Estimation of Bermudagrass Forage Intake from Canopy Spectral Absorbance Measurements Using Hyperspectral Radiometry

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Introduction Grazing animals on forage have a lower cost of gain than animals fed in feedlot on mixed rations. However nutrient levels of warm-season forages frequently fall below animal requirements, thereby necessitating protein and/or energy supplementation. Conventional methods of estimation of forage quality are slow and labor intensive processes. Recent work has suggested that it is possible to assess pasture forage quality in real-time, which allows stocker operators the technology to quickly recognize the need for supplementation (Starks et al., 2005). However, uncertainty exists in the determination of actual nutrient deficiencies due to difficulties in estimation of forage intake in grazing animals. Therefore, the objective of this study was to evaluate the potential for the estimation of forage intake in grazing animals utilizing hyperspectral forage canopy light absorbance.

Materials and methods Hyperspectral forage canopy absorbance was estimated on eight plots in each of three 1.2 ha common bermudagrass pastures weekly over a period of 9 weeks from June through early August, 2005 using an SE590 spectroradiometer (Spectron Engineering, Denver, CO, USA) and/or an ASD FieldSpec FR spectroradiometer (Analytical Spectral Devices Inc., Boulder, CO, USA). Forage in each plot was harvested weekly using a sickle mower and weighed amounts were fed to one of 12 individually penned lambs. Dry matter was estimated for both forage fed and forage refused for two 24-hr periods each week and dry matter intakes were calculated for each lamb. Hyperspectral data from the ASD Fieldspec was converted to wavebands corresponding to wavebands from the SE590. Dry matter intakes were expressed as a percent of body weight and corrected for fixed effects and time and subsequently regressed on forage canopy wavelengths (range of 410 nm to 1010 nm) using the stepwise MAXR regression procedure (SAS, 2000). Dry matter intakes as a percent of body weight were also regressed on forage canopy light absorbance using partial least squares procedures (SAS, 2000).

Results The best 10-, 20-, 30-, 40-, 50-, and 60-variable prediction models yield R^2 values of 0.27, 0.49, 0.61, 0.73, 0.81, and 0.92, respectively (all $P < 0.01$). The plot of actual vs. predicted dry matter intake for the best 60-variable model is given in Figure 1. Partial least squares regressions yielded R^2 similar to the 60-variable model.

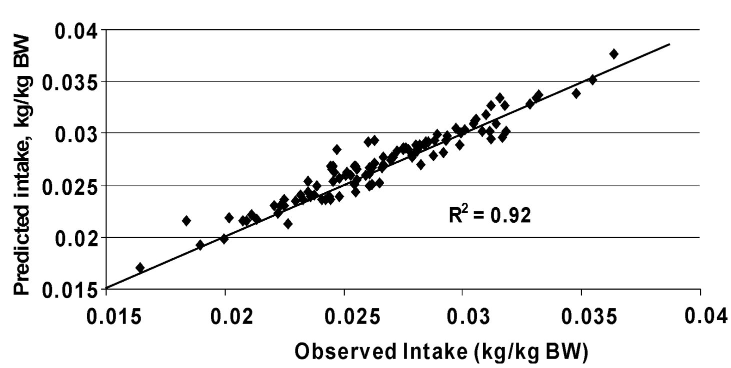

Figure 1 *Plot of observed vs. predicted (60 wavelength model) dry matter intake, kg/kg.*

Conclusions Pasture forage dry matter intake as a percentage of body weight can be predicted using forage canopy absorbance estimates from hyperspectral radiometers. In conjunction with forage quality estimates, it appears possible to precisely estimate nutrient balance of grazing animals and provide precision supplementation to meet production targets.

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