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Molecular Markers for Crop Improvement

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SUMMARY

With the event of molecular marker technology within the 1980s, the fate of plant breeding has changed. Differing types of molecular markers are developed and advancement in sequencing technologies has geared crop improvement. The last 30 years have witnessed endless development within the molecular marker's technology from RFLP to SNPs and a diversity of array-technology-based markers. Altogether, the history, the kinds of markers, their application in plant sciences and breeding, and a few recent advancements in genomic selection are discussed.

INTRODUCTION

The genetic material is basis of all living entity passes from one generation to subsequent, with modulation within it with time consistent with the environment. It may in the form of DNA or RNA according to the organism to organism. It stored in three places in organism nucleus, chloroplast and mitochondria. As time and environment changes the genetic information get slightly or in some cases shows drastic changes, these variations arise within the stored genetic material due to base substitution, insertion, deletion and duplication. Expression of a specific trait is depending upon genetic constitution this variation manifests the expression; different constitution shows different expression. These nucleotide sequence variations may be beneficial for human beings, so to study these variations in expression for quick and faster result we would like to use markers. These are three major categories of markers; first is morphological markers where on the idea of size, shape, colour we will distinct the varied expressions. Secondly biochemical markers are those which shows variation in protein and amino acid banding pattern. Third but most useful molecular markers, basically it shows DNA sequence polymorphism in several individual within species example are RAPD, RFLP, AFLP, SSR, ISSR, SNP, etc markers.

Ideal marker should possess characteristic listed below

- It should have high polymorphism, non-epistatic and simplicity of observation.
- It should not show any influence of environment
- It should be reproducible, low cost and stability

As compare other markers the molecular marker has more impressively less limits. There are three different generation of molecular markers.

- RFLP: Botstein *et al.* (1980) developed marker supported hybridization, polymorphism detected long of fragment is due to variation in restriction site of enzyme. It's co-dominant in nature but this assay is tedious and time consuming.
- RAPD: Willians *et al.* (1990) gave RAPD marker supported PCR. These are dominant in nature, polymorphism studied based on presence and absence of band. It requires less DNA, no need of prier DNA sequence information however it has some weakness lack of reproducibility and dominant in nature.
- AFLP: Vos *et al.* (1995) has given AFLP markers to review polymorphism. AFLP involves restriction digestion of DNA, preselection amplification followed by selection amplification, results are visualized by autoradiography. The strength of AFLP is generation of fingerprints of any DNA regardless of their origin. It served as bridge between physical and genomic maps like strength but also it has weakness it's time consuming, required skilled person and dominant in nature.
- SSR: Also referred to as microsatellite, there variable tandem repeats range from 1-10 base nucleotide throughout genome. More than 10 nucleotides repeat also known as minisatellite, these repeats also used for primer synthesis. Polymorphism strength of SSR marker is uniformly distributed in genome. Its co-dominant in nature, highly reliable whereas its weakness is high developing cost of primers.

- SNP: Marker shows polymorphic result due to substitution, deletion or insertion as difference found at single nucleotide position these are mostly biallelic and co-dominant in nature. SNP marker is fast and shows possibility to discover new alleles hence useful in allele mining. It has weakness too, most of the SNP are biallelic thus it is less informative and costly than SSR markers.

Application of Molecular Marker

- To study genetic diversity
- To differentiate and identify new variety because it is employed in marker assisted breeding
- Used for construction of maps

CONCLUSIONS

The progress made in molecular plant breeding, genetics, genomic selection and genome editing has contributed to a more comprehensive understanding of molecular markers and provided deeper insights into the range available for crops and greatly complemented breeding stratagems. The approaching years are likely to ascertain continued innovations in molecular marker technology to form it more precise, productive and price effective so as to research the underlying biology of varied traits of interest.

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