CIMMYT MR
International Maize and Wheat Improvement Center

Gene-Edited Maize Lethal Necrosis (MLN) Tolerant Maize

Frequently Asked Questions (FAQs)

Q: How serious is the maize lethal necrosis (MLN) disease threat in sub-Saharan Africa?

A: A widespread, deadly viral disease, Maize Lethal Necrosis (MLN) spoils nearly a quarter of Kenya's maize harvest each year and can cause the complete loss of a maize crop, if it strikes early in the season. MLN is endemic in eastern Africa, affecting maize in Ethiopia, D.R. Congo, Kenya, Rwanda, Tanzania and Uganda, with a high risk of spreading to other maize-growing areas. Most elite maize lines used in Africa are susceptible to the disease, posing a major threat to the food security and livelihoods of millions who grow and depend on maize for food and incomes.

Q: How are people coping with MLN?

A: Farmers and seed companies use several strategies, including spraying suspected or infected fields to control the insects that spread viruses, rotating maize with non-susceptible crops, using clean tools and field equipment, and pulling and burning affected maize plants. These practices can help, but the most economical and effective solution is to grow MLN tolerant maize varieties. A growing number of MLN tolerant hybrids are available to farmers but developing and deploying more is a top priority.

Q: How will gene editing contribute to the fight against MLN?

A: Gene editing technology can help develop MLN tolerant maize more quickly than by traditional breeding alone, reducing the time required from as much as 5 years to only 2-3 years. It can also be used for precisely targeted improvement of disease tolerance in popular maize hybrids, without altering the hybrids' other important traits. Gene editing cannot replace traditional breeding, but it will convert MLN susceptible to MLN tolerant varieties, offering smallholder farmers and small- and medium-scale seed companies additional options to produce healthy and nutritious maize grain.

Q: What is CRISPR-Cas9?

A: This is a gene-editing system that works in plants and animals. CRISPR refers to "clustered regularly interspaced palindromic repeats" in DNA and Cas9 is an associated protein. CRISPR-Cas9 is a natural part of the immune system in *Streptococcus pyogenes* bacteria, recognizing and destroying DNA of invading viruses. The CRISPR-Cas9 system can be used in plant breeding to alter specific genes and thus change their expression.

Q: Do gene edited products pose a threat to human or animal health or the environment?

A: Gene edited products are no more or less risky than those developed through traditional or other breeding techniques. The method itself is generally not risky; the presence or absence of risk will depend almost entirely on the specific product. Gene editing as proposed for this project replicates natural mutations in maize that strengthen tolerance to MLN. This type of MLN tolerance is a genetically simple trait that poses no threat to humans, animals, or the environment.

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Q: What are the risks of gene editing technology?

A: First, although unlikely, gene editing targeted to a specific DNA sequence in a maize line can result in an unexpected edit elsewhere in the genome of the line. Important edits of this type will most likely be detected and discarded when the edited maize lines are tested in the laboratory or glasshouse. Undetected changes, if any, are likely neutral, or will be identified during field testing of the edited line or its derivatives. Second, it is possible that the correctly-edited target gene will somehow influence another trait of the new line in an unexpected way. If the impact is important, this will most likely be detected during development and evaluation of the edited line or varieties that include the edited line. Although a very small chance exists that an unintended edit passes undetected to the finished variety, this contrasts with traditional breeding approaches, where numerous other genes are always affected.

Q: How do gene edited MLN tolerant varieties differ from transgenic plants?

A: A transgenic plant contains DNA that was inserted from another living species. Genome editing as proposed here would involve small, precise changes in "native" genes already present in the plant. Breeders use gene editing to replicate a mutation or change that already occurred naturally in a native gene of one or a few maize plants, resulting in tolerance to MLN.

Q: How are gene edited products regulated?

A: The decisions of whether and how genome edited plants will be regulated have not yet been made in most countries in Africa. Project partners will fully respect national sovereignty and follow all regulations of partner countries.

Q: Who owns genome editing technologies?

A: Currently, no one clearly owns these technologies, and many organizations and companies are using them. CIMMYT will implement genome editing projects in collaboration with reputable public and private sector laboratories that have credible claims for ownership and that allow us to develop and share products from the research among our partners and beneficiaries, as we do with all our products and knowledge.

Q: When will gene-edited MLN tolerant maize hybrids be available?

A: Project partners envision developing the first genome edited maize lines in the next two years or so. Three years will then be needed to validate their performance, multiply seed and produce the commercial hybrids for marketing. The gene edited MLN tolerant hybrids will be available for planting on approximately 40,000 hectares, benefiting about 20,000 farmers by 2025 in Kenya.

Q. Are other CIMMYT gene-edited maize or wheat varieties being grown?

A: No; there are no CIMMYT-derived gene-edited maize or wheat varieties on the market or in farmers' fields. Gene-edited MLN tolerant maize would be the first.

For additional information: 1) see CIMMYT's position statement on novel genome editing technologies; 2) Contact MLN gene editing project leads: k.pixley@cgiar.org or k.dhugga@cgiar.org; 3) contact CIMMYT directly: https://www.cimmyt.org/contact/.