Forage nutritive value changes in a stratified canopy of a mixed cool-season grass sward affected by season

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Introduction

The seasonal pattern of herbage growth rate is an important determinant on forage system productivity. Pasture stocking rates and supplemental feed requirements are influenced by the dynamic balance between forage growth and the amount of herbage available. There is limited information regarding vertical distribution patterns (layers within the sward) in nutritive value in cool-season grasses, especially for vegetative herbage (Burner and Belesky 2004). More complete information could support decisions regarding cutting schedules, residual mass and heights to meet nutritional value targets, and timing of pasture allocation. The objective of this study was to characterize the vertical distribution of nutritive value components within a grass sward and the relationship between days past clipping over time on NDF and NDFD. This information was then used to determine the effect that forage canopy removal will have on the nutritive value of the remained forage.

Methods

Location and measurements

The research was conducted at Columbus, Ohio, from April to October 2009 and 2010 in a mixed cool-season grass sward comprised predominantly of tall fescue (*Festuca arundinacea* Schreb.) (73%) and Kentucky bluegrass (*Poa pratensis*) (15%). Growing periods were initiated in April, May, June, July, and August. On each initiation date, the sward was clipped to a 5-cm stubble height and allowed to grow for the remainder of the growing season. The initiation dates were replicated four times in a randomized complete block design. Samples to characterize morphological composition and nutritive value of the sward canopy were collected from a random 0.1 m^2 area within each experimental unit on a weekly basis, after the designated initiation date commenced. Forage samples were collected from each 10-cm vertical section of the forage present, above the 5-cm stubble height. The vertical strata subsamples were separated into morphological components (green lamina, stem + leaf sheath and dead material). Vertical strata were defined as the top, 2nd, 3rd and 4th 10-cm layer of the sward canopy. NDF and NDFD were determined using α-amylase and Na_2SO_3 (Sigma no A3306, Sigma Chemical Co., St Louis, MO) according to Method 6 of ANKOM (2011).

Statistical analysis

The REG procedure of SAS was used to test regression coefficients for nutritive value variables of individual canopy strata over time. All differences were considered significant if the statistical test resulted in $P \leq 0.05$.

Results and discussion

Regression analysis was used to describe the relationship between neutral detergent fibre (NDF) and neutral detergent fibre digestibility (NDFD) over time within the different forage accumulation periods. There was a good relationship for all canopy strata between NDF concentrations and time (age) for initiation of growth in April, describing a reduction in nutritive value with maturity (Table 1). The relationship of NDF and time became poor for the following growing periods suggesting lower variation

Table 1. Regression coefficient for neutral detergent fibre (NDF) and neutral detergent fibre digestibility (NDFD) of individual canopy strata (10-cm layers within the sward) regressed against time from different dates of growth initiation of a cool season grass sward during the grazing season in two consecutive years (2009 and 2010).

Year	Initiation date	NDF				NDFD			
		Top layer	2nd layer	3rd layer	4th layer	Top layer	2nd layer	3rd layer	4th layer
2009	April	0.08*	0.09*	0.08*	0.03	-0.29*	-0.28*	-0.23*	-0.24*
	May	0.03	0.002	.	.	-0.13*	-0.17*	.	.
	June	-0.03	0.04	.	.	-0.05	-0.15*	.	.
	July	-0.11*	-0.13	.	.	0.09	-0.01	.	.
	August	-0.20*	.	.	.	0.16	.	.	.
2010	April	0.01	0.03	0.05*	0.04	-0.29*	-0.28*	-0.21*	-0.19*
	May	0.01	0.04	0.09	.	-0.21*	-0.18*	-0.21*	.
	June	0.03	0.08*	.	.	-0.10	-0.09*	.	.
	July	-0.03	0.16*	.	.	-0.11	-0.25*	.	.
	August	-0.23*	.	.	.	0.09	.	.	.

* Significant at the 0.05 probability level.

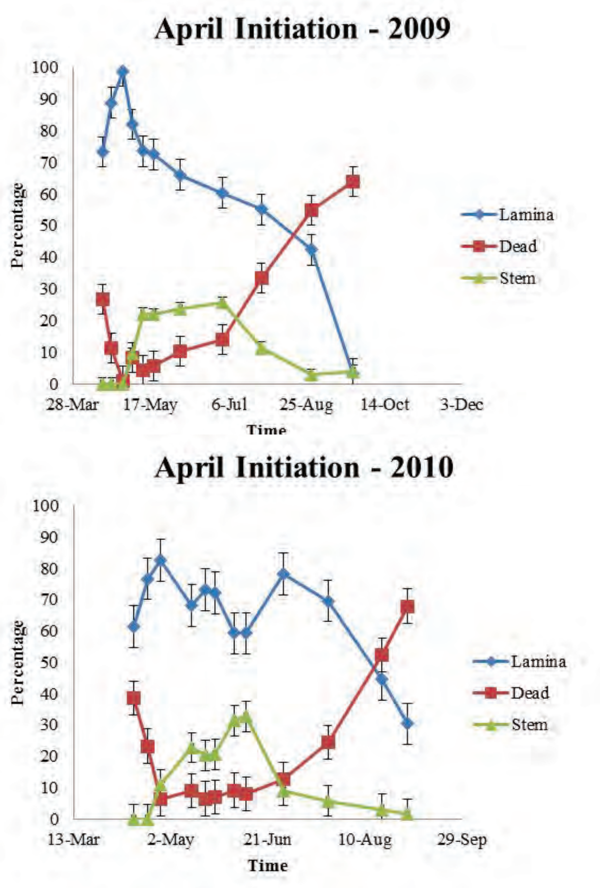

Figure 1. Morphological composition for April Initiation (lamina, dead material and stems) for the whole canopy across the grazing season in 2009 and 2010.

in fibre concentration within the canopies maintained in vegetative stages with consistent leaf percentages (Fig. 1). Changes in NDFD concentrations (April initiation) over time were evident, especially at the beginning of the season. In addition, the bottom of the canopy showed a consistent negative relationship of NDFD over time for most initiation dates (except August 2009) (Table 1). This suggests that the changes occurring at the bottom of the canopy with maturity are more consistent what occurs at the top of the canopy. Those results are in agreement with previous research where the effect of maturity on the vertical distribution of nutritive value was important in spring but not later in the season (Delegarde *et al.* 2000). At the beginning of spring and summer, a more rapid reduction in nutritive value occurs, (higher NDF and lower NDFD) than during the late summer or fall. Early and frequent harvests should occur when changes are occurring more rapidly, to achieve adequate nutritive value requirements (Brink *et al.* 2010).

Conclusion

There was a good relationship between NDFD and time for all initiation periods showing significant regression coefficients. Our results suggest the importance of maintaining the sward canopy at the vegetative stage to optimize forage nutritive value during the growing season. Early in the season, frequent harvestings should be made in order to control the appearance of seedheads that generates an overall lower nutritive. Vegetative pasture will produce forage with a constant leaf percentage throughout the vertical strata.

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