STMA Bulletin

Stress Tolerant Maize for Africa

July-September 2019

Collaborative product profiling captures farmers' demand for greater impact

A demand-driven, multi-lens approach ensures the best maize varieties are available to seed companies and farmers.

The International Maize and Wheat Improvement Center (CIMMYT) organized its first ever Maize Product Profile-based Breeding and Varietal Turnover workshop for eastern Africa in Nairobi, on August 29 and 30, 2019. The workshop, funded by USAID, was attended by maize breeders from national research institutes in Kenya, Uganda, Tanzania, Rwanda, Ethiopia and South Sudan, and by several partner seed companies including Seedco, Kenya Seeds, Western Seeds, Naseco and Meru Agro.

Participants from CIMMYT, EiB, NARs and seed firms attending the Product Profile workshop in Nairobi on August 29-30, 2019. (Photo: Joshua Masinde/CIMMYT)

A product profile is defined as a list of "must-have" maize characteristics or traits that are the unique selling points for the target beneficiaries who are looking for these qualities. The breeders also consider additional traits in their breeding strategy, "value-added" or desirable traits that could be future unique selling points.

"A product profile is not a secret sauce" nor a checkbox to tick, explained Georges Kotch, a renowned expert in the seed industry and lead for Module 1 of the Excellence in Breeding (EiB) platform on product profiling. A product profile is a blueprint to help maize breeding programs ensure their new varieties released respond to a true need with a clear comparative advantage for seed companies and ultimately for maize farmers. This demand-driven process "starts with the end in mind" by understanding what the customers want. The end goal is to replace leading old varieties on the market with better ones that will improve farmers' livelihoods, for example, with greater climate resilience and productivity.

Steering the breeding program through "healthy tensions"

Breeders may have had the tendency to focus on optimum yield for a certain agroecology, yet their priority traits may not reflect exactly the market or what farmers want. In addition to good yield, drought or disease resistance, grain color, taste, nutritional value, and appearance of plants and cobs are important in farmers' choice of seed. Socio-economic research tools like participatory varietal selection (PVS) or willingness-to-pay experiments help us weigh the importance of each trait to trigger adoption.

There may be tensions between farmers' needs, what suits seed companies like the seed reproducibility ratio, and what is possible and cost-effective from a breeder's perspective. CIMMYT does not only look through the lens of economic return. The social impact new varieties could have is also considered, for example developing provitamin A or quality protein maize (QPM) as a solution to combat malnutrition even if there is not a major demand from private seed companies in Africa for nutritious maize.

Qualities valued by some actors may be overlooked by others. For example, some maize varieties have leafy ears with deceptively small cobs, which may protect the grain against pests but could be rejected by farmers.

It is important to have a wide array of expertise from breeding, market research and socio-economic analysis so that the different trait choices are weighed according to different lenses and a clear strategy for varietal turnover is defined.

High performing hybrids may not be enough for large-scale adoption

In southern Africa, climate experts warn that farmers could face drought every three years. CIMMYT has rightly prioritized drought tolerance (DT) over the last decade under the Stress Tolerant Maize for Africa initiative. Recently developed DT maize hybrids often outperform the popular varieties on the market, yet the varietal turnover

STMA Bulletin is a quarterly publication of the Stress Tolerant Maize for Africa (STMA) project. This initiative funded by the Bill & Melinda Gates Foundation and the United States Agency for International Development (USAID) is led by the International Maize and Wheat Improvement Center (CIMMYT) and the International Institute of Tropical Agriculture (IITA). For more information about STMA visit: http://stma.cimmyt.org

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has been slow in some regions. Farmers' perceptions of what is a good maize may influence the success or rejection of a new variety. The risk for farmers and seed companies to try out a new variety is an important factor in adoption as well. An appropriate seed marketing strategy is key, often seen only as the responsibility of private seed companies, but should be considered by public research as well.

CIMMYT has been selecting maize that can withstand drought during the critical phase just before and during the flowering stage, when the silks of the future cobs form. Even if rains stop at this stage, farmers growing DT maize will harvest some decent grain. If a long dry spell occurs just after planting, the crop will fail regardless of drought-tolerant breeding efforts. Farmers may then reject DT maize after such failure if the messaging is not clear.

Product profiling is a collaborative process, not an imposing one

Redefining the breeding strategy through product profiling is not set in stone. Kotch recommends annual review as a vehicle for constant improvement. B.M. Prasanna, director of CIMMYT's Global Maize Program and the CGIAR Research Program on Maize (MAIZE) explained that the product profiles could vary among various partners, as each partner looks at their own comparative advantage to reach success.

It is important to have everyone from the maize seed value chain on board to succeed. Regina Tende, maize breeder and entomologist at the Kenya Agricultural & Livestock Research Organization (KALRO), warned that regulatory bodies who review and authorize new varieties to reach the market must be integrated in the discussion "as their interest, primarily yield, may not be the final requirement for the target market."

"A Product Profile is a demand-driven process that starts with the end in mind by understanding what the customers want."

Seed systems specialists are also crucial to operationalize a successful breeding and delivery strategy, to address the different scaling bottlenecks and identify "the market changer."

According to Kotch, CGIAR and national research organizations should avoid developing products too similar to the popular varieties on the market. Adoption occurs when something very different, for example new resistance to the devastating maize lethal necrosis, gives an innovation edge to seed companies. In Ethiopia, the replacement of an old popular variety BH660 by climate resilient BH661 was successful for various reasons including superior hybrid seed production with grey leaf spot resistance built in the seed parent population.

This demand-driven, multi-lens approach of product profiling including breeding, gender, socio-economic and policy dimensions will help to ensure that new varieties are more likely to be picked by farmers and partner seed companies, and increase the impact of CIMMYT's Global Maize Program.

For more information on CIMMYT's product profiles for Africa, please contact B.M. Prasanna, GMP director at b.m.prasanna@cgiar.org

Developing and delivering maize products in the most cost-effective way

CIMMYT's Global Maize Program (GMP) organized a three-day costing workshop for its African maize breeding team in Nairobi on September 10-12, 2019. Maize breeders, seed system specialists, research associates, technicians and enabling technology leads from Kenya, Ethiopia and Zimbabwe analyzed what it costs to develop and deliver the maize product profiles and how more of such work can be done with less resources.

On day one, the team dissected the different costs of each service unit from nurseries, phenotyping support to on-station and on-farm trials as well as seed systems activities. On day two, the GMP team brainstormed on how to define the costs per product profile based on the defined breeding scheme designed and implemented to deliver the target number of products. On day three, the costing exercise for the six product profiles for eastern and southern Africa were reviewed.

Biswanath Das, NARS support coordinator for the Excellence in Breeding (EiB) program demonstrated the breeding costing software developed by the University of Queensland. The tool can help breeders to quickly validate the best options to implement their breeding objectives in a cost-effective way. It for instance, defines what savings a breeder can make if they reduce the length or number of rows without affecting the efficiency of his selections. This operational costing work ultimately hopes to bring more transparency and clarity in the utilization of donor funds. It will also pave the way for continuous improvement of the maize breeding program.

Seed production innovations, conservation agriculture and partnerships are key for Africa's food security

Partner field days in Kenya presented sustainable solutions to crop threats and innovations in seed and agronomy.

Members of the International Maize Improvement Consortium Africa (IMIC – Africa) and other maize and wheat research partners discovered the latest innovations in seed and agronomy at Embu and Naivasha research stations in Kenya on August 27 and 28, 2019. The International Maize and Wheat Improvement Center (CIMMYT) and the Kenya Agriculture & Livestock Research Organization (KALRO) held their annual partner field days to present sustainable solutions for farmers to cope with poor soils, a changing climate and emerging diseases and pests, such as wheat rust, maize lethal necrosis or fall armyworm.

Versatile seeds and conservation agriculture offer farmers yield stability

"Maize is food in Kenya. Wheat is also gaining importance for our countries in eastern Africa," KALRO Embu Center Director, Patrick Gicheru, remarked. "We have been collaborating for many years with CIMMYT on maize and wheat research to develop and

Late maturity hybrid demonstration plot at Embu station. (Photo: Jérôme Bossuet/CIMMYT)

disseminate improved technologies that help our farmers cope against many challenges," he said.

Farmers in Embu, like in most parts of Kenya, faced a month delay in the onset of rains last planting season. Such climate variability presents a challenge for farmers in choosing the right maize varieties. During the field days, CIMMYT and KALRO maize breeders presented high-yielding maize germplasm adapted to diverse agro-ecological conditions, ranging from early to late maturity and from lowlands to highlands.

João Saraiva, from the Angolan seed company Jardins d'Ayoba, said having access to the most recent improved maize germplasm is helpful for his young seed company to develop quality seeds adapted to farmers' needs. He is looking for solutions against fall armyworm, as the invasive species is thriving in the Angolan tropical environment. He was interested to hear about CIMMYT's progress to identify promising maize lines resistant to the caterpillar. Since fall armyworm was first observed in Africa in 2016, CIMMYT has screened almost 1,200 inbred lines and 2,900 hybrids for tolerance to fall armyworm.

"Hopefully, we will be developing and releasing the first fall armyworm-tolerant hybrids by the first quarter of 2020," announced B.M. Prasanna, director of CIMMYT's Global Maize Programme and the CGIAR Research Program on Maize (MAIZE).

"Through continuous innovations to build varieties that perform well despite dry spells, heat waves or disease outbreak, maize scientists have been able to deliver significant yield increases each year across various environments," explained Prasanna. "This genetic gain race is important to respond to growing grain demands despite growing climate risks and declining soil health."

Berhanu Tadesse, maize breeder at the Ethiopian Institute for Agricultural Research (EIAR), was highly impressed by the disease-free, impeccable green maize plants at Embu station, remembering the spotted and crippled foliage during a visit more than a decade ago. This was "visual proof of constant progress," he said.

For best results, smallholder farmers should use good agronomic practices to conserve water and soil health. KALRO agronomist Alfred Micheni demonstrated different tillage techniques during the field tour including the furrow ridge, which is adapted to semi-arid environments because it retains soil moisture.

Innovations for a dynamic African seed sector

A vibrant local seed industry is needed for farmers to access improved varieties.

Maize Lethal Necrosis (MLN) sensitive and resistant hybrid demo plots in Naivasha's quarantine & screening facility (Photo: KIPENZ/CIMMYT)

Seed growers must be able to produce pure, high-quality seeds at competitive costs so they can flourish in business and reach many smallholder farmers.

Double haploid technology enables breeders to cut selection cycles from six to two, ultimately reducing costs by one third while ensuring a higher level of purity. Sixty percent of CIMMYT maize lines are now developed using double haploid technology, an approach also available to partners such as the Kenyan seed company Western Seeds.

The Seed Production Technology for Africa (SPTA) project, a collaboration between CIMMYT, KALRO, Corteva Agriscience and the Agricultural Research Council, is another innovation for seed companies enabling cheaper and higher quality maize hybrid production. Maize plants have both female and male pollen-producing flowers called tassels. To produce maize hybrids, breeders cross two distinct female and male parents. Seed growers usually break the tassels of female lines manually to avoid self-pollination. SPTA tested a male sterility gene in Kenya and South Africa, so that female parents did not produce pollen, avoiding a detasseling operation that damages the plant. It also saves labor and boosts seed yields. Initial trial data showed a 5 to 15% yield increase, improving the seed purity as well.

World-class research facilities to fight new and rapidly evolving diseases

The KALRO Naivasha research station has hosted the maize lethal necrosis (MLN) quarantine and screening facility since 2013. Implementing rigorous phytosanitary protocols in this confined site enables researchers to study the viral disease first observed in Africa 2011 in Bomet country, Kenya. Working with national research and plant health organizations across the region and the private sector, MLN has since been contained.

A bird's eye view of the demonstration plots is the best testimony of the impact of MLN research. Green patches of MLN-resistant maize alternate with yellow, shrivelled plots. Commercial varieties are susceptible to the disease that can totally wipe out the crop, while new MLN-resistant hybrids yield five to six tons per hectare. Since the MLN outbreak in 2011, CIMMYT has released 19 MLN-tolerant hybrids with drought-tolerance and high-yielding traits as well.

A major challenge to achieving food security is to accelerate the varietal replacement on the market. CIMMYT scientists and partners have identified the lengthy and costly seed certification process as a major hurdle, especially in Kenya. The Principal Secretary of the State Department for Research in the Ministry of Agriculture, Livestock, and Fisheries, Hamadi Boga, pledged to take up this issue with the Kenya Plant and Health Inspectorate Service (KEPHIS).

"Such rapid impact is remarkable, but we cannot rest. We need more seed companies to pick up these new improved seeds, so that our research reaches the maximum number of smallholders," concluded Prasanna.

Read the original article here.

Farmers adopting drought tolerant maize in Makueni County, Kenya

Alex Somba, 45, a father of three, owns 4 acres of land with his wife, Ruth Kanini. They grow maize and other crops such as pigeon peas and common beans. They started planting SAWA, a CIMMYT drought tolerant variety in 2017 after they were impressed with its performance after a visit to a demo farm a few kilometres from their home. When it rains marginally, they can harvest an average of 6 bags of 90kgs per acre. When rains are plentiful, they potentially harvest up to 15-18 bags per acre (equivalent to about 4 t/ha).

They normally apply animal manure and some artificial fertilizer as well as herbicides for weed control if resources allow. They do dry planting, typically about two weeks or so to the anticipated start of the rains in the main season of October.

"SAWA performs better than some of the most common and popular commercial varieties in this region because of its early maturity, drought tolerance and resistance to the Gray Leaf Spot (GLS). It is also quite resistant to weevil attacks," says Shomba. "With a delay in the onset of rain, say end of October instead of mid-October as expected, other varieties would perform poorly. SAWA on the other hand copes relatively well with such erratic rainfall pattern."

Alex Somba 45 years-old and his wife Ruth Kanini posing with one of their three children at their home in Makueni County. (Photo: Jerome Bossuet/CIMMYT).

Joy Nduku, Dryland Seeds Makueni County-based field officer says, "a good piece of advice that I normally give to farmers like Alex is to conduct optimum crop spacing." For better yield, she would advise that they enforce a 20cm x 30cm spacing, with one seed deposited per hole. Traditionally, farmers would deposit up to 5 seeds per planting hole. With the plants competing for available nutrients, they would produce small cobs, pushing yields drastically lower.

Demo farmer, Dolly Muatha, a widowed, 49 year old mother of four displaying part of her SAWA maize harvest stored at her home. (Photo: Joshua Masinde/CIMMYT).

Dolly Muatha, 49, a widowed mother of four, has been a SAWA demo farmer for three years. Her farm is located by the main Wote - Machakos road. This makes the farm strategically positioned for road-users to see the performance of the SAWA hybrid, and for other farmers to easily access during field days.

She likes the SAWA drought tolerant hybrid "because it produces two or three cobs of maize per plant, and it matures early. Compared to the non-drought tolerant varieties, it still produces the tassel and silks in case the rains stop when the maize plant reaches the knee height."


The underground revolution

Better seeds could help African farmers grow far more

The Economist

28 Sept.2019

But their governments are standing in the way

"On a 200-hectare farm in Kiboko, south-east of Nairobi, CIMMYT, an international institute, tests new strains in deliberately tough conditions. Thanks to a technique known as doubled haploid breeding, it can churn out new varieties quickly."

The Economist magazine makes a mention of how CIMMYT's drought tolerant maize hybrids are improving smallholder farmers' resilience in the face of climate change. The artice is titled, "Better seeds could help African farmers grow far more." To read the full article, click here.

"You've probably never heard of CGIAR, but they are essential to feeding our future"

By Bill Gates | July 9, 2019

gatesnotes

www.gatesnotes.com/Development/How-CGIAR-is-feeding-our-future

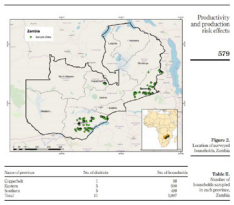
Bill Gates in a blog and video post, highlights the essential role CIMMYT plays in helping smallholder farmers adapt to the changing climatic conditions by developing and availing drought tolerant maize seed varieties. Smallholder farmers are particularly vulnerable to drought, poor soils, disease, pests, and weeds. The maize seed varieties are expected to give farmers up to 30 percent greater yields and help them fight malnutrition.

To watch the full video and read how Drought Tolerant Maize could help African farmers cope with climate change, scan this QR code:

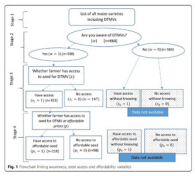
Publications

Recent impact studies done in Uganda and Zambia by a team from CIMMYT and the Center for Development Research (ZEF) show the yields of farmers adopting drought-tolerant maize increase significantly by 15 to 38 percent, and reduce risks of crop failure by a third. Active promotion of this climate-smart agriculture innovation and support for better access and affordability of such seeds could increase the adoption of DT maize by up to 30 percent, greatly improving food security, especially in drought years. For more information, read the reports below:

Simtowe et al, 2019, Impacts of drought-tolerant maize varieties on productivity, risk, and resource use: Evidence from Uganda, Land Use Policy vol. 88, Nov. 2019.
https://doi.org/10.1016/j.landusepol.2019.104091

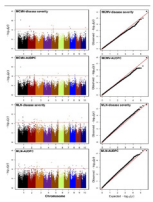


Amondo, et al, 2019, Productivity and production risk effects of adopting drought-tolerant maize varieties in Zambia, International Journal of Climate Change Strategies and Management Vol. 11 No. 4, 2019 pp. 570-591.
http://dx.doi.org/10.1108/IJCCSM-03-2018-0024



Simtowe, et al, 2019, Heterogeneous seed access and information exposure: implications for the adoption of drought-tolerant maize varieties in Uganda, Agricultural and Food Economics volume 7, Article number: 15 (2019).
https://doi.org/10.1186/s40100-019-0135-7

Combination of new molecular breeding approaches helped identify major molecular markers to Maize Lethal Necrosis (MLN) resistance on the chromosomes 3 and 6. These markers, or quantitative trait loci (QTL) are already used to increase efficiency of STMA's breeding work of developing new MLN tolerant hybrids.



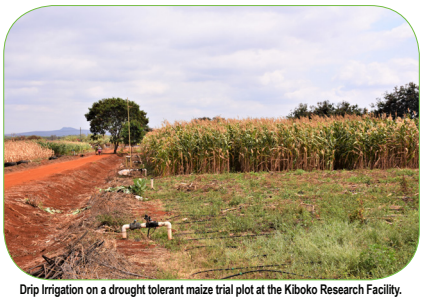
Sitonik, et al, 2019, Genetic architecture of maize chlorotic mottle virus and maize lethal necrosis through GWAS, linkage analysis and genomic prediction in tropical maize germplasm, Theoretical and Applied Genetics.
https://doi.org/10.1007/s00122-019-03360-x

PICTORIAL

CIMMYT breeders doing their scoring of 2019 Drought Tolerant Maize stage 4 lines in Kiboko station, 5 September 2019

From R-L: Dan Makumbi, Mosisa Regasa, Yoseph Beyene and Aparna Das during DT line selection Kiboko. Photo: Jerome Bossuet/CIMMYT.

A CIMMYT breeder examining grain filling in drought tolerant maize cob in Kiboko. Photo: Jerome Bossuet/CIMMYT.



Drip Irrigation on a drought tolerant maize trial plot at the Kiboko Research Facility. Photo-Jerome Bossuet.

Partners Field Day

CIMMYT's BM Prasanna explaining how hybrid demo trials were set up at Embu during the field day on Aug. 27, 2019. Photo: Jerome Bossuet/CIMMYT.

CIMMYT's Esther Mbaka and Manje Gowda at the Annual Partners Field day in Naivasha. Photo: Joshua Masinde/CIMMYT.

Western Seed CEO Saleem Esmail at the Annual Partners Field day in Naivasha. Photo: Joshua Masinde/CIMMYT.

Upcoming events

A training on "Product Profile Based Maize Breeding for Increased Genetics Gains on November 11-15 2019 in Lilongwe, Malawi".

To contribute to or participate in STMA, please contact:

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