RELATIONSHIPS OF VISUAL AND QUANTITATIVE METHODS OF GRASS SWARD DEVELOPMENT

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ABSTRACT

The objective of this study was to determine the relationship between visual and quantitative estimates of the morphological development of perennial grass swards. Pure stands of intermediate wheatgrass [*Thinopyrum intermedium* (Host) Barkw. & D.R. Dewey] and switchgrass (*Panicum virgatum* L.) were hand-clipped to ground level at 2-wk intervals in 1991 at Mead, NE, morphologically classified as mean stage count (MSC), and visually estimated for sward development. Visual estimations of sward development for both species were representative of quantitative measurements during vegetative growth. However, as sward development advanced to the elongation and heading stages, visual methods over-estimated the population maturity. The morphological development of perennial forage grasses can be visually estimated during vegetative growth. However, more quantitative and less subjective measurements are necessary to compensate for the visual dominance of elongating and reproductive tillers.

KEYWORDS

Grass, morphology, sward, maturity

INTRODUCTION

Intermediate wheatgrass is a perennial, cool-season grass introduced to the Great Plains of the United States for hay and pasture, and has proven to be very productive during the spring and fall grazing season (Asay and Jensen, 1996). Switchgrass is a perennial, warm-season grass native to the central Great Plains of the United States. Switchgrass has become increasingly important as a pasture grass in the central and eastern United States due to its ability to be productive during the hot summer months when cool-season grasses are relatively unproductive (Moser and Vogel, 1995).

The need for identifying the maturity of forage crops has long been recognized (Phillips *et al.*, 1954). Historically, maturity in perennial grass swards was visually estimated by identifying the most advanced tillers in the population. More recently, numerical systems have been used to quantify the developmental morphology of forage species. The system developed by Kalu and Fick (1981) has been widely adopted for quantifying the developmental morphology of alfalfa (*Medicago sativa* L.). The system developed by Moore et al. (1991) has been used to quantify the developmental morphology of perennial grasses such as prairie sandreed [*Calamovilfa longifolia* Hook.)], sand bluestem [*Andropogon gerardii* var *paucipilis* (Nash) Fern.] (Hendrickson, 1992), switchgrass, and big bluestem (*Andropogon gerardii* Vitman) (Mitchell, 1995). However, no single system has been widely adopted for quantifying the developmental morphology of perennial grasses. The objective of this study was to determine the relationship between visual estimates based on the most mature tillers in the sward and quantitative estimates of developmental morphology of perennial grass swards using the system described by Moore *et al*. (1991).

METHODS

Pure stands of ‘Slate’ intermediate wheatgrass and 'Trailblazer' switchgrass were seeded in 1986 as a randomized complete block with six replications on a Sharpsburg silty clay loam soil (Typic Argiudoll) near Mead, NE. Intermediate wheatgrass and switchgrass were harvested at approximately 7-d intervals in 1991, with intermediate wheatgrass sampling beginning 24 April and concluding 9 July, and switchgrass sampling beginning 22 May and concluding 3 September. Tillers were hand-clipped at ground level from two randomly located 0.09-m^2 quadrats and morphologically classified as mean stage count using the system described by Moore *et al.* (1991) to quantify the developmental morphology of the tiller populations. The morphological development was visually estimated by evaluating the tiller demographics of each species in six commonly used general categories (vegetative, early and late elongation, boot, and early and late heading). In the Moore *et al*. (1991) system, the MSC would range from 1.0 to 1.9 for a vegetative sward, 2.0 to 2.9 for an elongating sward, 3.0 for a sward in the boot stage, and greater than 3.1 for a sward in the heading stage. The actual MSC was then compared to the visual estimate, and the percentage of tillers in the sward actually represented by each visual stage determined.

RESULTS AND DISCUSSION

The vegetative stage for intermediate wheatgrass based on visual estimation occurred up to Day 134, whereas the vegetative stage for switchgrass ceased on Day 142. The MSC for intermediate wheatgrass and switchgrass was identical during the vegetative stage, and at least 95% of the tillers in both swards were vegetative (Table 1). This indicates that during the vegetative growth stages of perennial grasses, visual estimations of maturity may be adequate for making general recommendations.

The elongation stage based on visual estimation for intermediate wheatgrass was very brief, lasting only 2-wk before advancing to the boot stage. However, the elongation stage for switchgrass lasted for 4-wk before advancing to the boot stage. During early elongation, the MSC for intermediate wheatgrass and switchgrass approached 2.0, but both swards would still be classified as vegetative based on the Moore et al. (1991) system (Table 1). By the late elongation stage, the MSC for both species reached 2.0, indicating the mean growth stage for tillers in the population was elongated.

The boot stage for intermediate wheatgrass occurred on Day 156, 20 d prior to the boot stage for switchgrass. The MSC was 2.3 for both species with fewer than 9% of the tillers present reaching the boot stage (Table 1). Visual estimations of the boot stage severely underestimated the MSC of the swards, and are not reliable due to the visual dominance of tillers in the boot stage.

Intermediate wheatgrass entered the early heading stage on Day 162, and progressed rapidly to the late heading stage in 7 d. The MSC for intermediate wheatgrass indicated that the sward was still in the mid-elongation stage during both early and late head visual estimations (Table 1). Switchgrass entered the early heading stage on Day 183, and advanced to the late heading stage by Day 205. The MSC for switchgrass indicated that the sward was in the mid-elongation stage during visual estimation of early heading, but had progressed to the boot stage by the visual estimation of late heading (Table 1).

Visual estimations of sward development for both species were representative of quantitative measurements during vegetative growth. However, as sward development advanced to the elongation and heading stages, visual methods over-estimated the population maturity. The morphological development of perennial forage grasses can be visually estimated during vegetative growth, but more quantitative and less subjective measurements are necessary to compensate for the visual dominance of elongating and reproductive tillers. We suggest the adoption of the Moore et al. (1991) system for quantifying the developmental morphology of perennial grass swards due to its ease of use and reliable results under research and field conditions.

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Table 1
Visual stage estimation, actual morphological index expressed as mean stage count (MSC), and actual percent of tillers present in the visual stage for intermediate wheatgrass and switchgrass grown near Mead, NE in 1991

Visual Stage	Morphological Index (MSC)	Actual % Present in Visual Stage
	Intermediate wheatgrass	
Vegetative	1.5	At least 95%
Elongation		
Early	1.9	61%
Late	2.0	69%
Boot	2.3	5%
Heading		
Early	2.4	9%
Late[1]	2.6	19%
	Switchgrass	
Vegetative	1.5	At least 98%
Elongation		
Early	1.7	36%
Late	2.2	96%
Boot	2.3	9%
Heading		
Early	2.7	41%
Late	3.0	60%

[1]Late heading was determined when the maximum percentage of tillers in the population advanced to the reproductive and seed ripening stages.