A tale of two invaders: Chemistry, ecology and genetics of invasive Echium spp. in southern Australia

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Abstract

Echium plantagineum and *E. vulgare* are congeneric exotics that possess similar morphological and biological features and were introduced to Australia in a similar time frame. However, *E. plantagineum* is highly invasive in Australia, whereas *E. vulgare* is found only sporadically across southeastern Australia. Studies were conducted to evaluate the secondary chemistry, ecology and genetics of each species in an effort to understand their respective invasive success, or lack thereof. In a common garden experiment, *E. plantagineum* produced qualitatively and quantitatively higher levels of bioactive pyrrolizidine alkaloids (PAs) in its shoots when compared to *E. vulgare.* PAs have been well documented to be associated with reduced herbivory of insects and are highly hepatotoxic to grazing livestock. In contrast, the perennial *E. vulgare* produced somewhat higher levels of antimicrobial and potentially allelopathic naphthoquinones in its roots than did *E. plantagineum*, in a series of glass-house experiments. Similar trends were observed in field-collected plants. Potential ecological roles of these defensive metabolites in *Echium spp.* invasion will be discussed. The presence of *E. plantagineum* significantly reduced ($P < 0.01$) the number and density of other plant species co-habiting the same area in various field locations, while no significant impact of infestation was associated with *E. vulgare* co-habitation. *E. plantagineum* also exhibited a much smaller monoploid genome (1C = 0.37pg) when compared to *E. vulgare* (1C = 0.43pg), and these findings supported the large genome constraint hypothesis associated with reduced invasion success of plants exhibiting a larger genome size. In addition, intensively sampled Australian *E. plantagineum* populations suggested a much higher level of chloroplastidic genetic diversity (h=0.7661 compared to h=0.3800 in *E. vulgare*). We conclude that the upregulated production of defence compounds, significant impacts on endemic plant communities and elevated genetic diversity have all logically contributed to the successful invasion of *E. plantagineum* in Australia.

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