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## Uncovering the genetic diversity of *Hemileia vastatrix* in three coffee-producing areas in Guatemala and its implications for resistance of coffee varieties

JOSÉ ALEJANDRO RUIZ-CHUTÁN<sup>1</sup>, MARIE KALOUSOVÁ<sup>1</sup>, JULIO ERNESTO BERDÚO-SANDOVAL<sup>2</sup>,  
CARLOS VILLANUEVA-GONZÁLEZ<sup>3</sup>, AMÍLCAR SÁNCHEZ-PÉREZ<sup>2</sup>, NELSON PÉREZ<sup>4</sup>, EDER  
GONZÁLEZ<sup>4</sup>, BOHDAN LOJKA<sup>1</sup>

<sup>1</sup>Czech University of Life Sciences Prague, Fac. of Tropical AgriSciences, Dept. of Crop Sciences and Agroforestry, Czech Republic

<sup>2</sup>Universidad de San Carlos de Guatemala, Facultad de Agronomía, Guatemala

<sup>3</sup>Universidad Rafael Landívar, Facultad de Ciencias Ambientales y Agrícolas, Guatemala

<sup>4</sup>Asociación Nacional del Café, Centro de Investigación en Café, Guatemala

### Abstract

Coffee rust, caused by the fungus *Hemileia vastatrix*, is the leading disease that attacks the crop worldwide. One of the strategies for controlling the disease is the genetic factor, developed through breeding programmes that result in coffee genotypes resistant to the pathogen. However, to make the best use of this factor, it is essential to know the molecular factor of the pathogen. Despite the importance of coffee cultivation for Guatemala, there is no study of the pathogen's population structure, genetic diversity, and haplotypic diversity. This study evaluated the genetic diversity and population structure of *H. vastatrix* fungal populations in three coffee-producing departments in Guatemala using 17 microsatellite polymorphic markers and ITS. Between 2 and 11 alleles per locus were observed, with a mean of 5.22. The Shannon diversity index, nucleotide, and haplotypic diversity showed values of 0.86, 0.0051, and 0.985, respectively. High within-population variation was observed (92%). In addition, high levels of gene flow between populations were found, suggesting low genetic differentiation ( $F_{st} = 0.024$ ) between populations. The haplotype network showed that *H. vastatrix* isolates behave as a large population without defined differentiation, in which ancient haplotypes were detected from which new variants of the fungus emerged. The Tajima test showed that the populations of *H. vastatrix* are undergoing an expansion process. In general, *H. vastatrix* populations in Guatemala are highly variable, and genetic variation is widely distributed in all the departments studied. It was determined that the haplotypic diversity of *H. vastatrix* may influence the resistance of coffee cultivars. The severity tests of *H. vastatrix* exhibited a statistically significant difference ( $p < 0.001$ ) in the area under the disease progress curve (AUDPC) among the eight varieties evaluated. Still, the interaction between the pathogen and the plant is complex, and other environmental factors may also influence resistance.

**Keywords:** Coffee leaf rust, genetic diversity, haplotype network, ITS, microsatellites