Genetic diversity and evolution of European wheat populations submitted to contrasting agro-climatic conditions

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Abstract

In agro-systems, genetic diversity especially within-population diversity provides a buffering effect against the year-to-year variation of climatic or biotic pressures as well as a resource for the population to respond to selective pressures due to specific local conditions, thus allowing for local adaptation, particularly when a population is introduced into a new location. Wheat was chosen as a model crop in this study due to its high adaptive potential. Flowering time was evaluated as it is a major adaptive trait that has been involved in wheat adaptation.
The objective of this study was to gain insights on the influence of within-population diversity onto the short-term response of populations to contrasting agro-climatic conditions, by studying the genetic and phenotypic variation. Wheat populations (seven farmers' and one modern varieties), that have been grown on seven farms (distributed across Europe) for three years, were studied for their short term response to the contrasting agro-climatic conditions. Genetic diversity at neutral and candidate genes markers, as well as earliness and plant height (two major adaptive traits) were investigated in 54 samples corresponding to the initial and 3rd year populations of these eight varieties.

Results revealed that conservation history of these farmer varieties strongly influenced their genetic diversity and fine genetic structure. Ex situ conserved landraces and the modern variety showed low genetic diversity and simpler structure whereas in situ conserved farmers' varieties and mixtures revealed higher level of genetic diversity and complex genetic structure. Genetic and phenotypic spatio-temporal differentiation depending upon the level of diversity and structural complexity of the farmer variety was observed. The traditional varieties tend to become more differentiated than the modern variety arguing in favour of the use of diverse traditional (farmers') varieties in organic and low input agriculture systems.
This study at large provides useful knowledge on the understanding of farmers' varieties evolutionary response to be used in the development of different breeding and conservation approaches, taking into consideration the importance of within-population diversity, to satisfactorily address the problems of sustainable agriculture.

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