

Review and Perspectives

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Strategies for Preserving Tea Plant Genetic Resources

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Abstract This study analyzes the current status of global tea plant genetic resources and explores conservation strategies, including in situ conservation and ex situ conservation. It highlights the critical role of biotechnological approaches such as gene banks, cryopreservation, and tissue culture in the preservation of tea plant genetic resources. The findings indicate that international collaboration is essential for promoting genetic resource sharing and enhancing germplasm innovation. Using the conservation of indigenous tea varieties in Yunnan as a case study, this study summarizes the practical experiences of local communities and research institutions in genetic resource preservation and proposes feasible pathways that integrate traditional knowledge with modern science. This study provides a systematic analysis and recommendations for the global conservation of tea plant genetic resources, contributing to germplasm innovation and the sustainable development of the tea industry.

Keywords Tea plant genetic resources; Conservation strategies; Biotechnology; International collaboration; Sustainable management

1 Introduction

Tea (*Camellia sinensis*) is one of the most widely consumed beverages globally, with its cultivation deeply rooted in regions such as China and India, which are recognized as the primary centers for the domestication of the tea plant (Meegahakumbura et al., 2016). The genetic diversity of tea plants is vast, encompassing various types such as China tea, Chinese Assam tea, and Indian Assam tea, each with distinct genetic lineages resulting from independent domestication events. Studies have shown that tea populations exhibit significant genetic diversity and structure, with cultivated types generally displaying higher genetic diversity compared to wild types (Niu et al., 2019). This diversity is crucial for breeding programs and the development of new tea varieties that can adapt to changing environmental conditions and consumer preferences (Clarke et al., 2023).

Preserving the genetic resources of tea plants is vital for several reasons. Firstly, it ensures the availability of diverse genetic material necessary for breeding programs aimed at improving tea yield, quality, and adaptability to different environmental conditions. Genetic diversity also plays a critical role in the resilience of tea plants to pests, diseases, and climate change, which are significant threats to sustainable tea production (Jibola-Shittu et al., 2024). Furthermore, understanding the genetic relationships and diversity among tea varieties can aid in the conservation of unique genetic stocks, which are essential for maintaining the cultural and economic significance of tea cultivation in traditional growing regions (Chen et al., 2005; Meegahakumbura et al., 2016).

This study aims to evaluate the genetic diversity and structure of tea populations, identify effective methods for conserving genetic resources, and explore the implications of genetic diversity for breeding and sustainable production. By synthesizing findings from various studies, this study expects to provide insights into the best practices for preserving the genetic heritage of tea plants, thereby supporting future breeding efforts and ensuring the sustainability of tea cultivation in the face of global challenges.

2 Global Overview of Tea Plant Genetic Resources

2.1 Distribution of tea plant varieties

Tea plants, primarily *Camellia sinensis*, are cultivated globally, with significant genetic diversity observed across different regions. China, recognized as the origin of tea plants, boasts the broadest genetic variations and has