stalk and ear rots. Cooperative projects are also under way to develop tropical maize materials with resistance to several major disease problems in different regions of the developing world. Two of these research projects will be highlighted here: downy mildew, caused by

several species of fungus and mainly found in Asia, but now spreading to Africa and Latin America; and maize steak virus, disseminated mainly by a leafhopper and occuring widely tropical Africa.

The CIMMYT Asian regional maize program staff, headquartered in Bangkok, Thailand, have assumed responsibility, in cooperation with the Thai national maize program and scientists from Kasetsart University, for improving three widely adapted, lowland tropical populations for downy mildew resistance. Similarly, the West African regional maize staff, headquartered at IITA in Ibadan, Nigeria, are working jointly with IITA and West African national maize scientists to improved various maize materials for streak resistance. Progress has been made in the incorporation of downy mildew resistance into early- and late-maturing maize populations adapted to Asia and in the development of long-season, streak-resistant materials for sub-Sahara Africa.

Economics Program

Since 1974, the CIMMYT Economics Program has concentrated most of its energies on issues related to the planning and implementation of on-farm research activities. Its methodological approach is founded upon the conviction that, to be effective, an important part of the technology generation process must be carried out under the real-life conditions of representative farmers.

Technology Generation--CIMMYT has developed a set of cost-effective research procedures for the assessment of the biological and economic circumstances that influence farmers' actions and to identify priority research opportunities to increase maize and wheat productivity. Cooperation with national program scientists to

institutionalize these on-farm research methodologies continues to expand, especially in Africa, where greater attention is being given through special project funding.

Research Resource Allocation--CIMMYT economists are also involved in research studies related to the production and utilization of maize and wheat in the world economy. As part of this effort, domestic resource studies related to wheat production have been undertaken in Mexico, Ecuador and Thailand; each has produced important findings and implications for research resource allocation opportunities within those countries.

MANAGEMENT REPORT

Let me now turn the discussion to a series of management issues related to new staffing developments and other program issues. Dr. Barco has already reported to you on the appointment of four new CIMMYT trustees. We welcome these distinguished individuals to the Board of Trustees.

During 1984, a major change in the CIMMYT directing staff has also occurred. After thirteen years of service to CIMMYT, Dr. Ernest Sprague retired at the end of 1983 as Director of the Maize Program. The new Director of the program, Dr. Ronald P. Cantrell, joined us in early 1984. Previous to joining CIMMYT, Dr. Cantrell held a professorship in plant breeding at Purdue University in the United States. During 1981-83 he served as Team Leader for the Purdue University/USAID Farming Systems project in Upper Volta. We believe that Dr. Cantrell's previous work in plant breeding and in farming systems research in Africa will serve him well in his new position.

Inter-Center Cooperation and Coordination

Two important issues relating to mandate and inter-center cooperation and coordination with ICARDA and IITA were also clarified during 1984.

CIMMYT-ICARDA Discussions--Until recently ICARDA and CIMMYT shared rather poorly defined and apparently overlapping mandates for the genetic improvement of durum wheat and barley. Following the recent external program reviews of the two institutes, a division of responsibilities for the improvement of those two crops was clarified and endorsed by the CGIAR. Briefly stated, ICARDA will exercise a global mandate for barley improvement and has located a staff member at CIMMYT headquarters in Mexico to serve the needs of the Western Hemisphere and certain other areas. Similarly, CIMMYT's lead role for global durum improvement research was confirmed and CIMMYT has located a durum breeder at ICARDA headquarters to further strengthen durum wheat improvement activities to serve the Middle East region.

CIMMYT-IITA Discussions--The roles and relationships between CIMMYT and IITA in maize research in Africa have also been clarified and strengthened. After extensive discussions between IITA and CIMMYT, and with the TAC, an agreement was reached for a joint maize research program. Dr Yoel Efron, formerly IITA Director for Cereals Research, is spending the year at CIMMYT headquarters. On his return to Africa, Dr. Efron will hold a joint CIMMYT-IITA appointment and will direct the maize research activities of the two institutions in Africa.

Collaborative Research

CIMMYT already has dozens of formal and informal collaborative research projects under way with scientists in both developing and developed countries. In future years, we are especially interested in establishing new collaborative research projects which will draw on the strengths of scientific institutions in selected developing countries such as Brazil, China, India, Mexico and Turkey to serve the needs of the international maize and wheat research networks to which we collectively belong. Through the forging of these stronger collaborative research links, important new research projects can be undertaken which offer the potential of both national and regional benefits.

Two other collaborative research activities will be highlighted here today. In August of this year, CIMMYT co-hosted with U.S. universities a USAID-funded Global Maize Conference in Mexico. During this meeting, an informal committee of U.S. university maize researchers was formed to identify and develop a series of proposals for collaborative maize research projects with CIMMYT. This new mechanism for collaborative research should strengthen the international maize research activities of CIMMYT as well as U.S. universities in ways beneficial to the developing world.

A second new collaborative research effort involves the development of a biotechnology research consortium. Many donors to the CGIAR have stressed the need for some basic research to be conducted at the international centers. CIMMYT's wide cross research programs represent such a basic research element within an overall applied research program. A proposal has been developed which calls for a small group of donors who are supportive of basic research to provide longer-term, extra-core financing needed for this type of work.

REVIEW OF TRAINING

During the past two years, CIMMYT has been engaged in wide-ranging internal and external reviews of its training program activities. This review process included the conducting of a follow-up survey of former in-service trainees, program reviews by external consultants, a Center-wide, in-house review, and extensive discussions between the CIMMYT staff and Program Committee of the Board of Trustees. CIMMYT also hosted the first visit of TAC Training Review Study Team at headquarters and in Central America; outreach staff have also participated in all the TAC study team's visit to collaborating research institutions in a number of developing countries.

Conclusions to Date

Based on the former trainee survey results, and the TAC Study Team discussions with national institutes, it is apparent that CIMMYT has offered high-quality training courses in Mexico along with relatively frequent follow-up visits to trainees once they have returned home. CIMMYT's alumni overwhelmingly feel that the Center's in-service training is unique in its contribution to the development of effective research practitioners and it is considered to be an important complement to the more theoretical training given by universities.

Increased Support to National Training Programs--From the beginning, CIMMYT has opted to focus most of its training efforts on middle-level researchers (with 3-5 years of experience in national programs). However, the current size and scope of national research and production efforts in wheat and maize in the developing world means that thousands of research workers require some form of in-service training each year. CIMMYT can only hope to provide quality training

to a fraction of this manpower base and additional donor funds must be mobilized to establish national in-service training programs. Increased assistance is also needed to help developing country institutions to secure more donor funds for postgraduate training.

Training Activities in Mexico--CIMMYT plans to continue its tutorial form of in-service training in Mexico while expanding substantially the number of longer-term visiting scientist fellowships it offers annually to more senior researchers. Faced with a demand for training that cannot be satisfied at CIMMYT, the need to select the very best candidates for training at headquarters is becoming increasingly apparent. In order to maintain the level of our overall in-service training effort at headquarters while considerably expanding other training-related activities, both outside and in Mexico, CIMMYT intends to add new locally hired professionals to its training program staff. A new position of Training Coordinator who will provide guidance across the various training program areas is also budgeted.

In-Country Training Outside Mexico--CIMMYT plans to considerably increase its involvement in in-country training activities, particularly in the area of crop management research procedures. CIMMYT training officers and outreach staff, along with selected outside consultants, will serve as the principal resource personnel to national staff responsible for conducting in-service training within their own institutions. CIMMYT's 2500 training program alumni from 80 countries represent a major resource for these in-country training programs. To adequately support these efforts, a range of training course formats and instructional materials are also being developed.

Workshops and Conferences--CIMMYT plans to increase its networking activities with national collaborators through sponsoring and co-sponsoring more regional and global conferences and workshops. Such meetings can facilitate information exchange on germplasm development and production agronomy research programs as well as help CIMMYT in setting its research priorities and monitoring of progress in its various program initiatives.

INFORMATION SERVICES

CIMMYT's plans for its information services in the 1980s have been developed with the QQR recommendations in mind. Beginning in 1984, CIMMYT's information services have been integrated into one department and an overall head, Mr. Christopher Dowswell, has been appointed. In publications, staff have been added and new initiatives are under way to increase CIMMYT's output of scientific publishing and to develop a larger array of pertinent training-related materials, using print as well as audio-visual formats.

CIMMYT has also recently established a new Scientific Information Unit with the assistance of IDRC. As part of this project, new bibliographic journals have been jointly established with the Commonwealth Agricultural Bureaux (CAB) and with the Agricultural Information Service (AGRIS) of the FAO. These journals as well as a document delivery service will be provided to hundreds of national collaborators throughout the developing world, many of whom have difficultly acquiring scientific information where hard currency expenditures are required.

A NEW TRAINING, CONFERENCE AND INFORMATION FACILITY

CIMMYT's Long-Range Plan for 1980-86 indicated the likely need for additional headquarters facilities for training and

information activities. That need was further confirmed in 1982 by the CGIAR External Review of the Center's accomplishlments and future program needs. The Board of Trustees, after a thorough review of the Center's training and information programs, made a commitment to build a new training, conference and information facility at headquarters. With TAC concurrence in this project, we believe extra-core funding has been identified to build and equip this much-needed facility.

CIMMYT hopes to commence construction of this new facility in early 1985. Once completed, it should greatly increase CIMMYT's capacity to serve as the institutional hub for the international maize and wheat research networks so crucial to meeting world food production needs.

CLOSING COMMENTS

Let me conclude with a few general comments. At the top of the bracket, CIMMYT's program and budget plans for 1985 reflect the full adoption of the QQR recommendations. Funds permitting, we will continue to strengthen our training and information programs, and will launch new initiatives to incorporate more disciplinary research into our overall research program. With the continued support and cooperation of national programs in the developing world, the outlook for the 1980s is very encouraging indeed. I believe the facts show that the green revolution CIMMYT was so instrumental in creating is still green, but it must be tended and nurtured if the bountiful harvests promised are to be available and adequate for future generations. Thank you.