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A holistic and cutting-edge approach to food production by genome editing technology

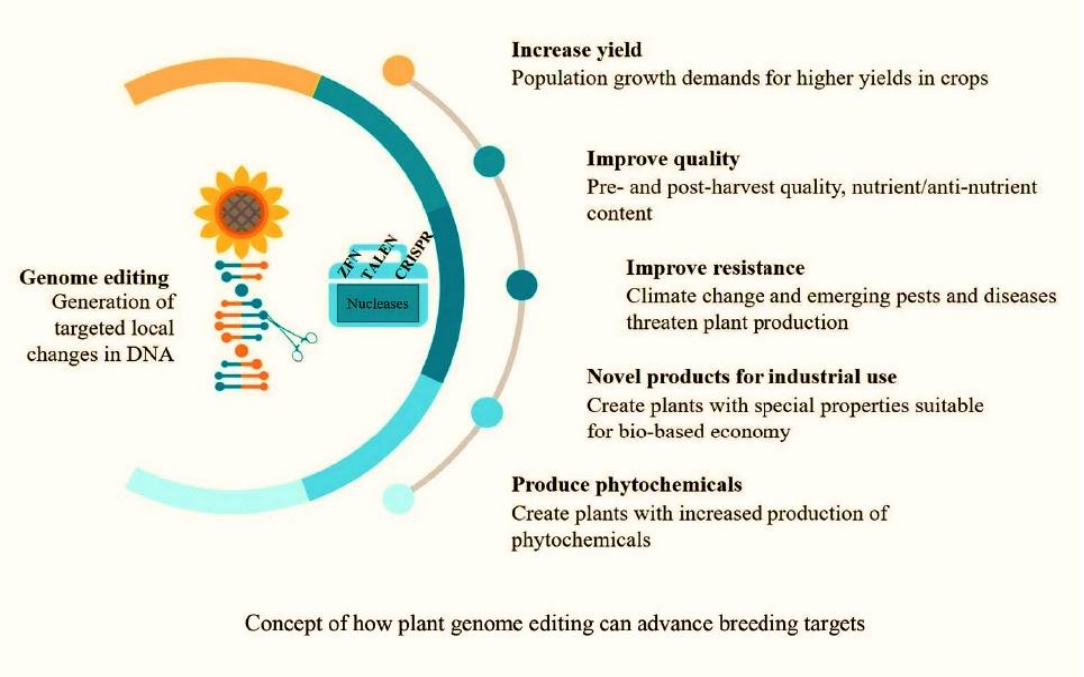
Rizwana Rehsawla[1*], Anu Naruka[2], Satender Yadav[3] and Himanshu Panday[4]

Introduction

A considerable shift in crop production will be necessary to provide an adequate supply of food for the ensuing decades in the face of challenges posed by climate change, population growth, and possible food-chain disruptions brought on by pandemics and natural disasters. Crop plant growth in indoor urban farms is one way to lessen disruptions in the food supply.

With urbanisation taking place in every nook and cranny of the country, arable land space is diminishing at an alarming rate. Feeding the population will be difficult in such a scenario. Conventional breeding programmes and farming techniques may not be enough. However, just adapting growth techniques from conventional outdoor farming is woefully insufficient. The Ukraine war jeopardises food security for 3% of the world's population.

Crop improvement strategies based on genome editing



Concept of how plant genome editing can advance breeding targets

Rizwana Rehsawla[1], Anu Naruka[2], Satender Yadav[3] and Himanshu Panday[4]*

[1]Division of Plant Pathology ICAR-IARI Pusa New Delhi, (India)
[2] Shri Vaishnav Institute of Agriculture, SVVV, Indore, Madhya Pradesh, (India)
[3]Chaudhary Charan Singh Haryana Agricultural University, Hisar, Haryana, (India)
[4]ICAR-Indian Institute of Sugarcane Research Lucknow, Uttar Pradesh, (India)

By the end of 2023, the world's food supply might be "deficient" by up to 60 million tonnes of grain. Therefore, increasing agricultural sustainability and production is crucial for the entire planet. To guarantee future global food security, technical advancements in crop production and scientific discoveries are critically required.

A. Genome editing-directed mutagenesis to disrupt genetic linkages and share traits across species.
B. Homeoalleles and gene family multiplex genome editing.
C. Modifying quantitative trait loci to generate novel alleles and characteristics.
D. Endogenous gene genome alteration for the purpose of inducing haploidy and creating artificial apomixis.
E. The use of CRISPR for large-scale screening and guided evolution for trait discovery.
F. Plant synthetic biology using CRISPR, in which plant cell behaviour is changed to promote plant growth and product production.
G. Changing the microbiome of plants to increase crop growth and pest resistance.

Better Seeds, an Israeli business, is harnessing CRISPR technology to address a rising worldwide concern. According to BetterSeeds, the game-changing features it can integrate will enable farmers to cultivate crops that are more resistant to disease and harsh weather while also being less dangerous and expensive to grow and harvest. The business is now developing extremely nutritious black-eyed peas that are more resistant to climate change than existing legumes farmed for plant-based proteins and will deliver larger yields on the same area of land while requiring less water and fertiliser.

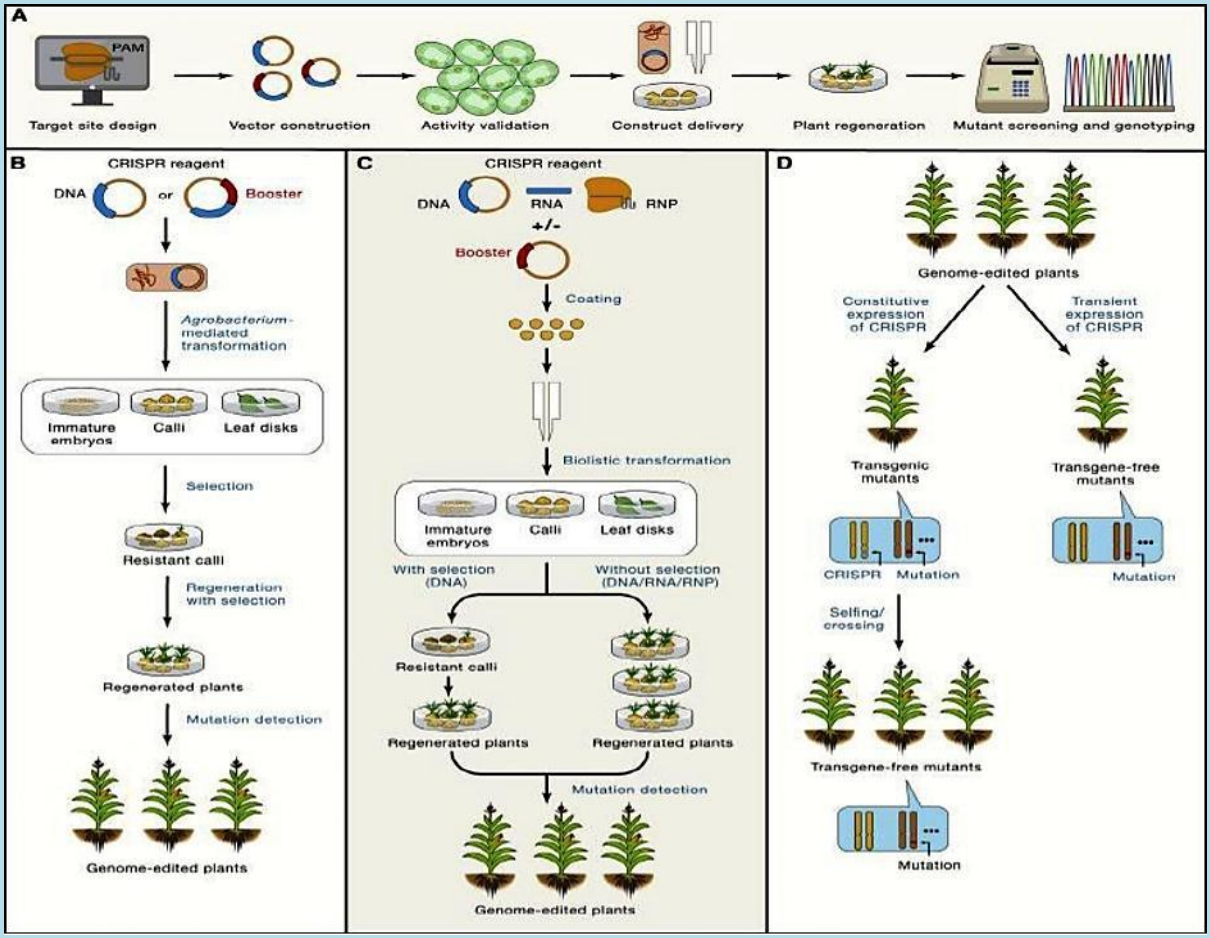
- Merck KGaA enters into a partnership and licencing agreement with the Israeli business BetterSeeds to expedite the use of CRISPR in agricultural applications and make it more broadly available. BetterSeeds intends to employ MilliporeSigma's fundamental CRISPR patent portfolio to edit cash crops like as cowpea and cannabis in order to generate and include game-changing characteristics that are now unavailable in many crops owing to conventional breeding restrictions.

Crop genomics for future food: a powerful tool

Genome-editing technologies, which allow for precise alterations to genomes, have the potential to enhance a wide range of agricultural plants, particularly those critical to food security in low- and middle-income nations (LMICs). Genome-editing methods, which capitalise on the increasing availability of pangenomes1 and whole-genome DNA

sequences for many crops, provide a degree of precision and predictability previously unattainable when attempting to change crop genomes. Since genome-editing technologies are widely available, public sector organisations, such as the Consultative Group for International Agricultural Research (CGIAR) can make use of them to create public goods that are unattractive to the profit-driven private sector and to benefit smallholder farmers.

necessary, with agriculture capable of anchoring many of the key parts. Continuous crop breeding programme development is critical for boosting agricultural yields, which leads to increased family incomes, which eventually helps to poverty reduction and SDG achievement. Additionally, crop stress tolerance has been improved through the use of genome editing, as well as several crucial metabolic and developmental processes (Xu et al. 2019).



To fulfil the set of Sustainable development goals, several technologies, factors, policies, and programmes will be

These modifications to horticultural plants and crops were employed as covert

methods to raise their productivity and performance in various settings.

Guidelines for altering the plant genome

(A) Illustration of the six main processes in plant genome editing in schematic form.

(B) Plants that have had their genomes altered thanks to the introduction of CRISPR DNA by an agrobacterium.

(C) Conventional and temporary expression techniques for CRISPR DNA, RNA, or RNP delivery during particle bombardment-mediated genome editing.

(D) Two methods for producing mutants devoid of transgenes.

Different biotechnology companies are involved in the production of the high quality crops to combat the various problems regarding the food security

- A new type of soybeans has been created by multigene bioengineering to absorb light more effectively, increasing yields by up to 25% without sacrificing quality. The scientists behind the new breakthrough emphasise that photosynthesis, the natural mechanism that plants employ to turn sunlight into energy and yield, is a "quite inefficient 100+ step process."
- Food security has always been a top priority for Chinese officials, who must feed around 20% of the world's population while only having 7% of the world's arable land.
- Pivot Bio, a US soil amendment business, continues to dominate, receiving $430 million in 2021 - the year's highest Ag Biotech round. With a $208 million fundraising, Inari, a US startup creating genetic technologies to promote global seed variety, secured the second biggest transaction.
- Ag Biotech solutions have the potential to boost agricultural output while also improving animal health, both of which are critical to global food security. According to the UN Population Division, there will be 9.7 billion people to feed by 2050, or nearly 30% more people than in 2017. Pesticides, herbicides, and other inputs can help reduce crop losses, but at a high environmental and human health cost. Ag Biotech businesses that discover less-harmful biological alternatives have a major potential ahead of them.
- Plantik is using genome-editing technologies to accelerate the development of novel plant types. It has made effective genome-editing experiments in hemp and is now working on other crops.

We can attain the results of plant breeding, which have been so effective in

managing diseases and increasing yields, but much more precisely to generate nutritious crops with much fewer fertiliser inputs and better resilience. We need innovation to get off the chemical treadmill that is modern agriculture. Doing nothing in the face of the climate disaster is no longer an option. To produce enough food for a growing global population, combat climate change, reduce food waste, and produce more nutrient-dense crops, gene editing is not a luxury but a need.

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