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## Ecophysiological Diversity of Wild *Coffea Arabica* Populations in Ethiopia — Implications for A Successful Conservation Strategy

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### Abstract

Drought is a serious constraint on the productivity of *Coffea arabica* in many countries worldwide that prevents the cultivars from expressing their full genetic potential. Hence, the development of drought resistant plants is considered a promising strategy to ensure economic production when resources are limited. However, early domestication and modern plant breeding severely eroded genetic variations of modern cultivars compared with their wild progenitors, making crop plants increasingly susceptible to environmental stresses. Consequently, wild populations of *Coffea arabica* that can be found in the Ethiopian Afromontane rainforests constitute the last remaining genetic reserves of great value for the producing and consuming world. Despite its importance however, natural stands of wild coffee are diminishing at alarming rate mainly due to deforestation activities. Thus, there is an urgent need to assess the ecophysiological diversity and to identify suitable sites for conservation activities in order to maintain the irreplaceable genetic resources of *Coffea arabica* found in Ethiopia.

The study focuses on distant wild populations of *Coffea arabica* in Ethiopia that are widely distributed over an area with high heterogeneity in water availability. It is hypothesised that this gradient promotes different selection pressure for traits related to water use. Differences in gas exchange, carbon isotope discrimination and leaf water relations were studied in their natural habitat as well as under controlled environmental conditions in order to determine whether climate-driven shifts in physiological traits between distant populations of *Coffea arabica* are caused by phenotypic plasticity or represent ecotypic differences.

The results of the *in situ* study indicate that there is a high variability in water use strategies among the populations and that they are well-adapted to their local environment. When grown under identical environmental conditions (*ex situ*), populations still maintain differences in their ecophysiological behaviour. However, their adaptive differences in physiology do not reflect the water availability of the site of origin. This has major implications for the conservation strategy of the threatened wild coffee populations and *in situ* conservation should be seen as the most important instrument in order to maintain the ecophysiological diversity found in the wild populations of *Coffea arabica* in Ethiopia.

**Keywords:** Drought, ecophysiological diversity, *in situ* conservation, rainfall gradient