Stress Tolerant Maize for Africa

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Ethiopian farmers adopting new DT maize hybrid for improved productivity and resilience

Many maize farmers in sub-Saharan Africa grow old varieties that do not cope well under drought conditions. In the Oromia region of Ethiopia, farmer Seguare Regassa is improving her family's life by growing the newer drought-tolerant maize variety BH661. This hybrid was developed by the Ethiopian Institute of Agricultural Research (EIAR), using CIMMYT's drought tolerant inbred lines and one of EIAR's lines. It was then officially released in 2011 by the EIAR as part of the Drought Tolerant Maize for Africa (DTMA) project, funded by the Bill & Melinda Gates Foundation and continued under the Stress Tolerant Maize for Africa (STMA) initiative.



Sequare Regassa stands next to her fields holding a wooden farming tool. Photo: Simret Yasabu/CIMMYT.

"Getting a good maize harvest every year, even when it does not rain much, is important for my family's welfare," said Regassa, a widow and mother of four, while feeding her granddaughter with white injera, a flat spongy bread made of white grain maize.

Since her husband died, Regassa has been the only breadwinner. Her children have grown up and established their own families, but the whole extended family makes a living from their eight-hectare farm in Guba Sayo district.

On the two hectares, Regassa cultivates on her own, she rotates maize with pepper, sweet potato and anchote, a local tuber similar to cassava. Like many farming families in the region, she grows maize mainly for household food consumption, prepared as bread, soup, porridge and snacks. Maize represents a third of cereals grown in Ethiopia. It is cheaper than wheat or teff - a traditional millet grain - and in poor households it can be mixed with teff to make the national staple, injera.

In April, as Regassa was preparing the land

for the next cropping season, she wondered if rains would be good this year, as the rainy season was coming later than usual. In this situation, the choice of maize variety is crucial. She used to plant a late-maturing hybrid released more than 25 years ago, BH660, the most popular variety in the early 2000s. However, this variety was not selected for drought tolerance. Ethiopian farmers face increasing drought risks which severely impact crop production, like the 2015 El Nino dry spell, leading to food insecurity and grain price volatility.

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Convincing demonstrations for farmers and seed companies

Under the DTMA project, maize breeders from CIMMYT and the Ethiopian Institute for Agricultural Research (EIAR) developed promising drought-tolerant hybrids which perform well under drought and normal conditions. After a series of evaluations, BH661 emerged as the best candidate with 10% better on-farm grain yield, higher biomass production, shorter maturity and 34% reduction in lodging, compared to BH660. The resulting BH661 variety was released in 2011 for commercial cultivation in the mid-altitude sub-humid and transition highlands.

The year after, as farmers experienced drought, the Ethiopian extension service organized BH661 on-farm demonstrations, while breeders from CIMMYT and EIAR organized participatory varietal selection trials. Farmers were impressed by the outstanding performances of BH661 during these demos and trials and asked for seeds right away. Seed companies had to quickly scale up certified seed production of BH661. The STMA project team assisted local seed companies in this process, through trainings and varietal trials. Companies decided to replace the old hybrid, BH660.

"In addition to drought tolerance, BH661 is more resistant to important maize diseases like Turcicum leaf blight and grey leaf spot," explained Dagne Wegary, a maize breeder at CIMMYT. "For seed companies, there is no change in the way the hybrid is produced compared to BH660, but seed production of BH661 is much more cost-effective."

EIAR's Bako National Maize Research Center supplied breeder seeds to several certified seed producers: Amhara Seed Enterprise (ASE), Bako Agricultural Research Center (BARC), Ethiopian Seed Enterprise (ESE), Oromia Seed Enterprise (OSE) and South Seed Enterprise (SSE). Certified seeds were then distributed through seed companies, agricultural offices and non-governmental organizations, with the technical and extension support of research centers.

From drought risk to clean water

After witnessing the performance of BH661 in a neighbor's field, Regassa asked advice from her local extension officer and decided to use it. She is now able to produce between 11-12 tons per hectare. She said her family life has changed forever since she started planting BH661. With higher maize grain harvest, she is now able to better feed her chickens, sheep and cattle. She also sells some surplus at the local market and uses the income for her family's needs. Sequare Regassa feeds her granddaughter with maize injera.

"If farmers follow the recommended fertilizer application and other farming practices, BH661 performs much better than the old BH660 variety," explained Regassa. "If we experience a drought, it may be not that bad thanks to BH661's drought tolerance."

Regassa buys her improved seeds from the Bako Research Station, as well as from farmers' cooperative unions. These cooperatives access seeds from seed companies and sell to farmers in their respective districts.

"Many around me are interested in growing

BH661. Sometimes we may get less seeds than requested as the demand exceeds the supply," Regassa said.

She observed that maize prices have increased in recent years. A 100 kg bag of maize that used to sell for 200–400 Ethiopian birr (about \$7–14) now sells for 600–700 Ethiopian birr (about \$20–23). With the increased farmers' wealth in her village, families were able to pay collectively for the installation of a communal water point to get easy access to clean water.

"Like women's role in society, no one can forget the role maize has in our community. It feeds us, it feeds our animals, and cobs are used as fuel. A successful maize harvest every year is a boon for our village," Regassa concluded.

Read the original article here.

BH660 vs. BH661, a rapid variety turnover

From half a ton of BH661 breeder seeds of the three parental lines produced by Bako Research Center in 2011, nearly 9,000 tons of certified seeds were produced and marketed in 2016 by various seed producers in Ethiopia (See figure below).

In 2017, improved seeds were planted at 60 percent of maize growing areas. BH661 constituted 30 percent of this area, covering 360,000 hectares. <u>At</u> <u>least 60 percent of certified seeds in</u> <u>Ethiopia are produced and</u> <u>marketed by public seed</u> <u>companies</u>, while local private seed companies (10 percent) and multinational seed companies with proprietary hybrids (30 percent) share the rest of the maize seed market.

One of the key drivers for the adoption of BH661 was the willingness by seed companies to take up the new hybrid and replace BH660. BH661 is marketed almost as an upgrade because of its higher tolerance to maize diseases and drought conditions.

Taye Terefe is a farm manager at Anno Agro-Industry, a private company located a few kilometers from Bako Research Center in Oromia region. The company is engaged in the production and marketing of foundation and certified seeds of BH661 as well as selling farm inputs to farmers in the area. It started producing BH661 three years ago, gradually replacing BH660. "Our company is happy with the seed producibility of the BH661, which is also

accepted by farmers particularly for its stronger stalk and good standability, significantly reducing lodging," explains Taye.

Anno Agro-Industry was producing the popular BH660 hybrid, but after EIAR and CIMMYT introduced BH661, the company decided to replace it gradually with the new variety. In 2015, the company produced BH661 seeds on 44 hectares of land, with average seed yield between 2.9 and 3.5 tons per hectare. They now produce BH661 seed on 150 hectares.



Comparison of the amount of certified seed production of BH660 and BH661 from 2012 to 2018.

Reference: Ertiro B.T. et al. (2019) Fast-Tracking the Development and Dissemination of a Drought-Tolerant Maize Variety in Ethiopia in Response to the Risks of Climate Change. In: Rosenstock T., Nowak A., Girvetz E. (eds) The Climate-Smart Agriculture Papers. Springer, Cham. DOI: https://doi.org/10.1007/978-3-319-92798-5_7

Shifting to a demand-led maize improvement agenda

In annual meeting, STMA project partners build on the successes of research in combatting drought, heat, pests and disease.

Partners of the Stress Tolerant Maize for Africa (STMA) project held their annual meeting May 7-9, 2019, in Lusaka, Zambia, to review the achievements of the past year and to discuss the priorities going forward.

The International Maize and Wheat Improvement Center (CIMMYT), the International Institute for Tropical Agriculture (IITA) and its partners across 13 countries in sub-Saharan Africa are working together in the fight against farming challenges such as drought, maize lethal necrosis and fall armyworm.

The STMA project applies innovative crop improvement technologies such as high-throughput phenotyping, doubled haploids, marker-assisted breeding and intensive germplasm screening to develop improved stress-tolerant maize varieties for smallholder farmers. The project team is also strengthening maize seed systems through public-private partnerships.

The meeting was officially opened by the Deputy Director of the Zambia Agriculture Research Institute (ZARI), Monde Zulu. "Maize in Africa faces numerous challenges such as drought, heat, pests and disease. Thankfully, these challenges can be addressed through research. I would like to take this opportunity to thank CIMMYT and IITA. Your presence here is a testament of your commitment to improve the livelihoods of farmers in sub-Saharan Africa," she said.

The efforts are paying off: in 2018, 3.5 million smallholder farmers planted stress-tolerant maize varieties in 10 African countries.

Yielding results

CIMMYT researcher and STMA project leader Cosmos Magorokosho pointed out that the improved maize varieties



The deputy director of the Zambia Agriculture Research Institute (ZARI), Monde Zulu (fourth from left), gives the opening address of the STMA Annual Meeting 2019 in Lusaka. Left to right: Mick Mwala, University of Zambia; Tony Cavalieri, Bill & Melinda Gates Foundation; B.M. Prasanna, CIMMYT; Monde Zulu, ZARI; Mwansa Kabamba, ZARI; Cosmos Magorokosho, CIMMYT; and Abebe Menkir, IITA.

developed through the project "provide not only increased yields but also yield stability even under challenging conditions like drought, poor soil fertility, pests and diseases."

"STMA has proved that it is possible to combine multiple stress tolerance and still get good yields," explained B.M. Prasanna, director of CIMMYT's Global Maize Program and the CGIAR Research Program on Maize (MAIZE). "One of the important aspects of STMA are the partnerships which have only grown stronger through the years. We are the proud partners of national agricultural research systems and over 100 seed companies across sub-Saharan Africa."

Down to business

On May 8, participants visited three partner local seed companies to learn more about the opportunities and challenges of producing improved maize seed for smallholder farmers.

Afriseed CEO Stephanie Angomwile discussed her business strategy and passion for agriculture with participants. She expressed her gratitude for the support CIMMYT has provided to the company, including access to droughttolerant maize varieties as well as capacity development opportunities for her staff.

Bhola Nath Verma, principal crop breeder at Zamseed, explained how climate change has a visible impact on the Zambian maize sector, as the main maize growing basket moved 500 km North due to increased drought. Verma deeply values the partnership with the STMA project, as he can source drought-tolerant breeding materials from CIMMYT and IITA, allowing him to develop early-maturing improved maize varieties that escape drought and bring much needed yield stability to farmers in Angola, Botswana, the Democratic Republic of the Congo, Tanzania and Zambia.

At QualiBasic Seed, STMA partners were given the opportunity to learn and ask questions about the company's operations, including the seed multiplication process in Zambia and the importance of high-quality, genetically pure foundation seed for seed companies.

Read the original article here.

FACTS & FIGURES ABOUT STMA ZAMBIA



Zambian population of 17 million people (2017) living below the poverty datum line. The total population will grow to 42 million by 2050. Zambians eat a lot of maize (about 100kg per capita per year).

Smallholder farmers in Zambia that grow maize on 1.43 million hectares. 2 thirds of maize fields are planted with improved varieties. Productivity remains quite low with an average yield of 2.6 tons/ha. Drought is a major concern. Ref: Indaba Agricultural Policy Research Institute (IAPRI)

STMA varieties were released in 2017: 2 early and 1 medium maturity.

STMA captures farmers' preferences to develop varieties farmers want

"What I am looking for is a maize variety that produces a lot, even when there is scarce rainfall," says Tabitha Kamau, 29-year-old single mother of three, who grows maize on a quarter an acre of land in Katheini location in water-stressed Machakos County, Kenya.

"Early maturity variety is interesting for me. If I can harvest in three and a half months or less compared to four months or more for other varieties, I can sell some grain to neighbors still awaiting their harvest and want to feed their families," Kamau adds.

STMA project has been undertaking since 2016 annual farmer participatory maize variety evaluations to provide feedback to maize breeders on farmers' trait preferences.

First, farmers get an opportunity to state what traits are important for them and rank a dozen varieties including popular ones and new hybrids, scoring each entry on individual trait and their overall performance. Farmers conclude the exercise by rating the best three plots.

"Through statistical analysis, we identify which traits contribute a lot in the overall

Tabitha Kamau checking her drought-tolerant maize. Photo: CIMMYT /Joshua Masinde.

appreciation of a variety," Bernard Munyua, CIMMYT research assistant explains. For instance, farmers may give high importance to height or biomass, yet it may not play a role in their ranking of best varieties. "Such data is important to maize breeders to support future variety improvement work," Munyua notes.

In the eastern part of Kenya, farmers might be interested in traits such as

drought tolerance, early maturity and disease resistance. In central Kenya where dairy farming is commonly practiced, a variety with more biomass can be an important factor.

In western Kenya, they could be more interested in grain yields and cob characteristics to improve their sales after harvest. *Read full article <u>here</u>.*

Hajia Asibi, a Nigerian woman empowered by maize farming

Hajia Asibi is "a community women leader, civil servant and a proud farmer" from Northern Nigeria. After a few years in civil service, she turned to the production and sale of grains to feed her family. However, labor drudgery and low profitability almost discouraged her.

Experts from the International Institute for Tropical Agriculture (IITA) and National Agricultural Extension and Research Liaison Services (NAERLS) provided the right technical support to Asibi, including access to stress tolerant maize seeds.

IITA-NAERLS team provided training and linkages to Asibi and the other members of Sabon Gari Women Multipurpose Cooperatives.



Hajia Asibi, a community women leader and civil servant turned maize farming to feed her family.

"We now harvest more than sixty bags of maize, about 5.4 tons from one hectare after we embraced the ST-maize varieties and other recommended farm management practices. Our profits soared dramatically, and our lives took a very good turn," she

says. Thanks to maize grain sales, she was able to buy her own house and provide education support to her five children.

Read more here.

STMA gender transformative research agenda: Women in Seed Business

The maize seed industry in Eastern and Southern Africa is male dominated. Rahma Adam, CIMMYT gender specialist, explained the rationale of gender research within the STMA project. In sub Saharan Africa, women farmers are less likely to use improved seed than men, leading to lower productivity levels. STMA gender research is three-fold:

• Provide state-of-the-art knowledge on gender in seed value chains.

 Advise seed companies and alternative development partners like NGOs or local extension organisations on gender sensitive awareness creation approaches.

• Determine through farmer participatory varietal testing if women maize farmers' trait preferences differ from male farmers and what such differences could mean for future uptake strategies.

Gender differences for some food-related grain quality criteria were identified like kernel flour vield, good flour swelling and shelf-life. Collaboration with food science specialists is recommended to understand how these gender preferred traits could be incorporated in STMA breeding strategy.

The video "Women in Seed Business" which featured nine women seed entrepreneurs from Kenva, Malawi, Mozambigue, Tanzania and Zambia was screened at the opening of the STMA annual review meeting.

Sylvia Horemans, founder and CEO of

Kamano Seeds in Zambia received a partnership award. When the seed company was created in 2004, not many farmers had access to improved seeds in rural areas and not many seed companies are around, explained Horemans, Women seed entrepreneurs face many challenges like access to finance to grow their business. Janey Leakey's Leldet Seed Company markets small seed packs especially for women farmers so that they could test new varieties for a modest sum. Other women seed entrepreneurs interviewed include Zubeda Mduruma from Aminata Quality Seeds Ltd in Tanzania and Grace Malindi from Mgommera Seeds in Malawi.



Sylvia Horemans, CEO, Kamano Seed Co., moves maize seed to the processing plant using a forklift at the company's warehouse in Lusaka, Zambia. Photo: CIMMYT/Kipenz Films.

PICTORIAL One-Acre Demos in Zimbabwe

Smallholder farmers were provided with stress-tolerant maize (STM) seeds to plant on one-acre demo plots in various drought-prone regions of Zimbabwe. The One-Acre Demo approach aims to raise farmer awareness about new drought tolerant varieties while demonstrating the performance of new varieties under real farm conditions. Photos: Shiela Chikulo/CIMMYT.



therine and Moses Phiri from Chakacha village, Ward 7 in Mhondoro-Ngezi district hosted the 'One-Acre' Field Day in collaboration with CIMMYT and Agriseeds.





MIND

maize cob during the 'One-Acre' Field Day held in Ward 9 Murewa, Zimbaby

Upcoming events

CIMMYT Partner Field Days and International Maize Improvement Consortium (IMIC) day will take place on August 27-28 in Embu and Naivasha, Kenya.

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