Influence of P fertility and grazing on plant species in a temperate Australian pasture

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Introduction Graziers in temperate Australia are increasing their use of P fertiliser so they can run more stock and maintain profitability. However, intensification changes grassland botanical composition and perennial grass cover can be reduced. Perennial grasses are important because they improve production stability, reduce deep drainage and slow the rate of soil acidification. This study examined how P fertility and grazing affected the botanical composition of pasture based on *Phalaris aquatica*, a key perennial grass in south-eastern Australia.

Materials and methods *Field experiment* Continuously-grazed *P. aquatica* and *Trifolium subterraneum*-based pastures growing on a yellow chromosol soil at Hall (ACT, Australia), were left unfertilised (extractable P (Colwell 1963) 0-10 cm depth 8-12 mg P/kg soil), or were fertilised optimally (Colwell P 20-25 mg P/kg) for six years. Basal cover of plants was determined across three replicates by the point quadrat method in Sept. 1999, 2000 and 2001. *Glasshouse experiment* Pasture species present at the field site (Table 1) were grown in steam pasteurised topsoil (pH($CaCl_2$) 4.8; Colwell P 10 mg P/kg) from an unfertilised paddock. Pots contained 1.5 kg of soil and were supplied a basal dressing of all nutrients except P, which was supplied as KH_2PO_4 at rates from 0 to 84 mg P/pot. Each species was harvested when the shoots of its highest P treatment reached ~6 g dry weight.

Results The most abundant species in the unfertilised system (Figure 1) were either effective at extracting P from unfertilised soil (e.g. *P. aquatica*, *Vulpia* spp.), had a low critical P requirement (e.g. *Vulpia* spp.) (Table 1), or were able to fix N (*T. subterraneum*). *P. aquatica* and *Bromus* spp. were more abundant in fertilised pasture at the low stocking rate (which gave underutilised pasture). Abundance of species in the intensive grazing system was inversely related to maximum relative growth rate (RGR, determined at high soil fertility).

Table 1 Relative P uptake rate (RPUR) and critical P (amount of P required for 90% maximum shoot growth) of *P. aquatica* (Pa), *Holcus lanatus* (Hlan), *Bromus molliformis* (Bm), *Vulpia* spp. (Vspp), *Arctotheca calendula* (Ac), *Lolium rigidum* (Lr), *T. subterraneum* (Ts) and *Hordeum leporinum* (Hlep)

Pasture species present at the site	Pa	Hlan	Bm	Vspp	Ac	Lr	Ts	Hlep
RPUR unfertilised soil (mg/g per d)	91.9	66.1	54.9	79.9	n/a	81.1	26.3	36.1
Critical P (mg P/pot)	22.0	8.0	25.1	13.0	14.7	13.9	34.0	28.5

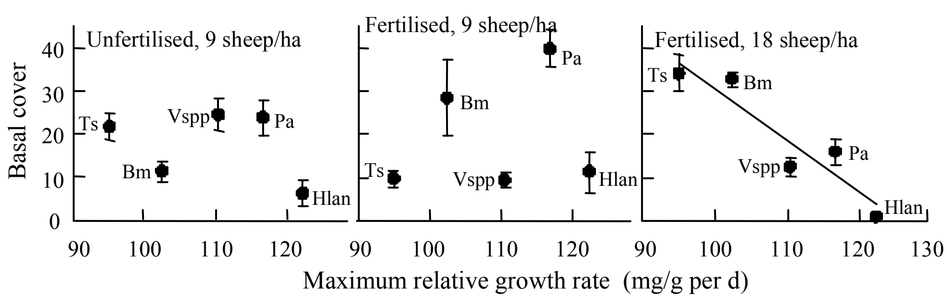

Figure 1 Maximum RGR (glasshouse) and mean basal cover (1999-2001) of main species (>5% cover) in the field. Bars = 2x sem.

Conclusions The C-S-R model (Grime 2001) adequately explains species abundance in the unfertilised pasture (dominated by stress-tolerant species) and the fertilised low stocking rate pasture (tall competitor species). It was expected that plants with high RGR would also dominate the fertilised high stocking rate pasture (Lambers & Poorter, 1992), but abundance and RGR were negatively correlated. We propose that this is because grazing pressure was a major factor controlling the success of plants in the intensive system and that slow growth either assisted a species to avoid being grazed or was associated with lower grazing preference. These propositions require further investigation in order to improve our ability to predict changes in pasture composition.

References

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