



Original Research

Horse Preference, Forage Yield, and Species Persistence of 12 Perennial Cool-Season Grass Mixtures Under Horse Grazing



Krishona L. Martinson^{a,*}, M. Scott Wells^b, Craig C. Sheaffer^b

^a Department of Animal Science, University of Minnesota, St. Paul, MN

^b Department of Agronomy and Plant Genetics, University of Minnesota, St. Paul, MN

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ABSTRACT

Cool-season grass mixtures are rarely evaluated for preference, yield, and persistence under horse grazing. The objectives of this research were to evaluate horse preference, forage yield, and persistence of cool-season grass mixtures under horse grazing. Eight commercially marketed and four experimental perennial cool-season grass mixtures were planted in 2009 in a randomized complete block with five replicates and grazed by four adult horses during 2010, 2011, and 2012. All mixtures contained four to six cool-season perennial grass species. Species density measurements were taken in each spring and fall, and yield was mechanically measured before each grazing period. After grazing, preference was determined by visually assessing percentage of forage removal on a scale of 0 (no grazing) to 100 (100% of vegetation removed). Data were analyzed using a mixed-model analysis of variance and linear regression. Horses preferred mixtures containing tall fescue, perennial ryegrass, Kentucky bluegrass, and timothy ($P < .001$). Horses had less preference for mixtures containing $\geq 30\%$ orchardgrass ($P < .001$). Mixtures had similar ($P = .11$) forage yields that ranged from 6,100 to 7,082 kg ha⁻¹. After 2 years of grazing, orchardgrass and tall fescue increased; Kentucky bluegrass remained stable; and festulolium, meadow fescue, and perennial ryegrass had the greatest rate of decline in mixtures. Orchardgrass became the dominant species, regardless of initial percentage in the mixture. Mixtures containing tall fescue, perennial ryegrass, Kentucky bluegrass, and timothy should be planted in midwestern US horse pastures; however, mixtures will likely transition to tall fescue and Kentucky bluegrass-dominated pastures.

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1. Introduction

Horses (*Equus caballus* L.) are known to be selective grazers and can graze forage species to a shorter height compared with other livestock, which may limit the productivity and survival of some pasture species [1–3]. Differences in preference, defined as the behavioral

response of an animal to plants when a choice is given, affect not only uniform utilization of forage species, but forage persistence if preferred species are repeatedly grazed [4]. In Minnesota and England, Allen et al [3] and Archer [2], respectively, determined that horses preferred Kentucky bluegrass (*Poa pratensis* L.), timothy (*Phleum pratense* L.), and meadow fescue (*Schedonorus pratensis* Huds.), whereas meadow foxtail (*Alopecurus pratensis* L.), meadow bromegrass (*Bromus inermis* Leyss), creeping foxtail (*Alopecurus arundinaceus* Poir), orchardgrass (*Dactylis glomerata* L.), and reed canarygrass (*Phalaris arundinacea* L.) were less preferred when planted in

* Corresponding author at: Krishona L. Martinson, Department of Animal Science, University of Minnesota, 1364 Eckles Ave, St. Paul, MN 55108.

E-mail address: krishona@umn.edu (K.L. Martinson).

monocultures. There is no research investigating horse preference of cool-season grass mixtures.

In the midwest and eastern United States, cool-season grasses are the foundation of productive pastures. Cool-season grass yield potential is variable and dependent on the environment, soil type and fertility, and harvest and grazing management. When planted in monocultures and rotationally grazed, orchardgrass produced the greatest yield, whereas creeping foxtail, smooth brome grass, and timothy produced the lowest yield [5]. In an irrigated, mechanically harvested system, tall fescue (*Schedonorus phoenix* Scop), meadow brome grass (*Bromus biebersteinii* Roem. & Schult), and orchardgrass had greater yields compared with smooth brome grass and perennial ryegrass (*Lolium perenne* L.) when planted in monocultures [6]. However, perennial pastures are rarely planted as monocultures. Pastures planted with forage mixtures tend to produce greater yields [7–10], are better adapted to marginal environments [11], provide insurance against complete stand loss due to winter injury [12], suppress weeds [9], and have positive effects on forage nutritive value [13]. Although cool-season grasses are commonly evaluated for yield in combination with legumes and other forage herbs [9,10,14], they are rarely evaluated for yield in grass-only mixtures.

Along with yield, forage persistence is a major component of pasture productivity. Cool-season grasses vary in persistence under livestock grazing. When planted in monocultures, orchardgrass, tall fescue, and meadow brome grass [5,15,16] withstand grazing better than timothy, festulolium, reed canarygrass, smooth brome grass, and creeping foxtail [5,15,17]. When planted in mixtures with legumes, similar trends in grass persistence were observed. The most persistent species after multiple seasons of grazing by cattle (*Bos taurus* L.) were orchardgrass and tall fescue, regardless of the initial botanical composition of the mixture [9,10]. In grass-only mixtures containing orchardgrass, tall fescue, and reed canarygrass, tall fescue was least persistent, whereas reed canarygrass dominated the mixture after multiple harvests [7]. There is no research investigating the persistence of cool-season grass mixtures under horse grazing. Therefore, the objectives of this research were to evaluate horse preference, yield, and species persistence of cool-season grass mixtures under horse grazing.

2. Materials and Methods

2.1. Establishment of Cool-Season Grass Mixtures

Research was conducted in St. Paul, Minnesota, in 2010, 2011, and 2012. A seedbed was prepared in 2009 from an existing, unimproved pasture dominated by Kentucky bluegrass and quackgrass that was killed with multiple herbicide applications followed by multiple disking and field cultivation passes during the summer of 2009. Eight commercially marketed and four experimental perennial cool-season grass pasture mixtures were broadcast seeded on August 19, 2009, at a rate of 16.75 kg ha⁻¹. Commercial cool-season grass mixtures marketed for the horse industry in the upper midwest included Agassiz CHS #4 and Agassiz

MN-G (Agassiz Seed and Supply, West Fargo, ND), CR heavy and CR light (Farmers Mill and Elevator, Castle Rock, MN), Dan Patch (Albert Lea Seed, Albert Lea, MN), LaCrosse BLM #4 (La Crosse Seed, La Crosse, WI), Marties (Marties Farm Service, Inc, Monticello, MN), and Waconia mix (UFC Farm Supply, Waconia, MN; Table 1). Experimental cool-season grass mixtures were formulated to maximize horse preference and forage yield based on results presented by Allen et al (2012; 2013; Table 1). All mixtures contained four to six of the following species: annual ryegrass (*Lolium multiflorum* L.), crested wheatgrass (*Agropyron cristatum* L.), festulolium, Kentucky bluegrass, meadow brome grass, meadow fescue, orchardgrass, perennial ryegrass, reed canarygrass, smooth brome grass, tall fescue, or timothy. The experimental design was a randomized complete block with five replicates. Each replicate contained the 12 cool-season grass mixtures in 1.8 × 6.0 m plots. Mixtures were fertilized with 56 kg N ha⁻¹ in early April and in mid-June of each year. A spring application of a selective broadleaf herbicide controlled broadleaf weeds each year. Any remaining broadleaf weeds were removed by hand pulling.

2.2. Grazing Management

All experimental procedures were conducted according to those approved by the University of Minnesota Institutional Animal Care and Use Committee. Grazing occurred on April 29, May 13, June 9, July 14, August 13, September 9, and October 7, 2010; on May 12, June 11, July 8 and 25, August 12 and September 9, 2011; and on April 27, May 16, June 5, July 13, August 28, and September 25, 2012. On those dates, most grasses averaged 20 cm, except Kentucky bluegrass which averaged 10 cm. Four adult stock-type horses averaging 538-kg bodyweight (BW) in 2010, 477-kg BW in 2011, and 406-kg BW in 2012 were rotationally grazed for 5 consecutive days, averaging 4 hours of grazing each day. Because of availability of research horses, the same four horses were not used each year. The grazing length was selected based on estimated available herbage biomass, estimated horse intake [18], and to achieve a minimum average residual height of 9 cm to avoid overgrazing. While grazing, horses were given ad libitum access to water. After grazing, manure was removed, and plots were mowed to 9 cm and allowed to regrow. When not grazing, horses were given ad libitum access to water, housed in a dry lot, and fed grass-alfalfa (*Medicago sativa* L.) mixed hay.

2.3. Horse Preference

After researchers observed differences in horse preference among the grass mixtures during 2010, preference was visually assessed in 2011 and 2012. Horse preference of the mixtures was determined by visually assessing percentage removal of available forage height and biomass [3,19] from all five replicates in May, July, and September of each year to represent the spring, summer, and fall seasons, respectively. Immediately after day 5 of grazing, plots were visually assessed for percentage of available forage removal on a scale of 0 (no grazing activity) to 100 (100% of the existing vegetation grazed down to 9 cm).

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