Spatial and Temporal Genetic Variation in Ethiopian Barley (Hordeum vulgare L.) Landraces as Revealed by Simple Sequence Repeat (SSR) Markers

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Abstract

Ethiopia is a center of diversity for barley (Hordeum vulgare L.) and it is grown across different agro-ecologies of the country. Unraveling population structure and gene flow status on temporal scales assists an evaluation of the consequences of physical, demographic as well as overall environmental changes on the stability and persistence of populations. Here, we examine spatial and temporal genetic variation within and among barley landrace samples collected over a period of four decades (1976-2017), using simple sequence repeat (SSR) markers. Our objective was to evaluate spatial and temporal changes in barley population connectivity associated with the closure of geographic origin and time periods. Low to strong genetic diversity was observed among the landraces and STRUCTURE, Neighbour joining tree and Discriminant Analysis of Principal Component analysis revealed three clusters. The cluster analysis revealed a close relationship between landraces along geographic proximity with genetic distance increases along with geographic distance. The grouping of landraces based on altitudinal classes was influenced by geographic proximity. From AMOVA year categories, it was observed that within population genetic diversity much higher than between population genetic diversity and that the temporal differentiation is considerably smaller. The low to strong genetic differentiation between landraces from various geographic origins could be attributed to gene flow across the region as a consequence of seed exchange among farmers. Nevertheless, we found some connectivity between changes in population dynamics as well as contemporary gene flow. The results demonstrate that this set of SSRs was highly informative and was useful in generating a meaningful classification of barley germplasms. Furthermore, our data also suggest that landraces are a source of valuable germplasm for sustainable agriculture in the context of future climate change, and that in-situ conservation strategies based on farmers use can conserve the genetic identity of landraces while allowing adaptation to local-environments.

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