# Chapter 5
# Quantum-Enhanced Plant Breeding and Genetic Optimization:
## Quantum Computing for Crops

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## ABSTRACT

*The conventional plant breeding has had some limitation in addressing the issues of global food security and challenges. Quantum computing proposes the way of improvement of genetic algorithm based optimization in plant breeding. The study attempts to analyse the impact of quantum computing in the acceleration of plant breeding. The chapter likewise examines the use of quantum algorithms and methods to anticipate complicated traits utilising genome selection and trait mapping. The research also focuses on quantum computing in order to find better gene combination, optimization-based breeding and crop resiliency in the face of the climate changes. Certain areas specifically include quantum acceleration, genome-wide association studies (GWAS) and quantum machine learning for phenotyping prediction and quantum inspired optimization algorithms to design novel breeding schemes. Such*

DOI: 10.4018/979-8-3373-3957-3.ch005

*perspective paves way for new era to concentrate on improvement of crop and sustainable food production. Such innovation offers something to solve the global food security challenge in the 21st century.*

## 1. INTRODUCTION

In the current global food security, accelerated plant breeding stands as a pillar for driving crop improvement for millennia (Lenaerts et al., 2019). But question states why is there need for accelerating plant breeding through hybrid seed production, where all these solutions come from, answer to all this bioengineering seeding. The causes are drought and heat stress due to excessive global warming (Halford, 2011). As the world's population growth spike towards 10 billion by 2050, there is need for more efficient and resilient agricultural practices. This can be cultivated through hybrid practices which has never been more critical (Arinarayanasamy et al., 2025). However, the breeding methods of plants got success but they have some limitations like solving complex genetic interactions and realising the full potential harboured in plant genomes (Guttman et al., 2014). The demand for advanced genomic technologies and quantum data analytics has created new venture for speeding the crop improvement (Bhuiyan et al., 2025). These kinds of approaches will often have great demands for computational strength and allow for classical computing's scope for quantum plant breeding work (Chen et al., 2020; Wahab et al., 2024).

The current chapter describes how quantum computing could make a big difference, plant breeding and genetic optimization. Among the basic concepts within quantum computing, quantum mechanics offers a boost in looking at efficiency and pace. With the help of this much so challenging information be worked by experts and can also make modelling possible with detailed biological systems (Acampora & Vitiello, 2023). Plant breeders can get faster breeding cycles in this advanced approach. This approach will enables breeders to increase the strength of the crops and gain better yields by using integrating quantum algorithms and ideas (Jiang et al., 2020). This chapter discuss the present status of quantum technologies for plant breeding, covering the basic science, their uses, difficulties and the path to further improvement in interdisciplinary field.

# Quantum Blockchain: A Systematic Review

Peter Nimbe, Benjamin Asubam Weyori, Jacob Mensah, Anokye Acheampong Amponsah, Adebayo Felix Adekoyaand Emmanuel Adjei Domfeh (2022).
*Advancements in Quantum Blockchain With Real-Time Applications (pp. 1-35).*
www.irma-international.org/chapter/quantum-blockchain/311205