Tall Fescue and Orchardgrass Productivity and Persistence Under Grazing Systems in Tennessee

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Abstract
The primary forage species used by cow-calf producers in grazing systems in Tennessee is tall-fescue. Tall fescue is considered an excellent cool-season perennial forage crop due to its high quality, production, and extended growing season. However, most of these tall fescue grazing systems are composed of tall fescue cv. Kentucky 31, which is known for containing a fungus endophyte that can be toxic to animals. Alternatively, orchardgrass is also a vastly used and important perennial cool-season forage in the United States. It can be used as a pasture, hay, and is a high-quality forage that is desirable for most livestock producers, especially dairy, beef and equine industries. The goal of this project was to compare four different cool-season forage species under grazing pressure while increasing productivity and persistence of the paddocks. The project assessed herbage mass, botanical composition, morphological composition, along with persistence of four different cool season grasses. While no statistical difference was seen among treatments within a single year for herbage mass, year did influence herbage mass. Additionally, botanical composition was noted as being significant on the year by treatment interaction.

Introduction
Orchardgrass (*Dactylis glomerata* L.), which is a cool-season perennial grass, is vastly popular across the country due to its high nutritional value and its high hay and pasture productivity. Historically, orchardgrass has been a persistent cool-season grass that could be harvested multiple times a year, while still maintaining a stand life that would meet or exceed 10 years without any interference or renovation needed. However, recently the persistence of orchardgrass has become a concern, which led to the development of grazing tolerant orchardgrass varieties. Some of the older orchardgrass swards have recently shown signs of persistence challenges, requiring intervention and renovation (Jones & Gordan, 2015). Although the exact reason affecting orchardgrass persistence is unknown, it can be attributed to several different factors. The reasons may include but are not limited to species adaptations to meet current environmental standards, soil fertility conditions, and harvest/management strategies (Jones & Gordan, 2015). The persistence of cool season grasses also varies under different levels of grazing pressure. For a cool-season perennial grass to be considered economically viable, it must maintain an acceptable level of herbage mass and persistence. As a result, the University of Tennessee has developed a new cultivar of orchardgrass known as Persist I, which maintains higher productivity and persistence to previous cultivars. Persist I was developed by the Tennessee Agricultural Experiment Station and released on 15 Dec. 2000 (Conger, 2003). Persist I is a six-clone synthetic that stems from a collection dated from 1959 to 1961 of which all stands were six or more years old harvested throughout Tennessee (Fribourg & Burns, 1966). Concluding the development of Persist production trials followed in numerous locations including Highland Rim Experiment Station, Knoxville TN, Lexington KY, Princeton KY, as well as Tangent OR. At all locations the forage yield met or exceeded the mean production of other cultivars, while in extended studies Persist showed significantly higher forage yield indicating greater stand life and persistence (Conger, 2003). Grazing trials done at the Ames plantation by Waller show Persist to produce more forage with and without clover than its competitor Benchmark (Conger, 2003). However, persistence was the distinguishing factor after four years of grazing with moderate drought and grazing pressure, the last two years Persist had a seventy to eighty percent stand, while Benchmark only had zero to ten percent of the stand remaining after four years (Conger, 2003). A complete account of Persist

breeding and formation can be found in Conger (2003). Although Persist I has not shown identifiable production or persistence issues within literature, developers moved to create another cultivar that was even more grazing tolerant and persistent. Plots were synthesized from existing Persist I seed stock; once fully established the small plots were grazed intensely with sheep, while the plants that exhibited the highest production and persistence after intense grazing were selected to breed the new cultivar of Persist, known as Persist II. Following the development of Persist I, Smith Seed Services is working to bring Persist II to market.

Methods

The research was conducted at the University of Tennessee, Middle Tennessee AgResearch and Education Center in Spring Hill, TN, from June through August of two consecutive years (2021-2022). The experimental area consisted of 12 paddocks, approximately 1.2 ha in size. Each paddock represented one experimental unit within a completely randomized design and three replications. The treatments consisted of 1) orchardgrass cv. Persist I, 2) orchardgrass cv. Persist II, 3) tall fescue cv. Kentucky 31, 4) novel endophyte tall fescue cv. Max Q. After the conclusion of the establishment period, paddocks were subjected to grazing pressure by stocker cattle. During the time of the study June – August, 3 tester steers were randomly assigned to each paddock and remained there until the stop trigger was meant. Cattle were to be pulled if the herbage mass of a paddock dropped below 1000 (kg ha -1). In addition, grazer steers were added based on forage availability to control excess forage accumulation, while the total number of cattle per paddock did not exceed 5. In doing so, a stubble height of 5-10 cm was maintained. After establishment, monthly measurements were taken to monitor herbage mass, morphological and botanical composition of the paddocks. Total above ground dry matter forage was measured once monthly at the time of sampling in each of the 12 paddocks starting in June and continuing consecutively every 28 days through the end of August with a calibrated rising plate meter (RPM). The RPM used consisted of a 0.1-m^2 ascending disk, and the measurement was made by a mechanical counter that partially compresses the sward in, 5-mm increments (Ferraro et al., 2012). During each of the monthly samplings, 100 points were measured at random across each of the 12 paddocks. To calibrate the RPM, 10 randomly placed 0.1-m^2 sample areas were measured with the RPM. Once recording the individual MRPM, forage within the 0.1-m^2 quadrat was hand clipped to ground level. Immediately following collection of all 120 samples, morphological separation took place, then samples were dried at 60° C to constant weight. The calibration was formed through a regression equation used to convert MRPM to total above ground dry weight. To ensure accuracy of forage mass estimates gained through MRPM, 10 calibrations per paddock per month were performed, equating to 60 calibrations per paddock for a given six-month sampling period. Significant variation across time in the slope coefficients of forage mass regressed on RPM suggest these should be made frequently enough to define the trend line for RPM slope coefficients (Ferraro et al., 2012). Then 10 forage samples collected for RPM calibration randomly within each paddock were also used to determine botanical composition, morphological composition. Samples were separated into five categories as follows: grass leaves, grass stems, grass dead matter, clovers, and weeds (broadleaf or grassy). Any grass other than orchardgrass or tall fescue were classified as weeds. After separations, samples were then dried at 60° C to constant weight. Once dried, samples were weighed to estimate the average percentage of each botanical and morphological component.

Results and Discussion

Results from the trial can be viewed in Tables 1 and 2 respectively below. While herbage mass was not shown to be statistically different within the year, Kentucky 31 had a higher monthly herbage mass then the three other cultivars. In 2022, Persist II ranked with the highest average herbage mass. With that said the variable year was shown to be a statistically significant factor in the study ($P=0.03$). In addition, botanical composition also showed significance in terms of the treatment year interaction as shown in

table 2 below. Specifically, more white clover was show in the second year of the Persist II paddocks (P=0.01) No other significant difference was seen in botanical composition amount treatment or year.

Table 1. Average monthly herbage mass (kg ha-1) among treatment and year		
Treatment	Year	
	2021	2022
1) Persist I	1922aA	2385bA
2) Persist II	2013aA	2837bA
3) Kentucky 31	2492aA	2651bA
4) Max Q	2101aA	2345bA
Lowercase letters compare treatment over both years; and Uppercase compare treatments within a year		

Table 2. Clovers proportion interaction among treatment and year			
Treatment	Year		SEM
	2021	2022	
1) Persist I	0.3aA	0.1bA	0.475
2) Persist II	0.1aB	2.3aA	0.475
3) Kentucky 31	0.6aA	0.4bA	0.475
4) Max Q	0.3aA	0.3bA	0.475
SEM	0.475	0.475	
Lowercase letters compare treatment over both years; and Uppercase compare treatments within a year			

Conclusions and/or Implications

Establishment and testing of four cool season grass stands in the mid-south region which has shown that Persist orchardgrass is comparable in terms of herbage mass production to that of Kentucky 31 tall fescue throughout the months of June, July, and August. Additionally, these stands maintained similar stand integrity and botanical composition. This study shows that Persist orchardgrass is a viable alternative to Kentucky 31 tall fescue in the mid-south region. However, further testing, data collection, and analysis needs to be pursued to determine the persistence characteristics of these four cultivars before recommendations can be made.

References

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