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High Chloroplast Diversity of Cacao (*Theobroma cacao* L.) in Western Amazonia

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Abstract

The cacao tree, *Theobroma cacao* L., is cultivated in the tropics mainly in agroforestry systems for the production of seeds, the raw material for the chocolate industry. Thus, conservation and use of cacao genetic resources in breeding programmes are vital for the cacao economy. Wild cacao populations have a wide geographic distribution in their native range along the Amazon basin. However, the phylogeographic structure of natural cacao populations is not well known. In this context, chloroplast DNA (cpDNA) polymorphisms can be used as informative markers to study geographic variation of cacao populations and geographic origin of planting material used in cacao farms and breeding programs. Here we show how chloroplast genetic diversity is geographically distributed in Amazonia, and how it is represented in common cacao genotypes by using cacao chloroplast microsatellite (simple sequence repeat - SSR) markers to genotype 235 cacao samples. Western Amazonia has high cpDNA variation. In total, 23 chloroplast haplotypes were identified. Two observed haplotypes were widespread across the Amazon basin suggesting seed dispersal patterns from west to east in Amazonia, likely influenced by humans. We also observed a common haplotype in selections representing cacao farms in west Ecuador. When we compared the observed haplotypes with previously identified cacao genetic groups based on nuclear DNA we observed specific chloroplast haplotypes within eight genetic groups. Our results can help to determine the chloroplast diversity of cacao accessions, and using them together with agronomic characteristics geographically distinctive varieties can be selected in breeding programs. The analysis of different cacao populations with wide geographic distribution in the Amazon basin may reveal new haplotypes. Furthermore, the detection of new haplotypes will expand our understanding of patterns of geographic genetic variation and dispersal in cacao. This information will help to guide the conservation of cacao genetic resources.

Keywords: Chloroplast haplotypes, chocolate, crop dispersal, geographic origin