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Conceptual Paper

Gene-Editing in Plants

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A promising set of biotechnological advancements that has led to meticulous and speedy production of mutated or altered genes to manipulate plants characteristics for better phenotypic expression, disease resistance and tolerance enabling high quality, processability, food security and sufficiency.

The four families of engineered nucleases- mega nucleases, zinc finger nucleases, transcription activator like effector based nucleases (TALEN) and clustered regularly interspaced short palindromic repeats CRISPR/Cas9, Cas13 had witnessed genome editing evolution and advent of second generation biotechnology evolution in agriculture.

The ongoing plant interactions with the biotechnologist faces a staggered growth conducting an attitude of earnestly wanting to avoid the problems and political regulatory issues that occurred with the first generation genetically modified varieties. The problem includes controversial guidelines, environmental issues, rejection by consumers and the old nature vs nurture debate including ethical issues.

The scientific community has failed largely in gaining public confidence. This is due to lack of consolidation, forgetfulness, lack of transparency and lack of concern towards will of global citizens.

Holding a strong side with the potential gene edited crops can unleash to meet the rising need of increasing the food production by 2% each year, nutrition 12.9% population suffering from malnutrition, protecting 6 - 20% crop loss due to biotic and abiotic factors and meeting the challenges due to changing climate conditions lets us look into the concerns about gene edited plants.

Concerns about gene editing

Are gene-edited plants 'genetically modified organism?

Since the first use in 2013 CRISPR/Cas9 has been widely accepted by the scientific community as there role as biological mutagens two produce out of frame mutations in gene of interest. There is a great confusion and controversy on whether gene edited crops to be classified under GMOs (Genetically Modified Organisms) previously known as transgenic Organisms. My argument is if chemical and irradiation mutants are generally used in breeding programs for crop improvement then why a biological mutagen is being repeatedly put under scrutiny. Firstly we have to revisit the definition of what GMOs because the basic framework of genome modification by gene editing is essentially different from transgenics as mutant effects of CRISPR are small indels rather than large insertion or rearrangements such indels are presents even in naturally occurring plants. Secondly the CRISPR plants are transgene free.

Now, knowing the facts the matter of concern is there is no universally accepted regulatory framework for regulation of gene edited plants. For example the two school of thoughts are that US Department of Agriculture has determined that gene-edited crops are exempt from regulation, while the European Court of Justice has recently ruled that gene edited products should be treated like traditional GMOs by the European Union.

The gene edited crops are not more than biologically mutated plants just like chemically and irradiated plants. I feel gene editing should be created just as mutation breeding is treated and widely accepted after all the regulatory bodies have a hard time differentiating the CRISPR mutation from chemical mutation.

Off-target mutations

Now our CRISPR is better than the conventional mutation induction in terms of specificity but its specificity still remains a big matter of concern when it comes to gene therapy specially in humans but we are still on safe side as when whole genome sequencing was applied in *Arabidopsis*, rice and tomato very low off-target frequency was observed. Just in case you are worried about those low frequency specific guide RNA can be designed by tools like CRISPR-P or by using engineered cas9 protein. It appears insignificant to me in case of plants as any unwanted mutations can be segregated out through genetic crosses.

Hence as concluding remark I would like to add until its benefiting human race its good and I support it but when it comes to malpractices like gene edited babies it becomes a threat to human existence and this powerful tool gives us the responsibility to handle all such negative factors so that such advancements can benefit human race.