Competition between *Lolium perenne* L. and *Agrostis capillaris* L. growing under different light regimes as response to fertiliser addition in a degraded pasture

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Introduction

At the field level plants can experience solar irradiance fluctuations caused by cloud cover or canopy shading. The majority of the research in this area has been done on forestry/pastoral systems using artificial structures so that the pasture has the desired light level (Peri *et al.* 2006). However, the effect of a change from high to low irradiance on the seasonal plant growth and production in a degraded pastoral system has not been previously studied, especially when fluctuating light regimes are involved. The aims of this study were to evaluate tillering dynamics of *Lolium perenne* L. (Lp) and *Agrostis capillaris* L. (Ac) in a degraded pasture under different intensities of fluctuating light regimes and also to evaluate the effect of fertiliser addition on plant growth under different levels of light.

Methods

In April 2010 (autumn), a complete randomised block design (20 x 20 m plots, 3 blocks), was established on a degraded pasture (low soil fertility) with (DM basis) 59% Ac (browntop), 21% *Holcus lanatus* L. (yorkshire fog), 11% *Anthoxanthum odoratum* L. (sweet vernal) and 5% broad leaf weeds. Each pasture was grazed by 25 sheep when it reached an equivalent of 2100 to 2300 kg DM/ha until biomass reached 1000 to 1200 kg DM/ha. The maximum length of defoliation frequency was 60 days. Two treatments were applied: non fertilized pasture (NFP) and fertilised pasture (FP) with an annual fertilisation of: 180 kg N/ha/year, 120 P_2O_5/ha/year, 120 kg K_2O/ha/year and lime 2 t/ha/year. In October, 2012, the NFP had 36.7% Ac and 6% Lp, while the FP had 39.5% Ac and 16.8% Lp. Within each plot, shade structures covered with mesh were used to reduce light incidence to three levels of photosynthetic active radiation (PAR): 60.7, 140.5 and 199.9 x10µmol/m^2/s (Heavy shade 70%: 30 cm height, 70 cm length, 100 cm width [HSh]; Medium shade 30%: 20 cm height, 65 cm length, 75 cm width [MSh]; and Open sunlight [OS]). The position of the shade structures was South-North. Six rings (6 cm diameter) were placed in the pasture under each structure and fixed to the soil (October 2012). The rings (2 rings for each class) contained 100% Ac tillers (Ac), 100 % Lp (Lp) tillers or 50% Ac-Lp tiller combination (Acm-Lpm). The number of alive tillers, Relative Competition Index and length of canopy were evaluated from October 2012 to March 2013. Data were analysed using ANOVA and PDIFF (Steel *et al.* 1997).

Results

The rings containing monophytic pasture showed tillering fluctuations of Lp and Ac over time. The main factors significantly diminished or increased ($P \leq 0.05$) tillering for the species, according to whether it was spring or summer. The results of competition for each shade level and fertility status are shown in Figure 1. In NFP, under HSh, tiller population decreased over time for Lp and Lpm species especially during summer (Lp:-20%; Lpm:-40%), while tiller population of Ac and Acm increased (Ac: 45%; Acm: 13%). For MSh, Lp tiller population increased over time while Ac diminished, i.e. during summer Lp increased 35%, while Ac decreased -11%. Lpm was negatively affected by competition, decreasing 16%, while Acm increased 26%. It was shown that at HSh level, Lp tiller buds had less light stimulation than those of Ac (spring time -17% v/s 13%). This negative effect on Lp was greater during summer due to soil water restriction (López *et al.* 2010). For OS, Ac and Acm tillering increased (spring: 26% Ac, -4% Acm; summer: 64% Ac, 25% Acm), while Lp and Lpm tillering diminished (spring: -13% Lp, -22% Lpm; summer: -49% Lp, -38% Lpm).

The advantage of Ac and Acm growing in NFP in relation to Lp and Lpm was most likely based on its stress tolerant features. In FP and under HSh, Lp and Lpm were able to increase their tiller population during spring and summer (spring: 22% Lp, 4% Lpm; summer: 46% Lp, 5% Lpm) over Ac and Acm (spring: 1% Ac, -15% Acm; summer: -45% Ac, -33% Acm). A similar situation occurred under MSh, Lp and Lpm tiller population increased over time (spring: 68% Lp, 28%

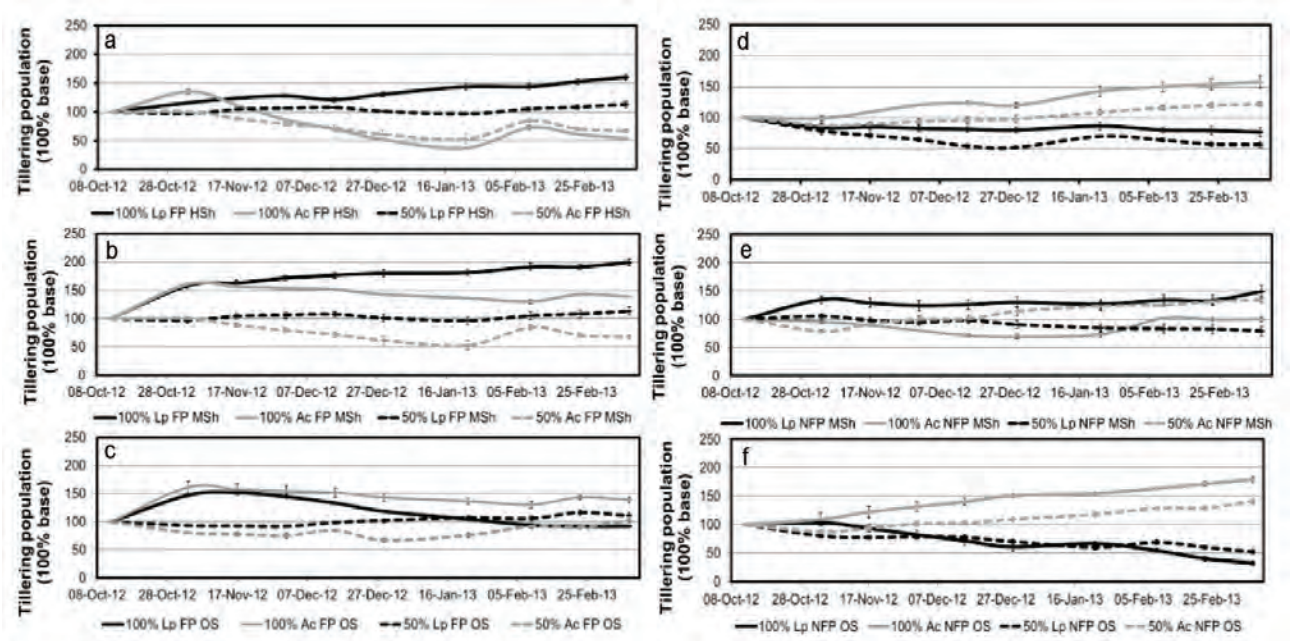

Figure1. Tiller population for *Lolium perenne* L. (Lp) and *Agrostis capillaris* L. (Ac) grown as: fertilized pasture (FP) (a,b,c); non fertilized pasture (NFP) (d,e,f) affected by three levels of shade (HSh: Heavy shade, MSh: Medium shade, OS: Open sunlight). Bars represent ± sem.

Lpm; summer: 89% Lp, 19% Lpm), while Ac and Acm tillering decreased (spring: -24% Ac, -35% Acm; summer: -46% Ac, -22% Acm). In OS, light was not restricted thus the species grew according to their capabilities under normal field environmental constraints.

Species performance during spring differed than that in summer. Summer water drought restricted Lp growth (spring: 44% Lp, -6% Lpm; summer: 0% Lp, 9% Lpm) but not that for Ac (spring: 56% Ac, -20% Acm; summer: 39% Ac, -14% Acm).

Conclusion

Agrostis capillaris L. produced more tillers than Lp when light was diminished under low fertility soil conditions. *Lolium perenne* L. succeeded at competing with Ac when soil fertility was high especially when light levels were restricted.

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