Functional traits in exotic plant species along an elevational gradient in South Africa – the role of local adaptation

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Background

Montane ecosystems have long been considered less endangered by plant invasion, but several recent studies have contradicted this assumption (e.g. Kalwij et al., 2015). When climbing upwards, species are subjected to changing environmental conditions such as decreasing temperature and water availability, but also increasing UV-B radiation. Plant populations can meet these with different strategies, implying phenotypic plasticity, evolutionary changes or a combination of both.

Here, we examined the effect of UV-B radiation and water availability on exotic species with an additional focus on the elevational origin of the individuals. The aim was to study the relative importance of different strategies and to look for signs of adaptation in functional traits.

Results

Plant performance and functional traits were affected by water availability and UV-B radiation (Tab. 1). The combined effect of UV-B radiation and decreased water availability did not lead to an additional decrease in plant height (Fig. 1).

Relative reproductive biomass was significantly dependent on elevational origin. Individuals from high elevations invested more in reproduction than those from lower elevations (Fig. 2).

Variation in early SLA was significantly affected by UV-B radiation and elevational origin. Without UV-B radiation, SLA decreased with increasing elevation. Addition of UV-B radiation, however, resulted in an opposite effect. The magnitude of variation increased with UV-B radiation (Fig. 3).

Methods

Seeds of 11 herbaceous exotic species were sampled along an elevational gradient in South Africa (Sani Pass; 1500 – 3000 m a.s.l.). After germination, seedlings of different elevational levels were subjected to the following treatments (simulating local conditions) in a full-factorial crossed design for up to 12 weeks:

- 3 levels of UV-B radiation: None, Medium, High
- 2 levels of soil moisture: Low: 10%, High: >15%

Growth and functional traits were monitored throughout the experiment. Above- and belowground biomass determined at final harvest when species had reached maximum productivity.

A linear mixed-effects model was fitted to test for environmental and origin effects on traits.

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Table 1: LDMC = Leaf dry matter content, SLA = Specific leaf area. Plant height at start was included as co-factor and all responses were z-transformed.

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