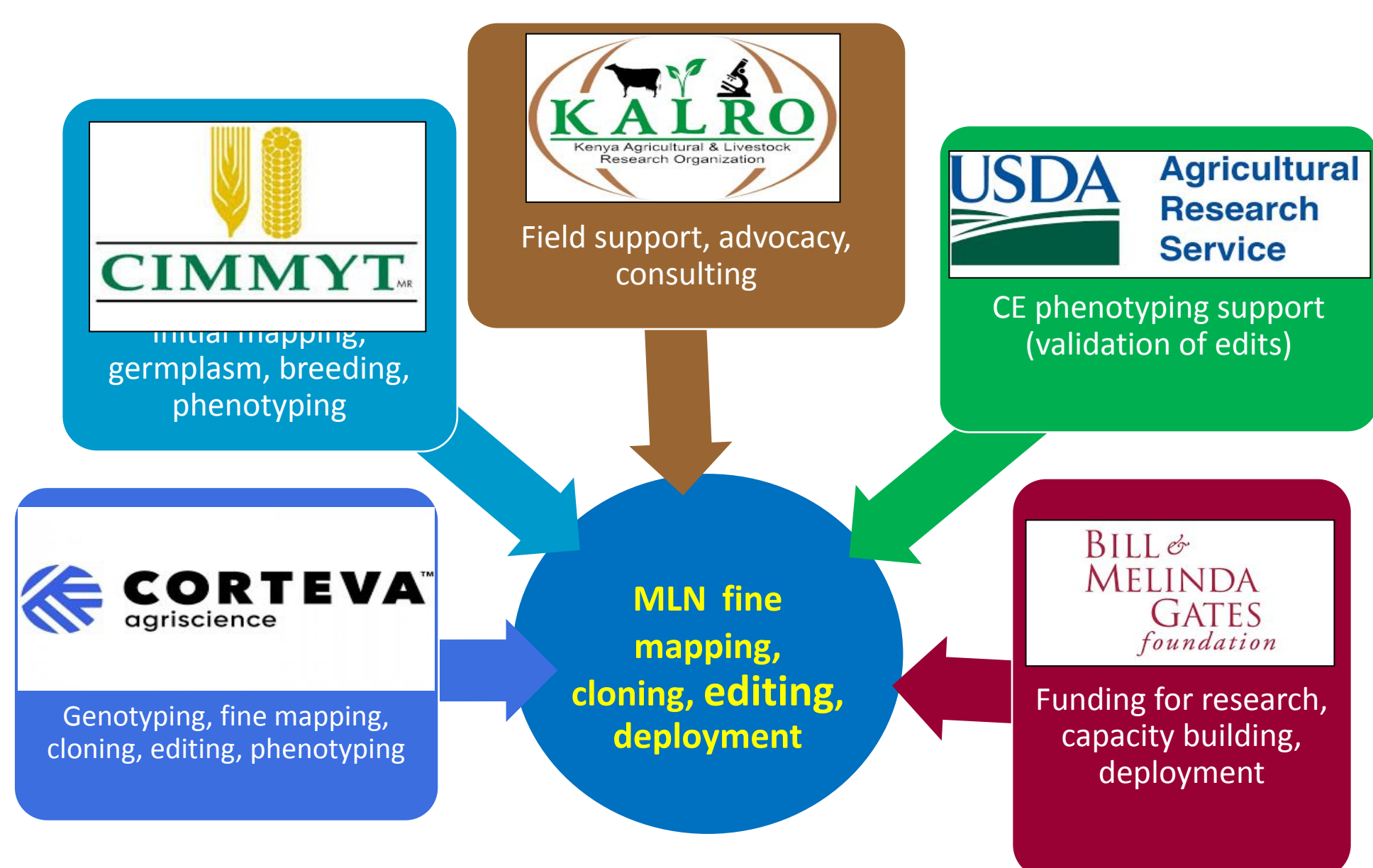


# Genome Editing for Tolerance to Maize Lethal Necrosis



Maize Lethal Necrosis (MLN) is a viral disease that severely reduces grain yield in Kenya by 23-100%, a loss estimated at USA \$180M annually. It is generally caused by a combination of two viruses; Maize Chlorotic Mottle Virus (MCMV) and a potyvirus, generally Sugarcane Mosaic Virus (SCMV). Most of the maize varieties in Kenya is susceptible to MLN. KALRO partnered with CIMMYT and Corteva Agriscience in 2016 to genetically map MLN resistance from an exotic resistance donor and then edit the susceptible gene in the CIMMYT commercial lines to its resistance form. The causative locus has been fine-mapped and the underlying gene identified. The identified gene has been edited in CML536, an otherwise susceptible line, which has confirmed to be resistant to MLN in the greenhouse. Conversion of the susceptible gene to its resistance copy in three additional CIMMYT lines, which along with CML536 are parents to two, 3-way commercial hybrids in eastern Africa is under way. Adoption of Gene Editing Guidelines for Kenya are being awaited to allow field testing of these MLN-resistant maize in Kenya. Once validated, this approach can be used to rapidly and efficiently convert any commercially available MLN-susceptible hybrid to its resistant version.

## Project Partners



KALRO is working with CIMMYT, Corteva, and US Department of Agriculture (USDA) on delivering genome edited versions of relevant commercial hybrids with MLN tolerance in Kenya

A drought and heat tolerant, high yielding commercial hybrid that is susceptible to MLN



Kiboko: No MLN pressure

Naivasha: Artificial MLN inoculation

(CKDHL0186\*3/KS23-6):B>1026>1106>1042-1011-1009-  
 (CKDHL0186\*3/KS23-6):B>1026>1106>1042-1011-1016-  
 (CKDHL0186\*3/KS23-6):B>1026>1106>1054-2006-1004-  
 (CKDHL0186\*3/KS23-6):B>1026>1106>1054-2006-1006-

C:C G:G  
 C:C G:G  
 T:T T:T  
 T:T T:T

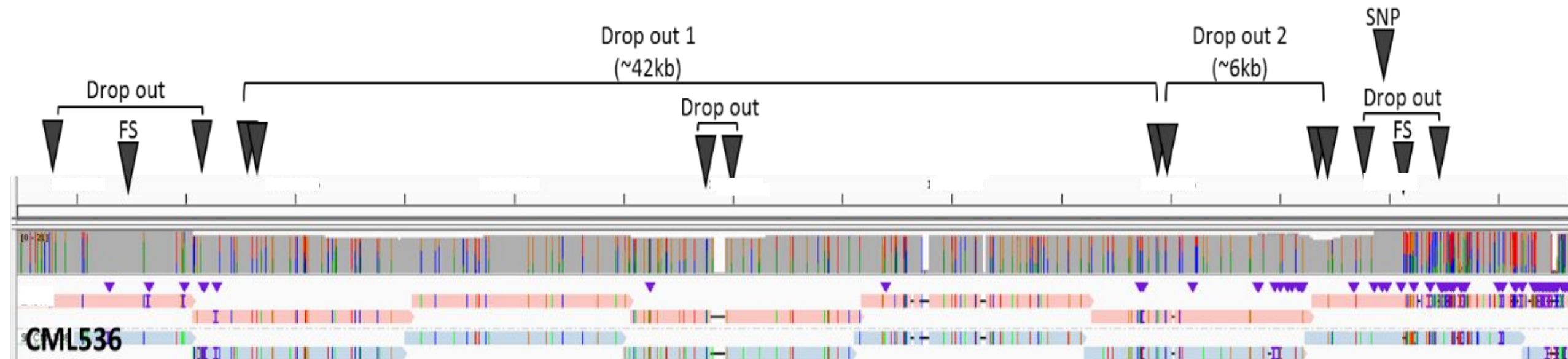


- KS23-6 allele

+ KS23-6 allele

Effect of KS23-6 allele on MLN resistance

## Progress in Editing designs in the MLNR QTL region



- 15 Editing projects – 14 successful 2020 - 2021
- Identified the causal gene and validated its role in MLN resistance in the greenhouse 2021
- No foreign DNA in G2 seed

## Project Supportive Activities

- Engagement of the regulatory agencies
- Engagement of seed industry players
- Capacity Building
- Communication



Chief Guest, Manu Chandaria and the STAK Board Chairperson visit the CIMMYT -KALRO stand during the annual STAK congress 2019

## Project timeline

MLN Project Timelines	Notes	2018	2019	2020	2021	2022	2023	2024
<b>Gates Foundation Funding</b>		1 2 3 4	1 2 3 4	1 2 3 4	1 2 3 4	1 2 3 4	1 2 3 4	1 2 3 4
<b>Fine Mapping/Nursery</b>								
Testing of additional recombinants - Naivasha								
Selection of additional recombinants - Kiboko								
Testing of additional recombinants from Kibiko selfs - Naivasha								
Increase of additional recombinants - Kiboko								
Testing of additional recombinants from Kiboko increase - Naivasha								
<b>Editing</b>								
<b>Make edits in CML536 and KS23-6</b>								
Vector construction, QC								
Editing start								
T0, outcross								
T1, outcross (initial T1 test)								
T2, self								
Testing of edited variants								
<b>Make edits in CKL05022, CKL05004, CML543</b>								
Sequencing, Vector construction, QC								
Editing start								
T0, outcross								
T1, outcross								
T2, self								
Testing of edited variants								
<b>Deployment</b>								
Make single cross female hybrid seed								
Inbred phenotyping in Kenya								
Make 3 way hybrid seed								
Hybrid phenotyping in Kenya								
Seed production - hybrids								
Hybrid seed available								

**CIMMYT and KALRO Team (alphabetical listing):** Yoseph Beyene, Kanwarpal S. Dhugga\*, Manje Gowda, **Simon Gichuki** and **Stephen Mugo** (Consultants), James Karanja, Ann Murithi, Veronica Ogugo, Mike Olsen, Kevin Pixley, BM Prasanna, and LM Suresh, Allen Wen. **Corteva Team:** Marc Albertsen, Keith Allen, Paul Calahan, Laura Church, Alyssa DeLeon, Jeff Farrell, Maria Federova, Kevin Fengler, Jim Gaffney, Tom Greene, Neal Gutterson, Jeff Habben, Kristi Harkins, Sabrina Humbert, Raju Jetty, Todd Jones, Mark Jung\*, Bailin Li, Emerson Limberger, Victor Llaca, Greg May, Bob Meeley, Martha Meyer, Mat Muller, Michaela Owens, Anne Pitts, Derrick Pundt, Abhijit Sanyal, Jan-Michael Schulze, Kevin Simcox, Kay Snopek, Shawn Thatcher, Amy Wilke, Emily Wu, Deping Xu, and Gina Zastrow-Hayes. \*Contact Science Leads.  
**USDA:** Mark Jones and Lucy Stewart.