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GENETIC STRUCTURE OF MAIZE LANDRACES FROM THE HIMALAYAN REGION

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Maize (Zea mays L.) plays an important role as staple food in the diets of millions of people, but the climate crisis threatens the sustainability of its production worldwide. Maize landraces have adaptability to different conditions and hold great value as a genetic resource to be exploited for breeding targeting improved agronomic and quality traits. Bhutan, the hermit kingdom of the Himalayas, hosts hundreds of landraces grown in a broad range of altitudes and microclimates exhibiting significant morphological variation. Up to today, the genetic and phenotypic diversity of maize landraces in Bhutan remained largely unknown.

Here we report the extensive genotypic characterization of 352 Bhutanese maize landraces, representing the entire maize agrobiodiversity maintained in the national seed bank, and of selected accessions from the neighboring Nepal and Indian-Himalaya. A double digestion RAD sequencing yielded 1.3 trillion reads and 6,628 high quality single nucleotide polymorphisms (SNPs) with MAF > 0.05 after strict quality control. SNPs were used to study the diversity of the collection in relation to geography and climate and to perform a genome wide association study (GWAS) with traits collected in a location in Bhutan. Furthermore, we conducted a climatic characterization of the landraces, associating local cultivation locations to past climate.

The optimum number of genetic clusters in the collection was determined at K= 4, and a phylogenetic tree analysis based revealed divergence based on geography with Bhutan (cluster 1, 2 and 3) separated from India and Nepal accessions (cluster 4). From outlier mapping, we detected 24 loci separating genetic clusters and suggestive of ongoing selection processes. GWAS was performed combining phenotypic and bioclimatic data separately,

with SNP data. For agronomic traits, 32 Marker-trait associations (MTAs) were identified, while 42 MTAs were identified for bioclimatic variables, suggesting potential for adaptation to current and future climates. The availability of genetic diversity information on maize genetic resources from Bhutan will aid in making an informed decision for their conservation, management, and utilization.