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Genetic Diversity and Adaptation of Date Palm (*Phoenix dactylifera* L.)

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Abstract

Acquiring sufficient information on the genetic variation, genetic differentiation, and the ecological and genetic relationships among individuals and populations are essential for establishing guidelines on conservation and utilisation of the genetic resources of a species. The aim of this study was to assess the extent and pattern of genetic variation in date palm cultivars; the genetic diversity and structure in its populations occurring over geographical ranges; and the variation in its drought adaptive traits. Genetic diversity and relationships among selected cultivars and populations were assessed using microsatellite markers. Separately, fruits of selected cultivars, involved morphological and chemical characterisation, and morphological and DNA polymorphism of the mother trees were also investigated. Morphological and photosynthetic adjustments of selected cultivars to water stress were also studied. Results showed a significant ($p < 0.001$, t-test) differentiation between Sudan and Morocco groups of cultivars. However, the major feature of all tested cultivars was the complete lack of clustering and the absence of cultivars representing specific clones. The results indicated high genetic as well as compositional and morphological diversity among cultivars; while, compositional and morphological traits were found to be characteristic features that strongly differentiate phenotypes. Significant ($p < 0.01$, AMOVA) divergence was observed for soft and dry types; however, the genetic divergence among populations was relatively weak. The results showed a complex genetic relationships between some of the tested populations especially when isolation by distance was considered. Soft and dry phenotypes responded differently to different levels of water stress. Although a large amount of diversity exists among date palm germplasm, the findings suggest that the role of biological nature of the tree, isolation by distance and environmental effects on structuring date palm genome was highly influenced by human impacts. Identity of date palm cultivars as developed and manipulated by date palm growers, in the absence of scientific breeding programmes, may continue to mainly depend on tree morphology and fruit characters. The pattern of genetic differentiation may cover specific morphological and physiological traits that contribute to adaptive mechanisms in each phenotype. These traits can be considered for further studies related to drought adaptation in date palm.

Keywords: Genetic diversity, microsatellite markers, morphological traits