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# FUTURE OF PLANT BREEDING WITH ARTIFICIAL INTELLIGENCE

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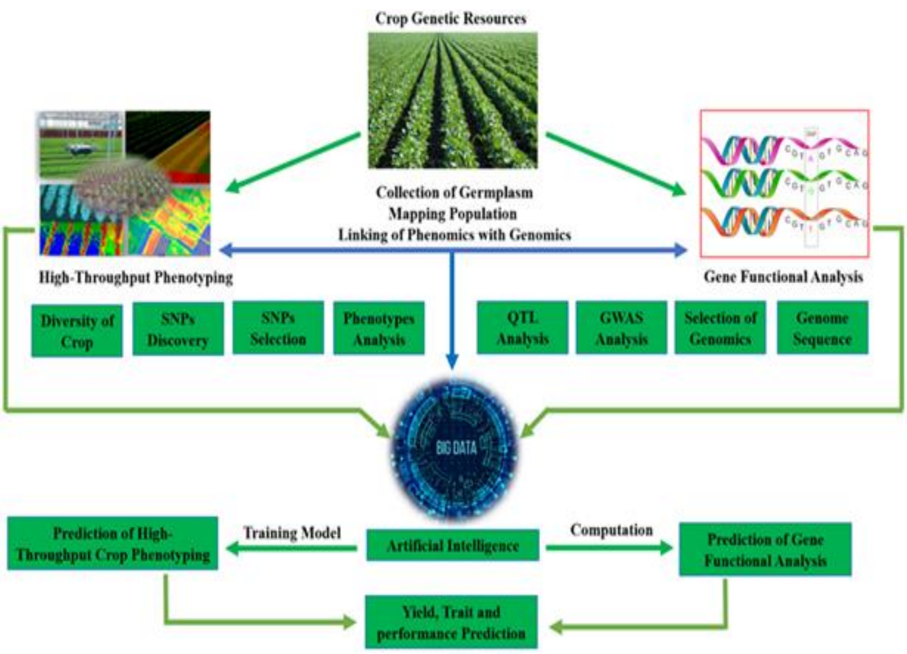
## Introduction:

Plant breeding is the art and science of modifying genes and various plant characteristics in a way which are useful for the human population and their growing food needs. Plant breeding dates back to man starting growing crops and it was simply selecting the phenotypes which are most suitable for their growing needs. After that, a lot of advances have been introduced into plant breeding which leads to the development of highly resistant plant varieties with high economic value. Plant breeding is interrelated with other domains such as genetics, bioinformatics, plant physiology, agronomy, plant pathology, and entomology. People from such diverse backgrounds should work together to develop any plant variety. But sometimes lack of coordination between the teams can lead to the failure of the entire project.




A lot of companies who are working in plant breeding have started testing the potential of artificial intelligence in this field. Artificial intelligence (AI) has recently emerged as a revolutionary field, providing a great opportunity in shaping modern crop breeding and helping in developing new plant varieties. Advances in crop phenomics, and enviromics, together with the other "omics" approaches pavedthe way for elucidating the detailed complex biological mechanisms that motivate to find potential in this area.

The ever-increasing population growth, decreasing arable land, and climate changes, these conditions stress the importance of more precise, high-throughput approaches that can mediate to development of crop cultivars at a greater pace, with higher accuracy, and precision. In this regard, the field of artificial intelligence has recently emerged, which has been suggested to possess the extraordinary potential to assist in breeding high-quality crop varieties at a faster pace.

Artificial intelligence has the potential to develop crops that are climate-resilient, crops that are adaptable to vast climatic conditions, improve in quality characteristics, resistant to both pest and insect infestation, and a lot more.The goal of artificial intelligence is to replicate some features of human intelligence using technology-driven decision-making. This field can be defined as a set of studies and techniques dealing with the computer sciences and some mathematical aspects of statistical modelling, with ongoing economic and social implications, and the goal of developing technological systems capable of solving problems and performing tasks or duties normally performed by the human mind to solve the real world problems.

The increased demand for AI in the breeding world is due to the technological maturity attained, i.e., the ability to analyse large sets of data in a short period of time to reveal unexpected linkages and other scenarios. This approach from a breeding standpoint, and allows individuals to channelize information that is typically already available on the market in a scattered form, transforming data into breeding decisions, and thus only considering these tools that are useful in decision-making processes in crop breeding. All these things lead to more precision in agriculture and satisfy the sustainability of crop production.

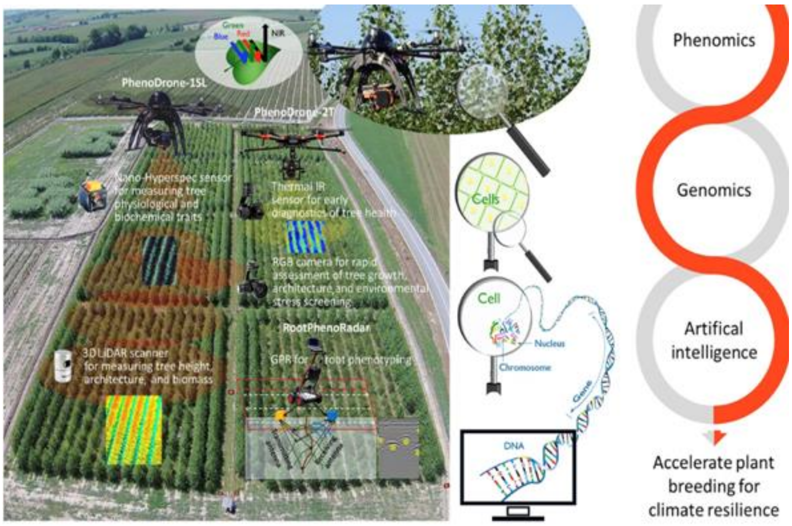
Another application of artificial intelligence is speed breeding. Speed breeding has emerged as an essential strategy for accelerating the breeding cycles of crop plants by growing them under artificial light and temperature conditions by continuously modifying the weather parameters. Furthermore, speed breeding can also integrate marker-assisted selection and cutting-edged gene-editing tools for the early selection and manipulation of essential crops with superior agronomic traits.

Precision Breeding uses artificial intelligence technology to guide genetic changes and access to more data that is currently available, breeders can quickly and accurately identify the precise changes needed to remove negative plant traits or emphasize positive ones. Ultimately, precision breeding results in the delivery of seed varieties tailored to growers' unique field conditions years ahead of schedule which helps to maintain food security. Integrating speed breeding with the classical approach requires definite planning and a good selection of candidate cultivars with higher genetic gain to accelerate the breeding program for generating high-yielding or vast tolerant cultivars. The choice of cultivars with higher genetic growth will allow the breeder to accelerate crop improvement programs and enable the early selection of cultivars with superior phenotypes and genotypes.

## Advantages and future scope:

The application of AI in plant breeding requires intelligent and efficient mining of breeding datasets by employing relevant models and definitive algorithms. Researchers are working to innovate and improve the efficiency of AI to enable high-definition image recognition for analysing complex data sets and therefore have become the main target for accelerating crop improvement. Components of AI, such as neural networks and deep learning, are currently being exploited to improve the efficiency and accuracy of multi-omics data. The mechanisms by which these two AI functions are often opaque involve multiple nonlinear hierarchical methods to build nodes for easy classification of datasets replicating brain neurons.AI will also be learned and improved iteratively to improve the mining of data, accuracy, and efficiency to predict better the factors underlying disease resistance/agronomic traits.

The technologies which are dependent on AI help to improve the overall efficiency in all the fields and also manage the challenges faced by various industries including the various fields in the agricultural sector like crop yield, irrigation, soil content sensing, crop-monitoring, weeding, and crop establishment. Agricultural robots are built in order to deliver highly valued applications of AI in the mentioned sector. With the global population soaring, the agricultural sector is facing a crisis, but AI has the potential to deliver a much-needed solution. AI-based technological solutions have enabled farmers to produce more output with less input and even improved the quality of output, also ensuring faster go-to-market for the yielded crops.




## **Conclusion:**

The main driver and promotion of AI and its cognitive implications across industries, has not been just to reduce manual calculations significantly, but also progressively and accurately predict results for future results. While initially limited to technology-driven businesses, the gradual increase of global warming and climate change, over the last fewdecades, has slowly and steadily allowed AI to penetrate into a traditional sector or like agriculture and plant breeding, to help cope with the increasing amount of complexity in modern-dayfarms. The prospects of AI in farming become even more important for a country like India, where more than 54.6% of the population is still engaged in direct agriculture, while nearly 70% of the population still depends on the agricultural sector directly or indirectly for their livelihood. Unlike the west, however, India's agricultural problems cannot be dealt with just advanced aggrotech solutions like plant breeding and yield multiplying, as farming in our country still remains largely scattered and unorganized. To tackle India-specific agricultural problems, many agritech start-ups are using AI not just to asses direct-on farming, but also in the development of improved seeds, crop protection, and fertility products.