



Genomics

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INTRODUCTION

What is Genomics ?

In plant breeding, genomics is a technique which involves use of advance molecular techniques to study and manipulate the genetic material of plants. By analyzing the entire genome, researchers can identify some specific genes which are associated with desirable traits, like disease resistance, yield and other environmental adaptability. This allows for more precise and efficient breeding strategies , accelerating the development of improved plant varieties. It combines conventional breeding techniques with genomic tools and approaches.

Genomic tools →

These tools plays a crucial role in modern plant breeding which aids the development of improved crop varieties. Some of them are:

- **Genome sequencing:** It involves determining the complete DNA sequence of a plant's genome. This process provides valuable insights into the genetic structure , genetic makeup and function of a plant's entire set of genes.
- **Genomic selection:** is a breeding approach that utilizes genomic information to predict the breeding value of plants. It is done step by step which starts from genotyping and phenotyping the plant's population and performing selection at the end. It makes early and accurate predictions of an individual's potential breeding value.
- **GWAS (Genome-Wide Association Studies):** is a very powerful approach in plant breeding that aims to identify genetic variations associated with specific traits across a diverse population aiding in the identification of candidate genes. In this steps such as population genotyping , phenotypic data collection, association analysis, candidate gene identification and at last marker assisted breeding is followed.

- **Functional genomics:** It helps in plant breeding by studying gene functions and interactions to enhance desirable traits which involves the use of techniques like CRISPR-Cas9 for targeted gene editing, transcriptomics to analyze gene expression and metabolomics to understand metabolic pathways. As a result, it aids in developing crops with improved yield, adaptation to the environment and disease resistance.

Merits of genomics in plant breeding →

There are many merits of genomics in plant breeding like,

1. **Precision breeding:** It allows for precise identification and manipulation of specific genes associated with desirable traits.
2. **Accelerated breeding:** High throughput sequencing expedites the identification of valuable genes and hence accelerating the breeding process by providing quicker insights.
3. **Increased genetic diversity:** Genomics allows for the exploration and utilization of a broader range of genetic diversity.
4. **Enhanced trait understanding:** These techniques and tools help the

researchers understand the molecular basis of traits, facilitating the selection and incorporation of specific traits.

5. **Predictive breeding:** Genomic information enables the prediction of phenotypic traits, allowing breeders to select plants with desired characteristics at earlier stages.

Demerits of genomics in plant breeding →

Despite its numerous advantages, genomics in plant breeding also has some demerits:

1. **Cost:** Genomic research and sequencing can be expensive that's why it is difficult to use these techniques for smaller breeding programs.
2. **Complexity of data interpretation:** The large amount of data generated requires sophisticated analysis tools and expertise, due to this it poses a challenge in handling data in genomics.
3. **Limited understanding of complex traits:** While genomics can identify individual genes, understanding complex traits involving multiple genes and environmental interactions remains a challenge.