Sward structure effects on light interception in rotationally-grazed orchardgrass (*Dactylis glomerata* L.)

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Introduction

Grazing managers need to know the relationship of sward height and mass to photosynthetic capacity. The aim of this study was to measure the interception of photosynthetically active radiation (PAR) and relate it to sward structure throughout the grazing season on rotationally-grazed orchardgrass/cocksfoot (*Dactylis glomerata* L.) pastures.

Methods

Two sites (farms) with rotationally-grazed, irrigated paddocks were sampled in Idaho in 2006 and 2007. The soils on the sites were sprinkler-irrigated silt loam (coarse-silty, mixed, mesic, Durixerollic Calciorthids) near Kimberly, Idaho, USA. The paddocks were primarily composed of orchardgrass/cocksfoot (*Dactylis glomerata* L.) in mixtures with Kentucky bluegrass (*Poa pratensis* L.), alfalfa (*Medicago sativa)*, and clovers (*Trifolium* spp.). The Bliss site (42°52'N 114°51'W, elevation 1200 m) and Smith site (42°25'N 114°20'W, elevation 1000 m) each comprised a 12-ha paddock, with a stocking rate of 12.5 beef cow/calf pairs/ha for a 7-day grazing period followed by a rest period of 30 to 40 days per rotation.

Sward height (cm), density (visual rating), herbage mass (kg DM/ha), and PAR (μmol/m^2/s) were determined once per week in three replications within three canopy densities during the growing season. Canopy density was visually rated using photo guides of low, medium, and high canopy cover. Only the results for the medium canopy density on both sites are presented in this paper. Herbage was clipped to ground level just above the soil, sorted by species, oven dried, and weighed to develop regression equations to predict herbage mass in orchardgrass-dominant grass-legume mixtures. Sward height was measured with a prediction stick (ruler) at the height below which an estimated 90% of the mass occurred.

Figure 1. Determining photosynthetically active radiation (PAR) intercepted by a medium density *Dactylis glomerata* canopy with a sunfleck PAR ceptometer.

A Sunfleck PAR Ceptometer Model SF-80 (Decagon Devices, Inc. Pullman, WA) was used to measure photosynthetically active radiation (PAR) at the 400-700 nm wavebands. This 88.5-cm probe containing 80 independent sensors, reads the sunlight PAR radiation (Fig. 1). These independent sensors are scanned by a microprocessor to give an average PAR reading in μmol/m^2/s (Decagon).

Discussion

The sward canopy closed in a logarithmic function of height (PAR = 455 ln(height)-187) or mass (PAR = 486 ln(DM)-2788) in irrigated *Dactylis glomerata* in medium-density stands (Fig. 2). With a 12.5 cm canopy, 969 μmol/m^2/s PAR were intercepted and with a 25 cm canopy, 1,284 μmol/m^2/s PAR were intercepted. Doubling the canopy height from 12.5 to 25 cm increased PAR intercepted by 33%. Grazing closer than 12.5 cm drastically reduced PAR interception to about 200 μmol/m^2/s, which means that regrowth energy must come from a higher proportion of stored energy in the crown. Grazing closer than 12.5 cm also removed more herbage mass and thus stored energy. In contrast, above 25 cm of canopy the rate increase of PAR interception per cm of canopy height was low.

Our results compare similarly to Pedreira *et al.* (2000) with studies on bermudagrass (*Cynodon dactylon*) pastures that were grazed to heights between 8 cm (capturing 22% of the radiation) and 24 cm (intercepting 78% of the radiation). The capture of PAR is dependent on the path of the sun beam through the sward, stand density and foliage characteristics (Welles and Norman 1991, Rohrig *et al.* 1999).

Forage dry matter yield had a low correlation with PAR interception in our study (Fig. 2). At 1,000 kg DM/ha the PAR ranged from 200 to 1,100 μmol/m^2/s. This was probably because our data spanned two sites over two growing seasons, measured weekly in rotationally-

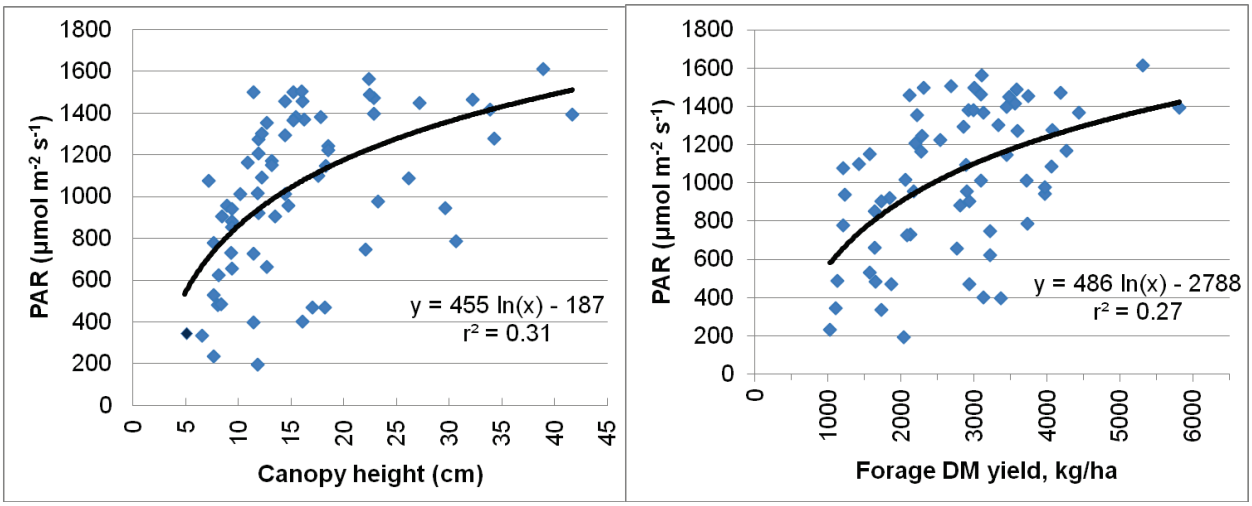

Figure 2. Photosynthetically active radiation (PAR) intercepted by *Dactylis glomerata* canopies as a function of canopy (sward) height and forage dry matter mass in medium canopy densities across 2 growing seasons and 2 sites.

grazed paddocks. Season of year and defoliation are known to affect leaf morphology and production. Another reason may be the patchy or non-uniform spatial distribution of herbage in this bunchgrass species.

Conclusion

The sward canopy closes in a logarithmic function of height or mass in irrigated *Dactylis glomerata* in medium-density stands. This study indicated that doubling the canopy height from 12.5 to 25 cm will increase the PAR intercepted by 33%.

References

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