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Genomic Resilience and Ecological Vulnerability in Coffea Arabica: Insights from Whole Genome Resequencing at Its Center of Origin

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Abstract : The study focuses on the evolutionary and ecological genomics of both wild and cultivated Coffea arabica L. at its center of origin, Ethiopia, aiming to uncover how this vital species may withstand future climate changes. Utilizing bioclimatic models, we project the future distribution of Arabica under varied climate scenarios for 2050 and 2080, identifying potential conservation zones and immediate risk areas. Through whole-genome resequencing of accessions from Ethiopian gene banks, this research assesses genetic diversity and divergence between wild and cultivated populations. It explores relationships, demographic histories, and potential hybridization events among Coffea arabica accessions to better understand the species' origins and its connection to parental species. This genomic analysis also seeks to detect signs of natural or artificial selection across populations. Integrating these genomic discoveries with ecological data, the study evaluates the current and future ecological and genomic vulnerabilities of wild Coffea arabica, emphasizing necessary adaptations for survival. We have identified key genomic regions linked to environmental stress tolerance, which could be crucial for breeding more resilient Arabica varieties. Additionally, our ecological modeling predicted a contraction of suitable habitats, urging immediate conservation actions in identified key areas. This research not only elucidates the evolutionary history and adaptive strategies of Arabica but also informs conservation priorities and breeding strategies to enhance resilience to climate change. By synthesizing genomic and ecological insights, we provide a robust framework for developing effective management strategies aimed at sustaining Coffea arabica, a species of profound global importance, in its native habitat under evolving climatic conditions.

Keywords : coffea arabica, climate change adaptation, conservation strategies, genomic resilience
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