Program and Information on the Field Tour and CIMMYT Visit

Mexico and CGIAR Day

26 October 2004

CGIAR ANNUAL GENERAL MEETING 04

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CIMMYT® (www.cimmyt.org) is an internationally funded, not-for-profit organization that conducts research and training related to maize and wheat throughout the developing world. Drawing on strong science and effective partnerships, CIMMYT works to create, share, and use knowledge and technology to increase food security, improve the productivity and profitability of farming systems, and sustain natural resources. CIMMYT is one of 15 Future Harvest Centers of the Consultative Group on International Agricultural Research (CGIAR) (www.cgiar.org). Financial support for CIMMYT's work comes from the members of the CGIAR, national governments, foundations, development banks, and other public and private agencies.

Program

07:00	Departure from Hotel Sheraton
09:00	Arrival at CIMMYT Group 1
09:10 – 09:20	Welcome by Masa Iwanaga, Director General, CIMMYT
09:20 –11:00	Guided visit to field plots for Group 1
11:00	Group 1 leaves for field visit to INIFAP
11:30	Group 2 arrives at CIMMYT from INIFAP
11:40 – 11:50	Welcome by Masa Iwanaga, Director General, CIMMYT
11:50 – 13:20	Guided visit to field plots for Group 2
13:30 – 14:25	Lunch at the big tent
14:30 – 14:35	Brief address by Masa Iwanaga
14:35 – 14:40	Welcome to all guests by Ian Johnson, CGIAR Chair
14:45 – 15:05	Keynote address by Dr. Norman E. Borlaug: "Feeding the World: Reflections from 60 Years in International Agricultural Research"
15:15 – 16:45	Latin America event organized by CIAT, CIFOR, CIMMYT, ICARDA, IWMI-IN, IPGRI, and WorldFish
17:00	Departure of buses from CIMMYT to the Sheraton Hotel

CIMMYT: Linking Science to Livelihoods

I'd like to welcome you to CIMMYT, home of the Green Revolution and the center of origin of international agricultural research. I'm going to add to the information presented in the short video you just saw.

The reason for CIMMYT's location in this lovely setting is historical. Our work grew out of a research program established by Mexico and the Rockefeller Foundation in 1943, 61 years ago. The program was led by Dr. Norman Borlaug. It made Mexico self-sufficient in basic grain production in the 1950s. The Center draws upon Mexico's ecological diversity and its strong research system. We work on five research stations in this country, taking advantage of the diverse agro-ecological conditions, to develop products for farmers worldwide. Our highland locations for wheat and maize are here and in Toluca, on the other side of Mexico City. We also breed wheat at a dry, sea-level station in northern Mexico. Finally, we have two more stations for maize—one tropical and the other subtropical. Our roots are Mexican, but we operate through 13 regional offices. These keep us close to partners and beneficiaries in Africa, Asia, and all of Latin America and make CIMMYT a partnership-based organization with an effective world reach.

CIMMYT has had great success as a commodity center. Dr. Borlaug received the Nobel Peace Prize in 1970 for his efforts at CIMMYT and in its predecessor organization. He and his partners began the Green Revolution, a clear model of successful international collaboration. We now take for granted the global exchange of public goods like knowledge and germplasm. Back then, this was a big innovation, and it was formalized through the creation of the CGIAR.

Even now, CIMMYT-related maize and wheats are sown on more than 80 million hectares in developing countries. Their annual economic value is calculated at three billion dollars. The cropping systems we and partners develop and promote are more productive, sustainable, and profitable. Thousands of researchers we train become key partners in our work.

Despite these achievements, many people in developing countries still cannot grow or buy the food they need. They live lives of poverty, hunger, and vulnerability. This year and last, my staff and I have worked to build and implement a new strategy. At the heart are people, especially those people who have yet to benefit from the first Green Revolution. We have a new mission, and have restructured our research agenda to include four eco-regional programs. These focus on cropping systems, involve stakeholders and farmers, and put more of our muscle into delivering impacts. Then there are two global programs. One is concerned with the collection, conservation, and use of crop genetic resources. The other works across programs to develop and apply strategies for managing and sharing knowledge. With these changes, we now feel ready to help more farmers escape poverty, to live with dignity and hope. The presentations you will see this morning provide some examples of how this happens.

One way we help is to provide small-scale farmers and their families with more robust crop varieties. Their traits include tolerance to drought and poor soils, or resistance to diseases and pests. They provide stable yields and food security in both good and bad years. We obtain these traits from our seed collections and many diverse sources. Farmers obtain food security and a safe base for trying new technologies or income-generating activities.

We also work with farmers to select varieties for traits they consider valuable, and not just yield. Through their participation, farmers gain control and receive a more useful product. What we learn helps us to work more effectively.

Diverse and healthy cropping systems are another form of "insurance" for small-scale farmers. They promote cropping diversity and add resilience to farming systems and household economies.

Finally, crops like maize are tied closely to culture and depend on people to grow them. CIMMYT is working to understand how farmers manage their maize diversity. We are also supporting those who chose to continue growing cherished, local varieties.

These are just a few of the principles today's field tour will demonstrate. I hope you enjoy it! This booklet describes what you will see at each station and gives contact information for the presenters. Please feel free to write or call our staff regarding questions or suggestions!

Masa Iwanaga, Director General
International Maize and Wheat Improvement Center
26 October 2004

Maize for Low-input, Rainfed Farming

Hugo Córdova and Kevin Pixley*

What You Will See: Examples of typical highland maize varieties, including the hybrid PROMESA (a Spanish word that means both "promise" and "for the table"), developed in collaboration with a local university (El Colegio de Postgraduados) that is also releasing it, among others to a local company that will produce seed for sale to farmers. CIMMYT provided one of the parents of the hybrid and material support to the Mexican developer of PROMESA, and has used PROMESA extensively as a check in yield trials. CIMMYT has also begun developing highland versions of quality protein maize, which looks, grows, and tastes like normal maize but is more nutritive for both people and farm animals. The open-pollinated variety growing next to the PROMESA plot is of this type. Finally, presenters will give an explanation/demonstration of a successful participatory varietal selection approach known as "mother-baby" trials.

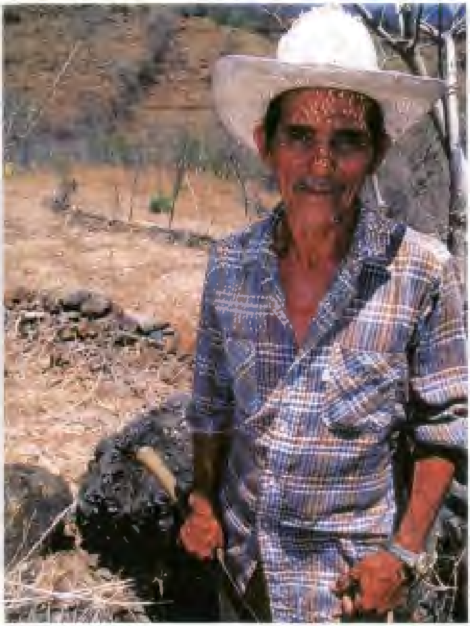
Issues: Maize is grown on more than 100 million hectares in developing countries and is a staple food for many of the poor (it is the main source of calories for the poor in over 20 developing countries). The Mexican highlands are the cradle of maize. Highland maize areas worldwide (Mexico, the Andes, eastern Africa, Nepal) are characterized by low-input, rainfed cropping systems and a high incidence of poverty. Maize in the highlands has economic value as food, feed, fodder, fencing, and even to wrap "tamales," a Mexican food made from meat, peppers, and maize dough. However, highland maize is typically low yielding, grows slowly, and has a weak root system that makes it prone to falling over. Protein quality maize is grown on 600,000 hectares in 22 developing countries, but until recently no highland maize of this type was available.

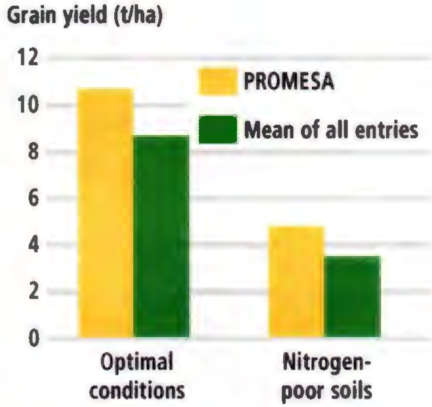
How CIMMYT and Partners Address the Issues: CIMMYT works in and for the three, main maize-growing ecologies of the developing world: (1) the lowland tropics; (2) midaltitude areas; and (3) the highlands. The center and its partners develop a broad array of high yielding maize varieties, hybrids, and inbred lines targeted to developing country settings and able to withstand major environmental rigors such as infertile soils, drought, insect pests, and diseases. CIMMYT and partners also develop and promote improved cropping system and resource management practices to exploit the full

* Hugo Córdova (Tel +55 5804 2004, ext. 1117; Email:h.cordova@cgiar.org) is a maize breeder who has worked extensively promoting quality protein maize. Kevin Pixley (Tel +55 5804 2004, ext. 1206; Email: k.pixley@cgiar.org) is Director of the Tropical Ecosystems Program. Other researchers involved in this work include Dave Beck, Marianne Bänziger, Peter Setimela, Mick Mwala, and numerous colleagues.

potential of improved seed and to preserve or enhance farmers' soil and water resources. In the case of highland maize, CIMMYT has successfully addressed its shortcomings by interbreeding it with subtropical varieties, and has begun developing quality protein maize adapted to highland settings. The center and partners are working jointly to enhance the resistance of maize to post-harvest pests that destroy an average 15-20% of stored grain in developing countries and even greater portions in isolated, impoverished zones. Center staff are applying geographic information systems to identify with greater precision areas of extreme poverty whose inhabitants depend on maize for food and subsistence. Finally, because good varieties are not always adopted by farmers for a range of reasons, CIMMYT has been helping farmers and researchers together to test experimental varieties and share results among themselves and with seed companies, NGOs, and policy-makers, and has supported the development of sustainable systems for making quality seed of maize available and affordable to small-scale maize farmers in areas not served by the private sector.

Impacts on Productivity and Livelihoods: Maize varieties developed by CIMMYT and its partners are planted on nearly half of the area sown to improved varieties in non-temperate areas of the developing world and are providing economic benefits on the order of USD 1 billion yearly. The improved yield and other traits (stable yields, grain quality, early maturity, husk production) of highland maize from CIMMYT and partners offer farmers enhanced food security, increased cropping and livelihood options, and reduced risks. Improved cropping systems and our network of partners, literally thousands of whom have benefited from training activities organized by CIMMYT, provide an additional lifeline to farmers in rainfed, low-input areas. Participatory varietal testing is now being used by national programs throughout southern Africa and in Asia, and has increased the demand for seed of stress tolerant, open pollinated maize varieties (see graph).



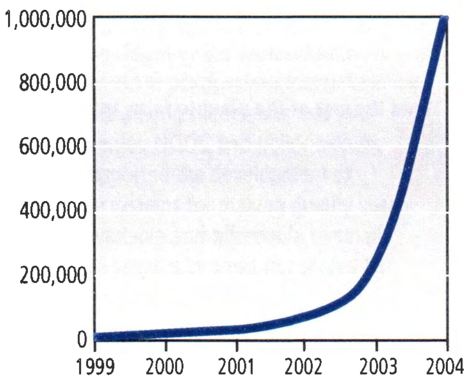


The highland maize hybrid, PROMESA, has high and robust yields and performs well in poor soils and dry conditions. It has good fodder and silage quality, which is important because many highland farmers harvest maize grain for food, but feed the rest of the plant to farm animals.

The tropical highlands occupy about 6.3 million hectares worldwide.

	Yield	Tate	Storability	Overall
Maize A	Good	Fair	Bad	2
Maize B				1
Maize C				3

In participatory varietal selection, farmers grow subsets of trials grown near their communities by researchers and score the varieties for traits they value, using a simple system like that shown in this table. Involving farmers in varietal testing has empowered them and made their preferences known to numerous seed suppliers, contributing to the increased use of improved, stress tolerant, open pollinated varieties in places like southern Africa, as shown in the graphic below.



Stress tolerant maize seed to sow area indicated (ha)

Wheat to Meet Developing World Demands

Ravi Singh and Oscar Banuelos*

What You Will See: Examples of the original semi-dwarf wheats that spurred the rapid move to science-based agriculture in South Asia nearly four decades ago will be shown, together with plots of hardy, productive bread wheats, durum wheats and triticales for both the irrigated and rainfed environments—fully 120 million hectares in developing countries. Topics will include historical breakthroughs in wheat breeding and efforts of recent years to develop resilient, resource-efficient varieties, outlining successes to date and challenges ahead.

Issues: Wheat's central and growing role in food consumption means that developing-country production of this crop will have to increase by almost 50 percent by 2020, from the current 300 million tons to 440 million tons, according to the Food and Agriculture Organization of the United Nations. And it all has to be produced with less available water, no new land for agriculture, and in ways that do not degrade natural resources. In addition, half of the area sown to wheat in developing countries suffers from poor or erratic rainfall, poor soils, aggressive diseases, and sometimes extreme heat or cold. Food security and resource conservation are major concerns in these very diverse ecologies, which cover large areas of Asia, northern, southern, and eastern Africa, and Latin America, and include countries where half of the daily food requirement is met by wheat alone.

How CIMMYT and Partners Address the Issues: On irrigated wheat lands, higher grain yields and value-added wheat varieties that use resources more efficiently are key components of intensive wheat cropping systems. Work continues with partners worldwide to provide varieties with durable, inherent resistance to the most damaging diseases of wheat, such as the rusts. For rainfed wheat zones, the center and partners are working to meet farmers' needs for varieties that provide high and stable yields, are water-use efficient and drought tolerant, resist soil-borne pests and pathogens, and contain enhanced levels of important dietary micronutrients, such as iron and zinc. CIMMYT has introduced into bread wheat many useful traits, including several mentioned above, from wild grasses by crossing them with durum wheat and using the progeny as a bridge. For wheat farmers everywhere, the focus of CIMMYT and partners on superior grain quality ensures the marketability of harvests and adds income that can help

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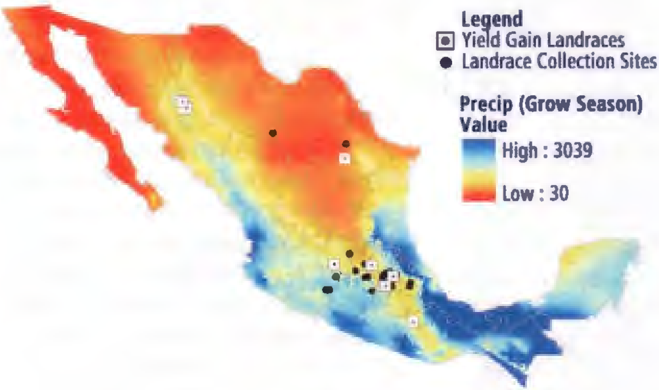
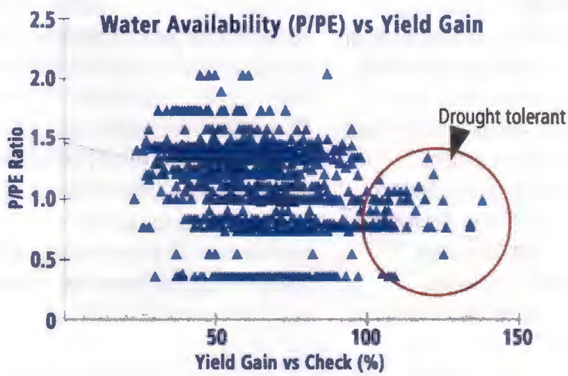
families to escape poverty. The center and partners are also developing varieties adapted especially for conservation agriculture systems. Finally, in addition to its global wheat testing system, CIMMYT is working with researchers and farmers in participatory varietal testing approaches that provide relevant products for farmers and feedback for all stakeholders.

Impacts on Productivity and Livelihoods: Recent estimates indicate that wheat varieties developed by CIMMYT and its partners are planted on more than 64 million hectares in developing countries, representing more than 75% of the area planted to modern wheat varieties in those countries. Annual benefits to farmers and consumers are valued at USD 2.5 billion. A recent economic study attributed a value of 5.3 billion 1990 USD in savings in losses to leaf rust, through use by farmers over the last few decades of CIMMYT-derived spring bread wheat varieties possessing durable resistance to the disease. (This estimate does not consider the economic, health, and environmental benefits from applying far less fungicide on wheat crops in the developing world over the same period.) As part of CIMMYT's participation in the HarvestPlus Challenge Program, the center and partners developing micronutrient-enhanced wheat varieties that could greatly improve the nutrition of the resource-poor who depend heavily on wheat in their diets.

Drought tolerance, disease resistance, root health (resistance to soil-borne pathogens and pests), and grain quality are traits that add value to wheat varieties and improve farmers' food security and livelihoods.



Diversity between and within Mexican landraces



Wheat landraces from dry regions in many countries serve as sources of drought tolerance.

Maize Diversity: Heritage of Farmers and Humanity

Suketoshi Taba and Mauricio Bellon*

What You Will See: Plots of maize "landraces"—varieties developed by farmers through centuries of selection. A range of plant types from "gene pools;" populations in which the diversity of landraces and other types of maize is mixed and enriched for use by breeders.

Issues: Maize is Mexico's gift to the world: the crop was probably first domesticated in south-central or southwestern Mexico. Maize diversity is embodied in landraces, local varieties developed over centuries by farmers as a subsistence crop on small plots. *People*, through their preferences and practices, create the diversity of maize: maize's genetic diversity is not just a biological accident! If farmers disappear, so too will the diversity of which they are creators and caretakers. Diversity in farmers' fields is dynamic, constantly changing—it's not like a vase in a museum. The world benefits from having access to crop genetic diversity. Farmers benefit from having access to improved varieties.

How CIMMYT and Partners Address the Issues: The CIMMYT maize genebank conserves nearly 24,000 unique seed collections, mostly of landraces from Mexico and other parts of the Americas. Conservation is costly and landraces cross borders in their dispersion, so CIMMYT works through broad partnerships. Through conventional breeding and newer methods, like molecular markers and functional genomics, CIMMYT and partners draw on the useful diversity from landraces, and make it available to breeders. They in turn mix this diversity into experimental varieties and return it to farmers in the form of robust, value-added cultivars. Samples of the maize genetic resources conserved by CIMMYT are freely available for research and development. Those who receive this seed agree not to restrict access to it. Finally, because conservation in seed banks is ideally complemented by conservation in farmers' fields, CIMMYT and partners are exploring ways to capture and use maize genetic diversity from the field, while supporting farmers who are interested in maintaining that diversity.

Impacts on Productivity and Livelihoods: Since 1992 CIMMYT has organized and supervised work with specialists in 13 countries of Latin America to rescue more than 10,500 endangered landrace seed collections and to conserve back-up sets. Many of the collections contained seed of landraces no longer grown in farmers' fields, which thus could have been

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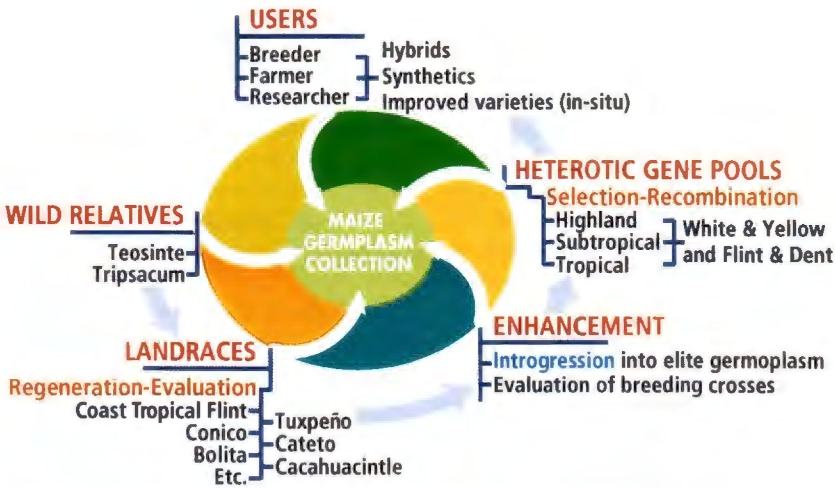
lost forever to humanity. In 2003 CIMMYT maize genetic resources staff produced a CD (The CIMMYT Maize Collection: Evaluation of Accessions and Preliminary Breeder Core Subsets) containing results of trials involving major landrace complexes. Applying painstakingly researched methods for analysis and grouping, the scientists developed readily searchable "core" subsets of large collections for major races. Each represents at least 70% of the diversity in the original collections. Intended as a resource for breeders seeking to add useful diversity to varieties for farmers, the CD has been distributed to hundreds of research partners worldwide. Through extensive research in southeastern Mexico involving farmers, breeders, crop geneticists, and socio-economists, CIMMYT and partners have gained insights on the relationship between farmers' practices and the genetic structure of folk varieties of maize and seed flow among farmers. Among other things, the results have implications for the future management of maize diversity in-situ and the possible effects of transgenic maize.



Conservation and use of maize genetic resources go full circle: From farmers, to evaluation and enrichment, to breeding, and back to farmers.

Diversity at Work: New Wheats from the Garden of Eden

Carmen Velazquez and Marilyn Warburton*

What You Will See: Samples of wheat landraces and evidence of how their genetic diversity is being tapped and returned to farmers in resilient, improved varieties. Samples of wheat derived from crosses between wild grass species and durum wheat—a ready bridge to the grasses' enormous and previously untapped genetic diversity. A presentation on how genetic diversity and yield have evolved over four decades in improved what varieties.

Issues: Modern bread wheat originated about 10,000 years ago from three crosses, each involving only a few types of the wild grasses that existed. This event represents a sort of genetic bottleneck in the evolution of wheat: the bread wheat that resulted is genetically diverse, but contains only a fraction of the diversity available in the grass gene pool. If you go back and replicate the crosses using other grass species, you multiply the diversity in the wheat gene pool. The CIMMYT wheat genebank contains 150,000 seed samples from more than a hundred countries and is the largest unified collection for any single crop. The volume of seed and the lack of precise information on collection sites or useful traits make it expensive to access useful diversity.

How CIMMYT and Partners Address the Issues: CIMMYT researchers have replicated the original cross that resulted in bread wheat, but using other of the available grass species to create "remixes" of bread wheat. Researchers are discovering that these remixes contain many useful, new traits, such as better tolerance to drought or saline soil conditions. In other work, because there are so many seed samples in the CIMMYT wheat gene bank, the center and partners are using biotechnology and geographic information systems to identify useful traits. With GIS, you can look at conditions in the region from where a sample was collected and thereby get an idea of qualities it might have. You may also find that you have little seed from an area where, say, a particular pest or disease of wheat is prevalent, so you can assume that local varieties may have resistance to the pest or disease and you target that area for future collection. A major partner in this work is the Generation Challenge Program, hosted by CIMMYT.

As with human beings, the appearance of an individual plant is an imperfect guide to its actual genetic make-up. So the center is using biotechnology, especially DNA signposts called "molecular markers," to

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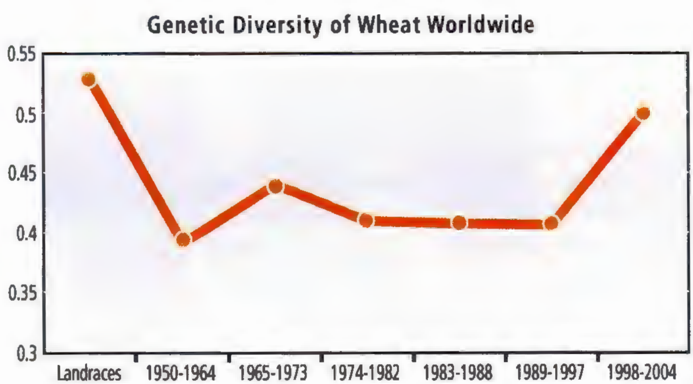
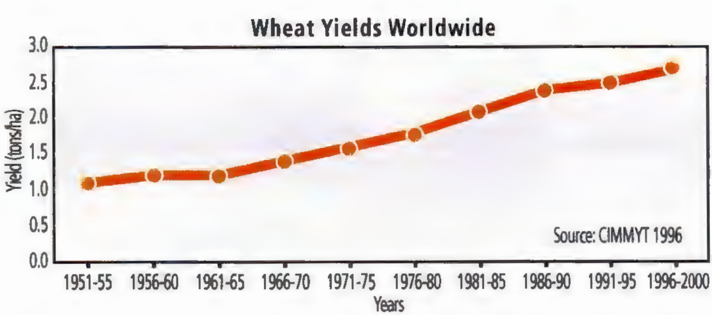
assess genetic diversity more accurately. In one study of wheat genetic diversity over the last 50 years, researchers found that levels of genetic diversity in CIMMYT-derived varieties are as high as in farmers' original varieties, but yield and other traits are improved. There are at least two probable reasons for this: (1) the use of more numerous and diverse breeding materials, partly fostered by participation in CIMMYT's global wheat testing network; and (2) the use since the mid-1990s of the new wheat remixes mentioned above (about one quarter of the experimental lines now distributed contain contributions from those sources).

Impacts on Productivity and Livelihoods: The new wheat remixes are being used now as a resource material by wheat breeders worldwide, and China and Spain have already released varieties that draw on traits from the new wheats. The study on diversity described above shows that recent, improved varieties provide higher and more robust yields under all conditions, so farmers can sow less wheat to meet their food needs. Among other benefits, the resources saved improve household economies and allow farmers to diversify to other food and cash crops.

Crossing durum wheat with a wild grass species results in a new kind of bread wheat that gives access to useful, previously untapped diversity from the grasses.





Healthy Soils, Healthy Households

Fernando Delgado and Bram Govaerts*

What You Will See: A long-term field experiment was begun at El Batán in 1991 involving 32 different crop management practices. These include continuous maize and wheat cropping or rotations of both crops, and varied tillage (conventional, zero-tillage, and cropping on permanent, raised soil beds) and crop residue management practices (full, partial, or no retention). The experiment is entirely rainfed. The presenters will outline interesting outcomes to date and explain how they relate to CIMMYT's global research on conservation agriculture and on farmers' livelihoods.

Issues: Soil fertility and productivity are declining on many farms in the developing world. Soil erosion is widespread, and farming practices often extract organic matter without ever replacing it. This means that precipitation runs off, without being absorbed and used by crops. More and more land is falling into deserts. After many years of irrigation in some crop areas, the minerals left behind make soils saline and impossible to farm. Conventional tillage, where land is heavily plowed, causes some of these problems or makes them worse. There are several ways to fight these conditions and help keep soils healthy and productive. The two most important involve reducing soil disturbance to a minimum and keeping a cover of crop residues on the surface. Crop rotations and green manure cover crops can also help. Together, these types of practices are known as "conservation agriculture"—basically because they work to conserve the soil, water, and other resources on which farmers depend. The many benefits of conservation agriculture include: better infiltration and retention of moisture, reduced soil erosion; savings in labor, water, and machinery use; higher yields; increased soil organic matter; reduced carbon emissions from tractor use or irrigation pumping; and less burning of crop residues.

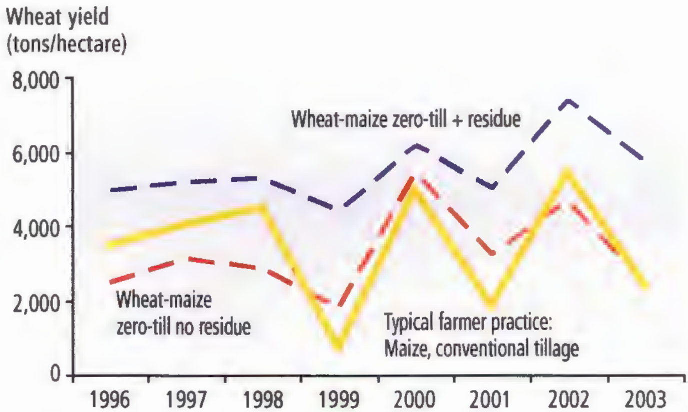
How CIMMYT and Partners Address the Issues: CIMMYT works with partners worldwide, including farmers, to test and promote conservation agriculture and other resource conserving practices. Two key partners are the Soil Fertility Consortium for Southern Africa and the Rice-Wheat Consortium for the Indo-Gangetic Plains (RWC). Challenges include overcoming the "culture of the plow," identifying and support local "champions" of innovation, and

* Fernando Delgado (Tel: +52 728 287 0560; Email: f.delgado@cgiar.org) is Field Superintendent and an agronomist at CIMMYT's research station in Toluca, Mexico, and in recent years has worked extensively with maize farmers in the Toluca Valley promoting conservation agriculture practices. Bram Govaerts (+52 55 5804 2004; Email: b.govaerts@cgiar.org) is a PhD student from Katholieke Universiteit Leuven, Belgium. Key CIMMYT researchers advancing these efforts also include Pat Wall, Ken Sayre, Stephen Waddington, and Raj Gupta.

increasing participatory research in farmers fields. Farmers also need training, among other things to learn of the value of leaving residues on the soil surface when these have high economic value as fodder. Finally, promoting these practices also requires lobbying science managers and policymakers in national programs, and providing support for agricultural machinery suppliers.

Impacts on Productivity and Livelihoods: Two examples of impact include adoption of conservation agriculture on 300,000 hectares in Bolivia, and the use of zero-tillage for sowing wheat after rice on 1.3 million hectares in South Asia. Adoption of zero-tillage could exceed several million hectares in a few years, as local manufacturers continue to meet the demand for machinery, farmers share insights, and knowledge of the benefits spreads. Net benefits in India and Pakistan through higher yields and lower land preparation costs amounted to more than USD 100 million in winter 2003 alone. Use of zero-tillage for wheat saves more than 50 liters of diesel per hectare, representing a savings of 75 million liters, worth more than USD 40 million, region-wide. The success of zero-tillage has opened the way for other resource-conserving innovations, such as permanent beds for rice, wheat, and diverse other crops. Among the most active innovators are small-scale farmers in eastern Uttar Pradesh, many of whom missed out on the prosperity the Green Revolution brought to peers in more developed regions further west. Farmers save money and drudgery, improve the resilience of cropping systems, and boost their incomes. The increased biomass yields from conservation agriculture systems means there is eventually enough residue both for fodder and to keep some on the soil.

A window on poor soil: Residues in the plot on the left have been removed continuously for years, leaving soil highly compacted and exposed to erosion. Despite generous rains this season and the damp soil, infiltration is so poor that the plants show the typical leaf rolling of drought stress. Residue retention in the plot on the right results in just the opposite and a healthy plant stand.



Long-term conservation tillage trial, El Batán, Mexico.

Zero tillage without residue (foreground) results in a variable crop stand; zero tillage with residue (background) provides a uniform crop.

Notes:

Thanks!

CIMMYT is grateful for the contributions of the organizations listed here, which support the work described in this booklet and the other efforts of the center and its partners toward improving the food security and livelihoods of the poor in developing countries.

Funding Sources

Asian Development Bank
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