Using Artificial Environments to Reveal Adaptive Responses of Alfalfa Landraces across Northern Italy

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Previous work showed that variety x location interaction for dry matter (DM) yield of alfalfa (*Medicago sativa* L.) in northern Italy is large and related to local soil type and level of summer drought stress, suggesting to exploit it by breeding for specific adaptation to each of two contrasting subregions. Defining a distinct genetic base and optimal selection environments for each subregion may complement this strategy. Thirteen farm landraces collected across the region, and four control varieties of known adaptation, were evaluated for two-year DM yield in four artificial environments created at one site by the factorial combination of soil type (sandy-loam or silty-clay) and drought stress level (almost nil or high), to assess the variation among landraces in adaptive response and its relationship with environmental factors at collecting sites, as well as exploring the possibility to reproduce in artificial environments the adaptive responses across the region.

Cultivars x environment interaction effects of cross-over type as modelled by Additive Main effects and Multiplicative Interaction analysis were remarkable and mainly due to cultivar response to stress level. Better response to drought of landraces (positive PC 1 score) was closely related (r = 0.82) to the level of summer drought at collecting sites estimated as the difference between ETP and rainfall + irrigation, highlighting the importance of evolutionary adaptation. Different top-yielding material may be exploited as genetic base to breed for a favourable and a drought-stressed subregion. The responses of control varieties successfully reproduced those across the region (i.e. La Rocca and Lodi adapted to no-stress environments and sandy-loam soil; Europe adapted to drought stress and silty-clay soil). The artificial environments may allow to reduce the cost of multi-locational selection.

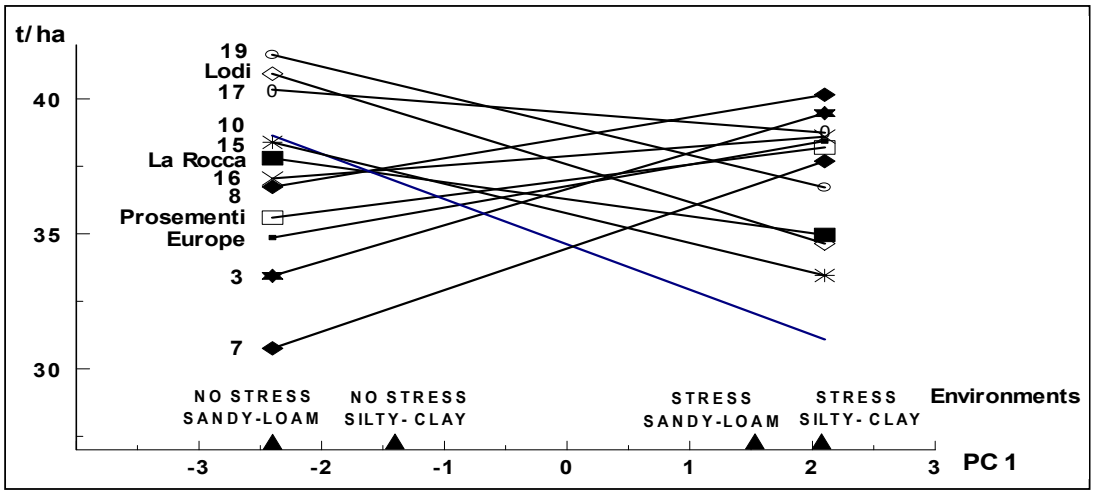

Figure 1. Nominal yield of alfalfa landraces (indicated by accession number) and varieties as a function of the first cultivar x environment interaction principal component of environments