CIMMYT
International Maize and Wheat Improvement Center

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Improved Maize to Boost Yields in Nitrogen-starved African Soils

Mike Listman

Sub-Saharan African farmers typically apply less than 20 kilograms of fertilizer per hectare of cropland — far less than their peers in any other region of the world. In 2014, partners in the Improved Maize for African Soils (IMAS) project developed 41 Africa-adapted maize varieties that respond better to low amounts of nitrogen fertilizer and are up for release in nine African countries through 24 seed companies.

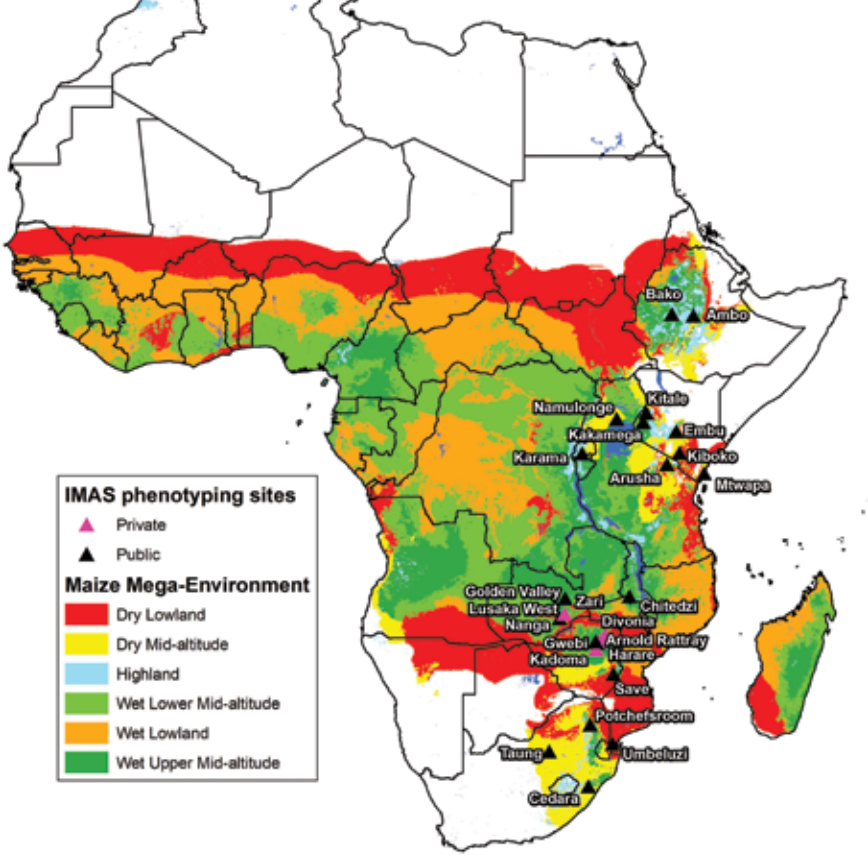
Photo: CIMMYT/IMAS.

A farmer applies nitrogen fertilizer to her hybrid maize.

After water, nitrogen is the single most important input for maize production; lack of it is the main constraint to cereal yields in Africa, in areas with enough rain to raise a crop. Year after year, infertile soils and high fertilizer prices (in rural areas as much as six times the global average) combine to reduce harvests of maize, sub-Saharan Africa's number-one cereal crop and chief source of calories and protein for the poor.

With funding from the Bill & Melinda Gates Foundation and the U.S. Agency for International Development (USAID) and led by the International Maize and Wheat Improvement Center (CIMMYT), an initiative launched in 2010 ▸

▲ Seed company representatives select IMAS maize hybrids. Photo: CIMMYT/IMAS.



has made dramatic progress to address this by exploiting natural genetic variation for nutrient-use efficiency in tropical maize. "Partners have been breeding maize varieties that respond better to the small amounts of nitrogen fertilizer African farmers can afford to apply," said Biswanath Das, CIMMYT maize breeder and coordinator of the Improved Maize for African Soils (IMAS) project. "We're aiming to raise maize yields by 50 percent and benefit up to 60 million maize farmers in eastern and southern Africa."

▲ Low nitrogen trials in Kiboko, Kenya, where new maize varieties are tested. Photo: CIMMYT/IMAS.

Smallholder Farmer Conditions: A Maize "Reality Check"

A public-private partnership that, along with CIMMYT, involves national research organizations such as the Kenya Agricultural & Livestock Research Organization (KALRO) and South Africa's Agricultural Research Council (ARC), African seed companies and DuPont Pioneer, IMAS has advanced quickly in part because participants share breeding lines and technical knowhow, according to Das.

"But a real key to success – and a significant legacy of the project – is that IMAS has established in eastern and southern Africa the world's largest low-nitrogen screening network for maize," Das explained. "There are 25 sites in 10 countries[1] and a total of over 120,000 experimental plots. Partners can test breeding lines and quickly and reliably spot the ones with superior nitrogen-use efficiency under smallholder farmers' conditions." According to Das, nearly a quarter of the plots are managed by seed companies, which recognize the value of nitrogen-use efficiency as a key trait for their farmer clients.

In an exciting 2014 development, regulatory agencies in eastern Africa began evaluating maize national performance trials — which varieties must pass as a prerequisite for release — under nitrogen stress in the IMAS network. "This is a clear recognition by policymakers of poor soil fertility as a critical constraint for African maize farmers," said Das. "To meet farmers' needs, IMAS varieties are also bred for drought tolerance and resistance to the region's major maize diseases."

1 Ethiopia, Kenya, Malawi, Mozambique, Rwanda, South Africa, Tanzania, Uganda, Zambia and Zimbabwe.

Also Yielding Under Well-Fertilized Conditions

Partners are augmenting conventional breeding with DNA-marker-assisted selection and use of "doubled haploids," a high-tech shortcut to genetically-uniform maize inbred lines. Experimental breeding stocks thus developed are field tested under low-nitrogen stress through "high-precision phenotyping," involving careful measurement of key traits in live plants.

"In this way, we've quickly developed maize varieties that yield up to 50 percent more than existing varieties under low-fertility stress, characteristic of smallholder farming systems," Das explained. "Crucially for farmers, these varieties also perform well under well-fertilized conditions, whilst several carry resistance to maize lethal necrosis, a devastating viral disease spreading through eastern Africa."

In 2014, 41 such varieties were nominated for release in nine countries in Africa, in partnership with 24 seed companies. This year IMAS also worked with seed companies to support the production and dissemination of 3,000 tons of seed of nitrogen-use efficient maize hybrids in Kenya, Mozambique, Tanzania and Zimbabwe, potentially benefitting more than 120,000 smallholder maize farmers and helping to enhance food security for over half a million household members, according to Das.

"Close collaboration with the private seed sector has been instrumental to IMAS since its inception," Das said. "These partners host over a quarter of the regional nitrogen stress screening network and have helped with the quick increase of seed of nitrogen-use efficient varieties and with managing farmer demonstrations and field days to support the fast release of new varieties."

A December 2014 report by the Montpellier Panel – comprising agricultural, trade and ecology experts from Europe and Africa – details the economic and ecological threats of degrading soils in Africa, and is highlighted in an 04 December BBC feature.

The Global Conservation Agriculture Program Wishes You a Happy Soil Day!

Soil health and the maintenance and/or improvement of our natural production base are core concerns of the Global Conservation Agriculture Program (GCAP).

If you are interested in reading more about how conservation agriculture is contributing to soil health and productivity, see below:

- Baudron, F., Jaleta, M., Okitoi, O., Tegegn, A., 2014. Conservation agriculture in African mixed crop-livestock systems: Expanding the niche. Agric. Ecosyst. Environ. 187, 171–182.
- at, R.K., Sapkota, T.B., Singh, R.G., Jat, M.L., Kumar, M., Gupta, R.K., 2014. Seven years of conservation agriculture in a rice-wheat rotation of Eastern Gangetic Plains of South Asia: Yield trends and economic profitability. F. Crop. Res. 164, 199–210.
- Thierfelder, C., Chisui, J., Gama, M., 2013. Maize-based conservation agriculture systems in Malawi: Long-term trends in productivity. F. Crop. Res. 142, 45–57.
- Turmel, M.S., Speratti, A., Baudron, F., Verhulst, N., Govaerts, B., 2014. Crop residue management and soil health: A systems analysis. Agric. Syst.

Also, look for the forthcoming special feature in *Agricultural Systems* on "**Biomass use trade-offs in cereal cropping systems in the developing world**," guest edited by CIMMYT's Olaf Erenstein, Bruno Gerard and Pablo Tittonell.

Reaching Out to Smallholder Farmers in Pakistan

Krishna Dev Joshi

CIMMYT entered an important new partnership with Pakistan's National Rural Support Program (NRSP) on 7 November 2014 for wheat varietal evaluation, promotion and deployment, as well as on-farm agronomic interventions and community-based seed production enterprises.

▲ The work of Pakistan's National Rural Support Program benefits millions of small-scale farmers and landless families. Photo: Mike Listman/CIMMYT.

A not-for-profit development organization established in 1991 that fosters a countrywide network of more than 200,000 grassroots organizations across 56 districts, NRSP enables rural communities to plan, implement and manage development programs for employment, poverty alleviation and improved quality of life. Through direct linkages with some 400,000 smallholder farming families, the organization will help extend the reach of the CIMMYT-led Agricultural Innovation Program for Pakistan (AIP), according to Dr. Rashid Bajwa, chief executive officer of NRSP. "We can now jointly scale out to a vast number of smallholders with average daily earnings of less than ▶

"This will contribute directly to the Center's mission of improving the food security and resilience of those most at risk"

–Muhammad Imtiaz
CIMMYT liaison officer for Pakistan and AIP Chief of Party

two dollars a day," Bajwa said, mentioning the organization's activities like microfinance enterprise development.

Aiming to Benefit the Disadvantaged

The partnership paves the way for a new and different kind of innovation platform focusing on smallholders, tenants and the landless, female-headed households and vulnerable groups such as flood victims, said Muhammad Imtiaz, CIMMYT liaison officer for Pakistan and AIP Chief of Party: "This will contribute directly to the Center's mission of improving the food security and resilience of those most at risk, not to mention opening avenues for other AIP partners to join hands in testing and promoting appropriate agricultural innovations."

Taking advantage of NRSP's gender-responsive approach, the partnership will work directly with and seek to empower women farmers, identifying wheat varieties and technologies that help increase their food security and incomes. Work will identify, test and deploy high-yielding and rust resistant wheat varieties across 23 districts and include improved farming practices for diverse settings from rain-fed to fully-irrigated. A major focus will be to develop community-based seed enterprises linked with NRSP, small seed companies, farmer associations and seed regulatory bodies, serving remote villages that have heretofore lacked access to improved varieties.

Getting Off on the Right Foot

A partnership inception meeting and staff training for NRSP were organized on 10 November in Islamabad, with 32 participants from NRSP and 11 from CIMMYT, including senior management from both the organizations, and with Malik Fateh Khan, NRSP Regional Manager, providing a welcome address.

Imtiaz Hussain, CIMMYT cropping systems agronomist, highlighted conservation agriculture technologies and their relevance for the partnership. Krishna Dev Joshi, CIMMYT wheat improvement specialist, discussed various types of varietal testing, including participatory varietal selection, mother-baby trials and on-farm demonstrations, to creating awareness and demand for improved seed among farmers. Three CIMMYT colleagues who also spoke at the event were: Shamim Akhter, AIP project manager; Amina Nasim Khan, communications specialist; and Ghazi Kamal, monitoring and evaluation specialist.

A group photo was taken at the NRSP inception meeting and staff training. Photo: Raja Zulfiqar Ali.

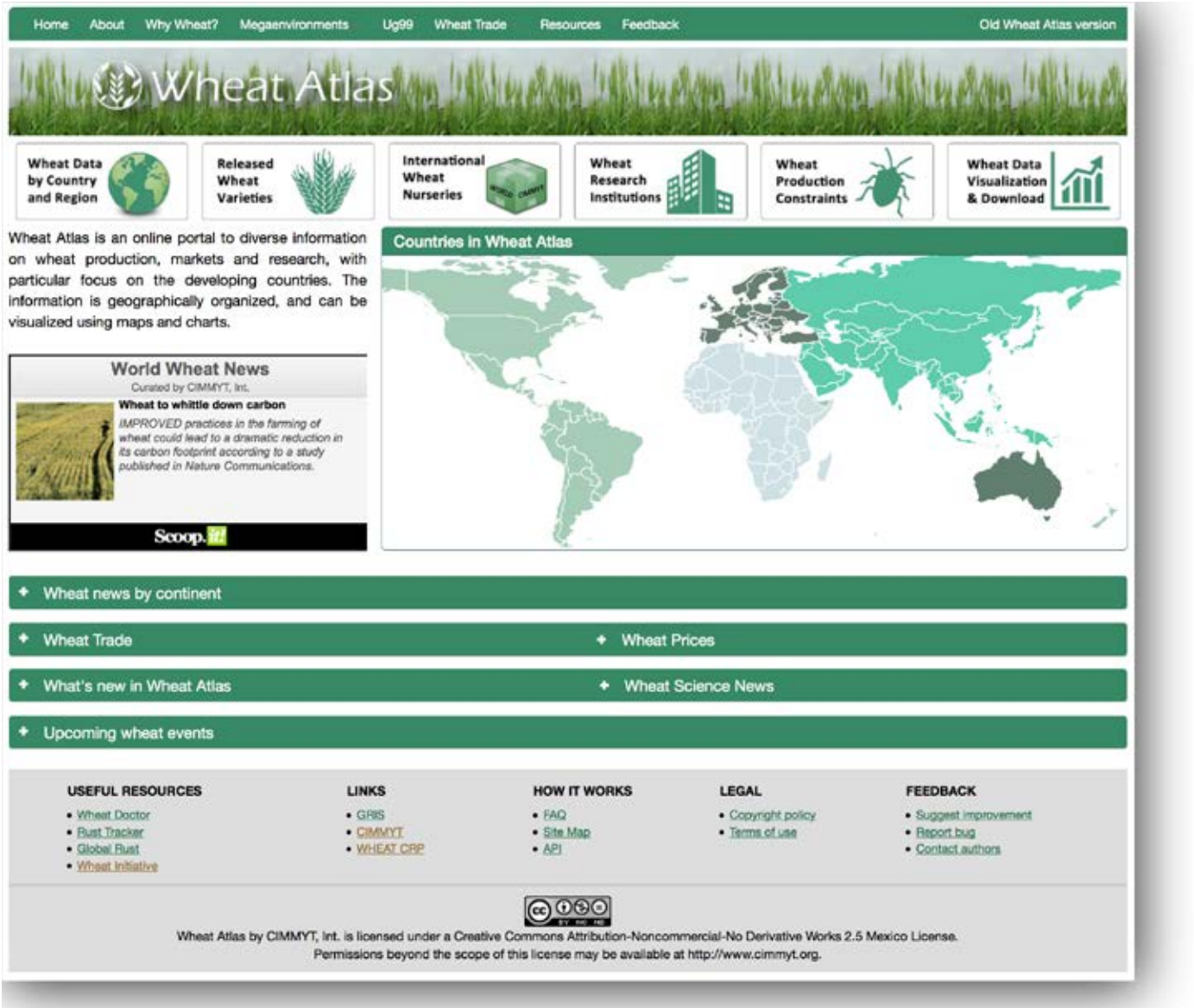
Updated Web-base Wheat Atlas 3.0 Prioritizes User Experience

Julie Mollins

Got a question about wheat? Whether you're a scientist, a researcher or simply interested in learning more about the vital staple crop that provides 20 percent of the world's calories, the Wheat Atlas can help.

The online resource developed by the CIMMYT Global Wheat Program (GWP) provides statistics on wheat production and trade wheat varieties, production challenges and international wheat nurseries, which evaluate the suitability of wheat to diverse environments.

"Although the primary users are wheat scientists, we know from anecdotal evidence that donors and policymakers are also using it," said Petr Kosina, CIMMYT consultant who led the development and recent revamp of the interactive website.



The Wheat Atlas was the brainchild of Hans Braun, GWP director, Kosina explained, adding that the project evolved into a collaboration involving consulting web expert Paul Moncada, senior scientist David Hodson, and Tom Payne, head of the Wheat Germplasm Bank, which stores seeds. CIMMYT's Geographic Information Services team created maps.

The website provides up-to-date information on new wheat varieties being released worldwide, as well as data from the Food and Agriculture Organization of the United Nations (FAO), the U.S. Department of Agriculture, the World Bank and the U.N. Development Programme.

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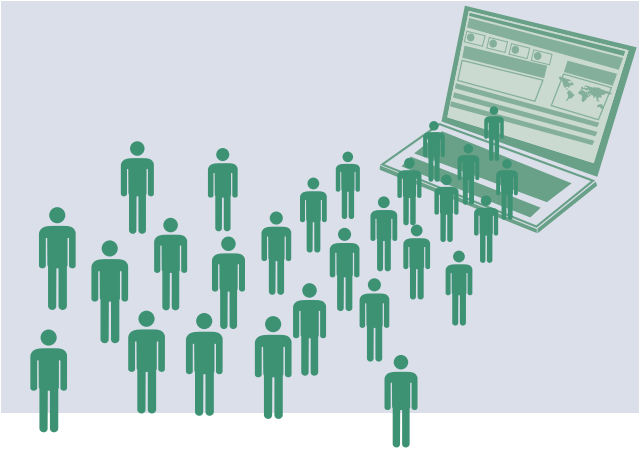
Improvements include a redesign of site structure and navigation based on user trends observed in Google Analytics data and a 2013 survey. The website now features daily wheat news on the homepage.

"The work is ongoing," Kosina said. "We're in continuous beta mode, improving the functionality of the site and user experience. For example, we're developing an online submission form for users to input data on newly released wheat varieties and a wheat scientists' 'hall of fame.' Before the end of the year we'll also improve data visualizations."



Since the official launch of the Wheat Atlas in 2009, web traffic has increased to an average of 2,200 unique visitors a month, said Kosina, who works closely with webmaster Moncada.

"We're very happy with recent access statistics, which have improved since the search engine optimization we did earlier this year, but we need secure funding for bigger plans and development," he said. "We need a new source of funding."

Wheat Atlas was supported until 2013 by the Durable Rust Resistance in Wheat project, led by Cornell University and which aims to reduce the devastating impacts of rust diseases on wheat.

The CIMMYT library has a large historic database of scientific publications with descriptions of new wheat varieties compiled over a 15-year time span, Kosina said. "My dream is to consolidate this database with the Wheat Atlas and GRIS, the world's largest database of wheat germplasm, with more than 160,000 accessions, and make it available online in the Wheat Atlas – this would be absolutely unique and smashing."

Every two years, the site managers gather information to provide a snapshot of the most important wheat varieties grown by farmers in developing countries, including area estimates. Mina Lantican, CIMMYT socioeconomist, is conducting the 2014 review as part of a wheat impact assessment study.

Since the launch, web traffic has increased to an average of 2,200 unique visitors a month...

–Petr Kosina
CIMMYT consultant

Student Reflection: Visit to CIMMYT-Hyderabad, India

Kartik Krothapalli and P.H. Zaidi

Three Purdue University graduate students, Ryan Gibson, Brad Thada and Rajdeep Singh Khangura, recently received training as part of the Heat Tolerant Maize for Asia (HTMA) project funded by USAID-Feed the Future and which aims to develop heat resilient maize for heat stress-prone ecologies in tropics.

The CIMMYT-Asia research station in Hyderabad, India, provides an ideal environment to evaluate maize genotypes for heat stress tolerance. Temperatures regularly reach 40°C or higher and the relative humidity is usually below 30 percent during maize flowering and grain filling. Additionally, the CIMMYT facilities in Hyderabad provide an excellent laboratory environment for studying the basis of heat stress-tolerance in maize.

On his second trip to the International Crops Research Institute for the Semi-Arid Tropics (ICRISAT) campus in Hyderabad, India, Gibson split his time on campus attending a statistics and genomics training course, collecting maize leaf samples in the field under the sweltering Indian summer sun and extracting leaf lipids from the collected samples in the lab.

For Thada, a graduate student studying thermal adaptation in maize, visiting the ICRISAT campus was "priceless" as he could "see first-hand the effects of heat on the maize trials we had planted there." Originally from Indiana, U.S.A., where summer

Photo: Do Van Dung, Ph Student

▲ Thada (far right) and Gibson (fourth from right) with CIMMYT-Hyderabad field-staff.

temperatures are mild compared to Hyderabad, Thada said this training was his first solo experience outside of his home country. In his words:

Photos: Do Van Dung, Ph Student

▲ Thada working in the CIMMYT-Hyderabad lab.

"I traveled to India to work on the HTMA project and collect data for my dissertation research. Having never traveled internationally alone or to Asia at all, I was both excited and a little nervous to land in Hyderabad, with only my clothes, sun screen and the promise that a driver would pick me up at the airport. I was greeted warmly by everyone I encountered during my month-long stay. Not only did my nervousness dissipate, but I grew to enjoy both the people and the culture of India. It was an amazing opportunity to work alongside the CIMMYT-Asia staff as a graduate student studying thermal adaptation in maize.

"Throughout the month of my stay, I enjoyed developing both professional and personal relationships while attending a statistics and genomics training course, working both in the field and the lab, exploring Hyderabad and enjoying the local food. I even had my first ride on a motorcycle, a staple of Indian transportation. I will not forget the beautiful country and wonderful people that made my trip memorable.

"I'm very grateful to my advisor Mitch Tuinstra, professor of plant breeding at Purdue University, for giving me this opportunity. I would like to thank P.H. Zaidi, Raman Babu, molecular, and Kartikeya Krothapalli, for all their help in getting me to Hyderabad and making my stay as productive and educational as possible. I would also like to thank M.T. Vinayan, Vishwanath, and Kiran for all their help and for smoothing out all the bumps that come when such different cultures merge."

This was the second visit to the ICRISAT campus for Khangura, who comes from the agrarian Indian state of Punjab (the first was in 2010 as a B.Sc. student at Punjab Agricultural University). He said his first trip left him with a desire to work with CGIAR centers because of their non-profit nature and attitude to serve humanity:

▲ Khangura working at CIMMYT-Hyderabad lab.

"I am a second year graduate student at Purdue University and one of five graduate students who are involved in the HTMA project. Being originally from Punjab and son of a farmer, agriculture is what I learnt since childhood. Wheat-rice is the major crop rotation in Punjab but spring maize production is increasing and fits very well into most crop rotation practices in South Asia. With the increase in the average global temperatures, the maize growing regions of South Asia are vulnerable to decline in the yields. The development of superior maize hybrids that can tolerate high temperature stress promises a better future for maize in the tropical belt.

"I heard about the hard work of the CIMMYT-Asia team many times but on this trip I had an opportunity to experience the excitement of the maize breeding program. On this visit, I worked with the CIMMYT team to process laboratory samples collected as part of the HTMA project. This was excellent opportunity to work with CIMMYT scientists, post-doctoral fellows, research assistants, and technicians. We got a lot of work accomplished as the work ambience was not just stress free but energizing. The tireless work and absolute commitment of the CIMMYT team to science was inspiring."

HTMA is a Public-Private-Partnership (PPP) involving active collaboration of CIMMYT, Purdue and private partners, along with the national agricultural research system of India, Pakistan, Nepal and Bangladesh, to develop robust hybrids with the help of seed companies in the region.

Training to Fill Gaps in Ethiopia's Maize Seed System

Seifu Mahifere

The Nutritious Maize for Ethiopia (NuME) project recently organized a three-day training workshop on quality protein maize (QPM) seed production and quality control, as part of the project's activities to enhance QPM seed production. There were 26 participants, including 2 women, from seed companies, farmer cooperative unions, the Ministry of Agriculture, seed laboratories, research institutes and universities. The workshop was facilitated by CIMMYT experts working in eastern Africa.

▲ Regasa Mosisa, maize seed specialist-CIMMYT Nairobi, facilitaties one of the sessions. Photo: Seifu Mahifere.

Opening the event, Dr. Dagnachew Beyene, advisor to the State Minister of Agriculture, said the workshop was very timely. "The expansion of the Ethiopian seed system is constrained by a shortage of skilled professionals," he said.

Developed over two decades of meticulous breeding from the late 1970s to the early 1990s, QPM contains enhanced levels of amino acids used for protein synthesis in humans and farm animals such as pigs and poultry. Nutritional studies have shown that it can improve the nutrition of people whose diets are highly-dependent on maize, especially young children. Major topics covered included maize variety development, maize seed research and field management for QPM seed production, maintenance of QPM inbred parent lines and open-pollinated varieties, as well post-harvest handling techniques for QPM.

The training also dealt at length with creating communication links between seed companies, customers and farmers and planning and developing seed production, marketing and financial strategies to promote of QPM seeds.

Addressing the participants at the conclusion of the training, the Crops Research Director of the Ethiopian Institute of Agricultural Research (EIAR), Dr. Asnake Fikre, stated that efforts need to be made to sustain QPM production in Ethiopia, because maize is the most produced cereal and a critical crop for food security in the country.

Asnake also noted that "in the transition to food security in the country, nutritional security is a critical concern and the crop sector in Ethiopia should work hard to sustain the QPM value chain by advocating its nutritional and agronomic benefits and creating demand for the production and use of QPM." The added that NuME's important work on QPM needs to be effectively backed up by multi-sectorial engagement and cooperation.

In their feedback, participants said the workshop had been timely, well-organized and valuable. They suggested that future such events include practical sessions and interaction with farmers. Typical remarks included statements that "strengthening of QPM and advocacy issues need to be consistent in promoting QPM until it reaches cutting-edge stage."

NuME is implemented by CIMMYT in Ethiopia and funded by the Department of Foreign Affairs, Trade and Development of Canada (DFATD). It is designed to help improve the food and nutritional security of Ethiopia's rural population, especially women and children, through the adoption of QPM varieties and crop management practices that increase farm productivity.

Pakistan: Maize Needed for Marginal Areas

Photo: Awais Yaqub

▲ From left to right: Shahid Masood, Md. Imtiaz, Iftikhar Ahmad and AbduRahman Beshir.

AbduRahman Beshir

Farmers in the farthest reaches of Pakistan need access to white-grained maize, according to Dr. Iftikhar Ahmad, chairman of the Pakistan Agricultural Research Council (PARC). "There is a good progress in the productivity of yellow maize varieties in the areas of Punjab and KPK provinces," Ahmad said, "but we need white maize varieties to reach farmers in the marginal areas of KPK, Sindh, Balochistan and Gilgit Baltistan provinces."

Speaking at the first National Maize Workshop-Annual Progress Review of Pakistan, held in Islamabad during 19-20 November, Ahmad also mentioned the importance of public-private partnerships to reduce the cost to farmers of hybrid seed, which is more expensive in Pakistan than elsewhere in South Asia. ▸

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> –Dr. Iftikhar Ahmad
> Chairman of the Pakistan Agricultural Research Council (PARC).

Jointly organized by PARC and CIMMYT, the workshop was an activity of the Agricultural Innovation Program (AIP) for Pakistan and its 50 participants represented public and private maize research and development institutions, local and multinational seed companies, higher learning institutions, and departments of extension and food processors from all provinces of Pakistan.

Dr. Md. Imtiaz, project leader of AIP, highlighted the role of CIMMYT in enhancing local capacity and requested the full collaboration of national institutions.

During the concluding session, Dr. Shahid Masood, Member of Plant Science and AIP focal person at PARC, mentioned the importance of deploying biofortified and specialty maize, providing farmers with agronomy training, diversifying maize uses and developing and deploying dual purpose maize for food and feed.

The workshop was followed by a field visit to the National Agricultural Research Center (NARC), where participants saw the performance of AIP-maize varieties and lines from CIMMYT breeding programs in Colombia, Mexico and Zimbabwe. AbduRahman Beshir, CIMMYT maize improvement and seed systems specialists, said the event helped to define shared objectives for AIP-maize partners and a common goal to work towards and helped CIMMYT to reactivate maize research and development activities in Pakistan. Finally, partners discussed "seed road maps" that describe and illustrate varietal release pathways and seed production targets.

Photo: Awais Yaqub

Dr. Beshir explains the traits of yellow maize at NARC, Islamabad. ▶

Photo: Awais Yaqub

▲ Dr. Iftikhar Ahmad, PARC Chairman, addresses participants.

Heat-tolerant Maize for Asia
Showcased at India-US Technology Summit

Ms. Kiranmayi T. and Dr. K. Seetharam

Under the theme, "Innovation in Agriculture," updates and products of CIMMYT's Heat-tolerant Maize for Asia (HTMA) project were displayed at the 20th India-US Technology Summit on 18-19 November in New Delhi. The summit was a high-profile event aimed showcasing the strong partnership and collaboration between India and the USA in science, technology, and innovation.

Photo: K. Seetharam/CIMMYT

▲ Ms. Kiranmayi T. explains HTMA products to Government of India officials.

The summit was jointly organized by the Confederation of Indian Industry (CII), the Indian Department of Science & Technology (DST) and the U.S. Department of State, the Indo-U.S. Science Technology Forum, U.S.-India Business Council and USAID. The event provided a unique platform for industries, institutions and government agencies from India and the United States to exchange ideas and showcase their expertise, forge new partnerships to increase trade and investment in the knowledge sector and bring together leaders from government, industry, research, and academia for high-level policy discussions.

HTMA was represented at the summit with a display, which included an informative poster highlighting up-to-date progress and maize cob samples of newly developed, heat-stress-tolerant hybrids.

Photo: K. Seetharam/ CIMMYT

▲ Dr. P.H. Zaidi discusses the HTMA project with the U.S. Assistant Secretary of State for Economic and Business Affairs and USAID-India Officials.

Charles H. Rivkin, US assistant secretary of state for Economic and Business Affairs, visited HTMA's display accompanied by USAID-India officials Dr. Srivalli Krishnan, project management specialist (Climate Adaptation), Food Security Office and Dr. Sheila E. Desai, senior science and technology advisor, Centre for Innovations and Partnerships. P.H. Zaidi, HTMA project leader, welcomed the delegates and discussed the main features of the project and progress to date. The visitors were impressed with the hybrid heat-tolerant maize they saw and noted the project's progress in the past two years. Rivnik asked about the HTMA deployment plan and suggested evaluating heat-tolerant hybrids for use by the poultry industry. Desai commented: "Everyone who saw the poster (and the corn cob exhibit) comparing the heat-stressed and tolerant corn remarked on how impressive it is. You've got a winning image with that."

Many other U.S. officials and representatives of India's ministries visited the exhibit. Ms. Kiranmayi T. and Dr. K. Seetharam from CIMMYT-Hyderabad attended most of the visitors including students, exhibitors, entrepreneurs, seed companies and the general public.

Tottori University Students Visit CIMMYT

Jennifer Johnson

A group of 16 undergraduate students and three professors from the University of Tottori, Japan, visited CIMMYT on 26 November. The visit was the last stop of a three-month study visit to Mexico, which also included visits to the *Universidad Autonoma de Baja California Sur* (UABCS) and the *Centro de Investigaciones Biológicas del Noroeste S.C.* (CIBNOR). The students began their visit with an overview of CIMMYT from Isabel Peña, Head of Institutional Relations-Latin America, followed by a meeting with Dr. Masahiro Kishii, a Japanese scientist formerly of Tottori University who now works in wheat cytogenetics in CIMMYT's Global Wheat Program. The group was then given a tour of the Wellhousen-Anderson Genetic Resources Center and the labs of the Biosciences Complex. The day concluded with a visit to the Global Conservation Agriculture Program's D5 demonstration plot, where the students learned about developments in machinery and post-harvest technology.

Photos: Xochiquetzal Fonseca

▲ Masahiro Kishii of CIMMYT's Global Wheat Program gives students a tour of the Wellhousen-Anderson Genetic Resources Center.

▲ Jelle Van Loon, leader of smart mechanization for CIMMYT's conservation agriculture program in Mexico, teaches students about machinery development.

▼ Isabel Peña, Head of Institutional Relations-Latin America, welcomes students to CIMMYT.

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Central American Agriculture and Livestock Council Signs Agreement with CIMMYT

Mike Listman

At El Batán, Mexico, on 03 December, Thomas A. Lumpkin, CIMMYT director general, signed a memorandum of understanding with Julio Calderón, Executive Secretary of the Central American Agriculture and Livestock Council (CAC), for shared work to strengthen the seed sector and to promote seed of improved crop varieties and relevant mechanization for small- and intermediate-scale farmers in the region. Created in 1991, CAC is part of the Central American Integration System (SICA) established by Costa Rica, El Salvador, Guatemala, Honduras, Nicaragua and Panama and helps to link agricultural with other key sectors and agencies, in benefit of farmers and rural inhabitants.

Photos: Xochiquetzal Fonseca

▲ Julio Calderón and Tom Lumpkin stop for a photo as they tour the CIMMYT campus.

◄ The CIMMYT delegation provides a presentation for Calderón. From left to right: Felix San Vicente, Víctor López, Lumpkin, Calderón, Arturo Hinojosa and Isabel Peña.

Calderón and Lumpkin sign the memorandum of understanding. ►

◄ From left to right: Bram Govaerts, Calderón, Lumpkin and San Vicente pause for a photo.

Recent Publications by CIMMYT Staff

Knowledge Center

Biofortified Orange Maize Enhances β-Cryptoxanthin Concentrations in Egg Yolks of Laying Hens Better than Tangerine Peel Fortificant. 2014. Heying, E.K.; Tanumihardjo, J.P.; Vasic, V.; Cook, M.; Palacios-Rojas, N.; Tanumihardjo, S.A.Journal of Agricultural and Food Chemistry. Online First.

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Dear Informa readers,

Due to upcoming events and holidays, today's Informa will be the last published this year. We will resume publication on 16 January.

Please continue to send your material for publication next year.

To those who celebrate at this time of year, the Informa team wishes you happy holidays!

A Last Look

Maize fields are not 'green deserts.' They act as part of the habitat of several species of fauna. The distinction made between cropland and natural areas is a human-perceived landscape pattern that does not reflect actual species distribution. In this picture, a female weaver has built her nest in the tassel of a maize plant, in a field in Adami Tulu, Ethiopia. Note: look closely at the center of the photo.

Three CIMMYT-Pakistan staff members (at left with hats) have a tea-time discussion with partners in the middle of a maize field. In the background are yellow (left) and white maize cobs (right) that were harvested while plants were still green. The maize field is located in Bhawana, about 330 kilometers south of the capital of Islamabad.

Informa is published by CIMMYT Communications Department. We welcome your input, preferably in both English and Spanish. The deadline for submissions is 9 a.m. on the Wednesday before publication. We reserve the right to edit all contributions. Please send proposed material to CIMMYT-International-Communications-Department@cgiar.org