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Morphological and Molecular Diversity in a Collection of the Andean Tree Tomato (*Solanum betaceum* Cav.)

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SUMMARY

Tree tomato or tamarillo (*Solanum betaceum* Cav., syn. *Cyphomandra betacea* (Cav. Sendt.) is a small tree native to the Andean region that produces juicy berries the size of a hen's egg. Tree tomatoes are commonly found in local markets of South America, where they are sold being consumed as a fresh fruit or for producing juices (Bohs, 1989). This species represents an important alternative to production, diversification and commercialization of non-traditional products and, in addition, it is a promising crop for some regions with Mediterranean climate (Prohens and Nuez, 2000). The expansion of the crop is limited by some factors, such as the lack of clear differentiation among varieties, low fruit quality (heterogeneity and phytosanitary problems), use of inappropriate varieties, or substitution of local varieties with materials from other origins; moreover, the tree tomato is frequently a subsistence crop and is considered a neglected crop, not included in programs of conservation and genetic improvement of genetic resources. This raises the need to undertake studies aimed at the characterization of its diversity, which is essential to its use and conservation, as up to now neither morphological descriptors for tree tomato characterization have been published, nor the morphological and genetic relationships among cultivar groups have been studied. We have made a morphological and molecular characterization of tree tomato including a significant number of morphological traits and AFLPs markers, based on a broad diversity of accessions (27 cultivated, collected in the Andean region -the center of origin of this species- or in other continents, and belonging to *S. cajanumense* Kunth, used as an outgroup in the molecular characterization). Accessions were assigned to five cultivar groups: orange, orange pointed, purple, red, and red conical. As a result of our research we have elaborated a list of 39 quantitative morphological descriptors, useful to differentiate accessions and to identify characteristics of interest in accessions and cultivar groups (Acosta-Quezada *et al*., 2011). Statistical analyses performed have included measures of position and dispersion (mean, standard deviation and coefficient of variation), analyses of variance (to validate the utility of descriptors), and heritability. Statistically significant differences ($P<0.05$) among accessions were found for most traits, especially for fruit traits, which indicates that a wide variation exists and that it is possible to select materials with fruit characteristics more appropriate for the markets. Fruit traits have also displayed high heritability values, showing that selection for

fruit characteristics would be efficient. Considerable variation was found within each cultivar group (with the exception of the red conical group, which contains a single accession). Many significant morphological differences were found between the red conical group, characterized by producing a high number of small fruits containing very few seeds, and all other cultivar groups. Most of the significant correlations found corresponded to traits from the same part of the plant. Multivariate cluster and principal component analysis separated accession A-41 (red conical cultivar group) from the rest of accessions, which in turn formed poorly differentiated groups not related to cultivar groups or origin of the materials. Eleven combinations of AFLP primers were used in the molecular characterization, which yielded a total of 197 AFLP fragments, of which 78 (39.59%) were polymorphic. Genetic fingerprints specific and unique to each accession were obtained; however, no AFLP fragments specific and universal to cultivar groups were found, suggesting a low genetic differentiation among cultivar groups. Cultivar groups showed considerable within-group diversity, indicating that each of them contains an important fraction of the species diversity, which has significant implications for both conservation and breeding. Multivariate cluster and principal coordinates analysis of molecular data did not reveal a clear accession grouping, showing a low genetic differentiation among cultivar groups and among geographical origins. Morphological and molecular characterizations showed a low correlation between them but provided complementary information useful for the conservation and genetic breeding of tree tomato. This study represents an important contribution to the knowledge on diversity, conservation of genetic resources and breeding of the tree tomato, which is relevant for the development of this neglected crop with high potential for Andean countries as well as for other areas of the world.

Keywords: AFLPs, cultivar groups, descriptors, genetic resources, *Solanum betaceum*, tree tomato

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