The effect of resource dynamics on invasive annual and native perennial grasses in grasslands of the mid-north of South Australia

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Abstract

The abundances of invasive annual grasses and native perennial grasses in the mid-north of South Australia are highly patchy. This study aimed to investigate the effects of soil moisture dynamics on the growth and interactions between these grass types. I proposed that different moisture dynamics favour different grass types and aimed to investigate the factors involved.

I measured grass abundances, environmental variables and soil-moisture regimes in several grasslands. At most sites annual grass abundance was positively correlated with rainfall, soil moisture after rainfall and higher soil productivity. Perennial grass abundance was negatively correlated with annual grass abundance and soil moisture after rainfall, and was weakly positively correlated with percentage summer rainfall, elevation, radiation, gravel, and slope.

In a field experiment seed addition or watering, but not removing perennial grasses increased the recruitment of annual exotics in perennial-grass dominated areas. No perennial grasses recruited successfully into areas dominated by annual grasses. In the glasshouse, seedlings of the common native perennial grass *Austrodanthonia caespitosa* (Gaud.) H.P.Linder required high soil moisture to establish. When in competition with a common annual exotic grass, *Avena barbata* (Pott ex Link), *Austrodanthonia* had significantly lower chances of surviving a drought than seedlings without competition.

At low soil moisture *Avena* had similar growth rates to common native perennial grasses but at high soil moisture its growth rates were significantly higher. It performed best in soil moisture regimes that included periods of extreme soil moisture as opposed to constant intermediate moisture. Throughout the soil moisture gradient *Avena* maintained a low root/shoot ratio. The perennial grasses increased growth rates less with increasing soil moisture and increased root/shoot ratios with decreasing soil moisture. In the field, regardless of soil moisture, annual grasses had a strong competitive effect on *Austrodanthonia*, while *Austrodanthonia* had no competitive effect on annual grasses.

Overall, perennial grasses responded little to the environmental variables investigated, but strongly to annual grass abundance, while for annual grasses soil moisture was the driving variable. Except for lower mortality at low soil moisture, there is no evidence that perennial grasses have any competitive advantage at any soil moisture availability during the growing-season shared with annual grasses. Increased perennial grass abundance thus requires decreasing annual grasses or encouraging perennial grasses outside the shared grass growing-season.