Phenotypic plasticity: a useful framework for understanding adaptation in forest species

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Abstract

Phenotypic plasticity is a relatively new name for a very old issue in plant sciences: the ability of a genotype to generate a range of different phenotypes, depending on the environment. Contrasting with a great deal of published research works recognising plastic responses in a wide variety of organisms, direct evidences of the adaptive role of such responses are still scarce and the evolutionary implications of phenotypic plasticity is under discussion. Different types of plasticity, operating at different levels within individuals or across generations have been recognised and several methodologies have been applied to characterize and quantify plasticity. Further research on this issue regarding forest tree species, especially in Mediterranean ecosystems is needed in order to understand the impact that global climate change may have on the existing populations.

Key words: Phenotypic flexibility, Developmental plasticity, Cross-generational plasticity, Ontogeny, AMMI models, Stressful environments, Forest management.

Introduction

Foresters and gardeners are fully aware that similar plants grown in different conditions may look very different. In fact, forest management has been using the control of micro-environment to shape trees into desired phenotypes for centuries. For instance, by modifying light, water and nutrient availability through variations in stand density, one can direct growth to build tall, branchless poles or alternatively to enhance crown development for seed production and subsequent stand recruitment. This ability of a genotype, i.e. of a single set of genes to generate a range of different phenotypes, depending on the environment that the developing organism must endure, is called phenotypic plasticity (Bradshaw, 1965; Schlichting, 1986). Phenotypic plasticity may take many forms, ranging from changes in physiology, to alterations of morphological structure and to shifts in behavioural repertoires (Schlichting and Pigliucci,