EFFECTS OF SEASON OF BURN ON NATIVE FORAGE QUALITY: IMPLICATIONS FOR CATTLE AND WHITE-TAILED DEER MANAGEMENT

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EFFECTS OF SEASON OF BURN ON NATIVE FORAGE QUALITY: IMPLICATIONS FOR CATTLE AND WHITE-TAILED DEER MANAGEMENT

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Abstract: Previous research has examined the benefits of fire and its ability to alter the nutrient quality of forages. Fire increases forage quality, but is largely based upon composite forage samples or on fire removing older, lower quality forage encouraging regrowth that is more palatable and higher in quality. Few studies have evaluated the effect of fire on individual plant species and their changes in nutrient quality following season of burn and how that contributes to meeting animal nutrient requirements. In this study I evaluated the changes in nutrient composition (i.e., protein and total digestible nutrients (TDN)) of (*Ambrosia spp.*), croton (*Croton spp.*), slender lespedeza (*Lespedeza virginica (L.) Britton*), buckbrush (*Symphoricarpos orbiculatus Moench*), greenbriar (*Smilax spp.),* little bluestem (*Schizachyrium scoparium var. scoparium (Michx.) Nash*) and Scribner's panicum (*Dichanthelium oligosanthes var. scribnerianum (Nash) Gould*) (ITIS. 2020) following dormant (April 2019) and growing (July 2019) season prescribed fire within a patch burn grazing system to aid in management decisions for cattle and white-tailed deer. I hypothesized that burning in multiple seasons (i.e., dormant and growing season) will increase and extend forage quality over some period of time, creating higher quality forage for cattle and white-tailed deer across a longer portion of the year. In this study, dormant and growing season prescribed fire did improve forage quality (i.e. crude protein, TDN) of the 7 studied plant species helping to meet the animal nutrient requirements. There was not any evidence to suggest that the incorporation of both dormant and growing season burns will extend the amount of time forage quality will meet animal needs with the exception of little bluestem (*Schizachyrium scoparium)*. Findings from this study will aid in the management and understanding of how different season of burns affect nutrient quality of commonly utilized forages of both cattle and deer. These results indicate that careful considerations need to be made when determining when, if, and how to implement burns; because each season of burn has its pros and cons when managing for cattle and white-tailed deer simultaneously.

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CHAPTER I

EFFECTS OF SEASON OF BURN ON NATIVE FORAGE QUALITY: IMPLICATIONS FOR CATTLE AND WHITE-TAILED DEER MANAGEMENT

ABSTRACT

Previous research has examined the benefits of fire and its ability to alter the nutrient quality of forages. Fire increases forage quality, but is largely based upon composite forage samples or on fire removing older, lower quality forage encouraging regrowth that is more palatable and higher in quality. Few studies have evaluated the effect of fire on individual plant species and their changes in nutrient quality following season of burn and how that contributes to meeting animal nutrient requirements. In this study I evaluated the changes in nutrient composition (i.e., protein and total digestible nutrients (TDN)) of (*Ambrosia spp.*), croton (*Croton spp.*), slender lespedeza (*Lespedeza virginica (L.) Britton*), buckbrush (*Symphoricarpos orbiculatus Moench*), greenbriar (*Smilax spp.),* little bluestem (*Schizachyrium scoparium var. scoparium (Michx.) Nash*) and Scribner's panicum (*Dichanthelium oligosanthes var. scribnerianum (Nash) Gould*) (ITIS. 2020) following dormant (April 2019) and growing (July 2019) season prescribed fire within a patch burn grazing system to aid in management decisions for cattle and white-tailed

deer. I hypothesized that burning in multiple seasons (i.e., dormant and growing season) will increase and extend forage quality over some period of time, creating higher quality forage for cattle and white-tailed deer across a longer portion of the year. In this study, dormant and growing season prescribed fire did improve forage quality (i.e. crude protein, TDN) of the 7 studied plant species helping to meet the animal nutrient requirements. There was not any evidence to suggest that the incorporation of both dormant and growing season burns will extend the amount of time forage quality will meet animal needs with the exception of little bluestem (*Schizachyrium scoparium)*. Findings from this study will aid in the management and understanding of how different season of burns affect nutrient quality of commonly utilized forages of both cattle and deer. These results indicate that careful considerations need to be made when determining when, if, and how to implement burns; because each season of burn has its pros and cons when managing for cattle and white-tailed deer simultaneously.

INTRODUCTION

Fire, grazing, and periodic drought have shaped and maintained grasslands for centuries (Anderson 2006). The historic fire return interval of approximately 2 to 7 years in the tallgrass prairie and the variable distribution of fire across the landscape maintained grasslands by preventing woody plant encroachment and increasing the production of perennial grasses (Clark et al. 2007, Scasta 2014). Lightning caused fires naturally during the summer whereas indigenous groups ignited fires intentionally to maintain native food plants, increase crop production, and to manage game species (Ellsworth and Kauffman 2017). Managers recognize

fire as a tool to manipulate the environment for their benefit, which has renewed fires occurrence and its impact as an ecological process (Bowman et al. 2011).

Prescribed fire is a tool used to manage native rangelands by controlling brush and invasive species, and improving the nutrient quality of forages for livestock and wildlife (Soper et al. 1993a). Nutrient quality of forages can often be altered using prescribed fire (Rasmussen et al. 1983). For example, crude protein of forages in recently burned areas can be two to three times greater compared to unburned sites because fire removes older lower quality forage and encourages regrowth that is higher forage quality (Allred 2011).

Fire is beneficial for creating heterogeneity of plant communities across the landscape (Fuhlendorf et al. 2006) and is an essential tool for restoring and maintaining ecological processes (McGranahan et al. 2018). Fire creates varied disturbance that is crucial for rangeland conservation, creating patchy vegetation that expands niche availability, improving species composition, and increasing aboveground biomass production (McGranahan et al. 2018). These characteristics create functioning ecosystems and habitat for a diversity of wildlife species endemic to grasslands.

One method used when conducting prescribed fire is patch burning - the practice where some areas of a landscape are burned while others are deferred to the following season or year. Patch burning allows for more flexibility in management rather than a single large fire that burns an entire area (Allred et al. 2011). When whole landscapes are burned little cover remains for wildlife to utilize, especially for less mobile species. Patch burning tends to be more beneficial for wildlife due to the diversity and heterogeneity of cover and habitat, and regenerative plant growth of greater quality (Lashley and Harper 2012, Hensley 2010). Patch burning is theorized to mimic the historical pattern of fire caused by lightning or set by indigenous people, which

affected subsequent grazing by bison (*Bison bison)*, further influencing the plant community and its phenology across the landscape (Fuhlendorf et al. 2008). Patch burning allows a manager to manipulate the landscape to focus grazing on a portion of the land while resting other portions, creating physiognomy of the plant community (Allred et al. 2011). Recently burned areas are preferred by livestock and wildlife compared to unburned areas. For instance, cattle and bison devoted approximately 75% of their grazing time in the most recently burned areas (Fuhlendorf and Engle 2004, Vermeire et al. 2004).

Season or month of burn is another consideration when conducting prescribed fire, since burning at different times of the year will affect plant species, biomass, and quality differently (Dickson et al. 2019). The two most common seasons considered for burning are dormant season and growing season. In the central Great Plains, dormant season burns typically are conducted from November to April and growing season burns from May to October. Dormant season fires travel at quicker rates, burning most of the vegetation. On the other hand, growing season fires burn more slowly without consuming all of the vegetation (Decker & Harmon 2019). Burning during the growing season can be more effective at controlling brush and undesirable forb species (Brockway et al. 2002) and for reinvigorating vegetation (Raynor et al. 2016). Conducting burns during different seasons allows managers to burn throughout the year, which could help to prolong plant nutrient quality, control grazing distribution, suppresses brush, and create habitat for diversity of wildlife species.

Dormant season burns in early spring promote C_4 (warm season) forage due to the short term change of environmental conditions created by burning enhancing desired grasses and the forage quality for livestock (Engle and Bidwell 2001, Fuhlendorf and Engle 2004, Vermeire and Russell 2018). Growing season and dormant season burns have similar effects when assessing

forage quality, but growing season burns have been shown to be more effective at killing and suppressing woody species while increasing the abundance of grasses and other herbaceous species (Cronan et al. 2015).

Forage quality is an important consideration when trying to match available forage with animal nutrient requirements, a function of quality and quantity of native forages changing throughout the year (Campbell 1989). Quality varies with soil type, ecological site, plant community, and season. During the early growing season forage has a higher quality making it optimal for livestock and wildlife species (George et al. 2001a). As the forage matures it becomes less palatable and lower in quality, quality while is increased when older, less palatable tissue is removed promoting regrowth (Raynor et al. 2016). Fire has been used for its capability to improve forage quality and quantity and the improvement of forage quality has been shown to improve livestock gains in a variety of environments (Farney et al. 2017). The use of prescribed fire can give managers or producers the ability to extend the availability of higher quality forage throughout the year depending on timing of the fire (Engle and Bidwell 2001).

Two of the primary nutrients of concern for animals on rangeland are protein and total digestible nutrients (TDN) (i.e., energy). These nutrients are sufficiently available to meet livestock and wildlife nutrient requirements for a short period of time when the forage is young and palatable, but they diminish over time as the plant matures (George et al. 2001b). Given deficiencies in protein and energy that occur during certain periods of the year, animals on range and pasture are commonly supplemented to meet nutritional requirements. Protein and energy are significant because they are required for animal maintenance, performance, and health; including reproduction, lactation, growth, resistance to infections, and prevention of metabolic syndromes (Guoyao 2014, National Research Council 1996). The goal of this study was to assess

the effect of dormant and growing season prescribed fire on nutrient composition of commonly utilized tallgrass prairie forage and browse species for domestic livestock (i.e., cattle *(Bos taurus)*) and native wildlife (i.e., white-tailed deer *(Odocoileus virginianus)*) . I hypothesize that by burning in multiple seasons (i.e., growing and dormant season) forage quality will increase and be extended over some period of time, creating higher quality forage for cattle and white-tailed deer across a longer portion of the year. The objective of this research was to monitor the changes in nutrient composition (i.e., protein and TDN) of 3 forb, 2 browse, and 2 grass species, following dormant and growing season prescribed fire within a patch burn grazing system to aid in management decisions for cattle and white-tailed deer.

Species Descriptions:

The 7 plant species selected were ragweed (*Ambrosia spp.*), croton (*Croton spp.*), slender lespedeza (*Lespedeza virginica (L.) Britton*), buckbrush (*Symphoricarpos orbiculatus Moench*), greenbriar (*Smilax spp.),* little bluestem (*Schizachyrium scoparium var. scoparium (Michx.) Nash*) and Scribner's panicum (*Dichanthelium oligosanthes var. scribnerianum (Nash) Gould*) (ITIS. 2020). These species were chosen due to the common utilization they receive from white-tailed deer and or cattle (Gee et al 1994, Tyrl et al. 2008).

During this study western ragweed (*Ambrosia psilostachya DC.)* and common ragweed *(Ambrosia artemisiifolia L.)* were sampled as *Ambrosia spp.* Sampling was conducted this way to avoid sampling bias due to the difficulty of consistently differentiating the two species from one another, especially during early growth stages. Western ragweed is a perennial forb that reproduces both sexually and asexually (Matocha et al. 2013). It grows in many different soil types and is characteristic of mid to late plant successional communities, flowering from late

July to October and is readily recognized by its gray-green leaves that are sessile. Common ragweed is an annual forb that is morphologically similar to western ragweed, but can be distinguished by its petiolate leaves and the lack of a woody root system (Tyrl et al. 2008). Ragweed can be variable with plants differing in inflorescence form, leaf shape, and size, ranging from 5 to 70 cm tall (Mitich 1996). Ragweed species are one of the most important food sources for wild turkey *(Meleagris gallopavo)*, bobwhite quail *(Colinus virginianus)*, and many songbirds due to the abundance of achenes they produce. The stems and leaves are also utilized by livestock, pronghorn antelope *(Antilocapra americana)*, cottontail rabbits *(Sylvilagus floridanus)*, and white-tailed deer. They are most heavily utilized during the spring and summer months when the plants are most palatable (Tyrl et al. 2008).

Texas croton *(Croton texensis (Klotzsch) Mull. Arg),* tropic croton (*Croton glandulosus L.),* and woolly croton *(Croton capitatus Michx)* were sampled as *Croton spp.* These 3 species were sampled this way due to the difficulty of consistently differentiating them from one another, especially early during their growth stages. These species are annual forbs that generally occur in sandy and sandy loam soils in open uplands and bottomlands. Flowering occurs from June through October and they increase in abundance following disturbance or overgrazing (Tyrl et al. 2008). Crotons are one of the most widespread genera of the family Euphorbiaceae (Van et al. 2009). Crotons produce large seeds that are used by small mammals, mourning dove (*Zenaida macroura)*, bobwhite quail, greater prairie chickens (*Tympanuchus cupido)*, wild turkey, and many other bird species. White-tailed deer and livestock also utilize croton during the summer months when the plants are most palatable (Gee et al. 1994).

Slender lespedeza (*Lespedeza virginica L.)* is a perennial legume that is recognized by its long, leaning stems with numerous spreading branches. It occurs in a variety of rocky or dry soils

in prairies. It can also be found in many different vegetation communities from prairies to open forests (Schutzenhofer et al. 2009), is prevalent in disturbed sites, and responds favorably to frequent fire (Tyrl et al. 2008). The foliage of slender lespedeza is an important food source for white-tailed deer and cottontail rabbits, while its seed from the fruit are utilized by bobwhite quail, wild turkey, and mourning dove. It is most significantly utilized during the summer by white-tailed deer (Gee et al. 1994). Cattle also seek out the high quality biomass produced by the plants, but its abundance will decrease if grazed too heavily (Tyrl et al. 2008).

Buckbrush (*Symphoricarpos orbiculatus Moench*) is a dominant shrub that spreads by rhizomes and forms large colonies (Scasta et al. 2014). Buckbrush is recognized by its shredding gray-brown bark, sessile or subsessile leaves, and purple-red drupes. Buckbrush is adapted to many different soil types and precipitation levels and occurs in both forests and prairies. Flowering occurs from June to August and the drupes mature during September and October (Tyrl et al. 2008). The drupes produced by buckbrush are utilized by a variety of song birds, bobwhite quail, prairie chicken, ring-necked pheasant *(Phasianus colchicus)*, and wild turkey during the winter. Buckbrush is also a good food source for white-tailed deer, mule deer *(Odocoileus hemionus)*, pronghorn antelope, cottontail rabbits, black bears *(Ursus americanus)*, and cattle who consume the drupes, twigs, and leaves (Tyrl et al. 2008). It is most heavily foraged by ungulates during summer, fall, and winter (Gee at al. 1994).

Herbaceous greenbriar (*Smilax herbacea L.)* and common greenbriar (*Smilax rotundifola L.)* were sampled as *Smilax spp*. Sampling of greenbriar was done this way due to the difficulty of differentiating them from one another consistently throughout the year. *Smilax spp.* are woody perennial vines recognized by their climbing habit and tough green stems that form dense thickets with sharp prickles (Gee et al. 1994). Flowering occurs from March to June and the

berries mature and turn shiny black in the fall. Greenbriar can be difficult to manage without frequent burning. The nutrient content of greenbriar can increase dramatically following fire (Soper et al. 1993b). Greenbriar are an important food source for wood ducks *(Aix sponsa)*, prairie chickens, songbirds, small mammals, and wild turkey. White-tailed deer, squirrels *(Sciuridae spp.)*, cottontail rabbits, raccoons *(Procyon lotor)*, and black bears also consume various parts of greenbriar. Greenbriar is highly preferred by white-tailed deer and cattle and is considered one of the most important white-tailed deer foods in the southeast United States (Tyrl et al. 2008).

Little bluestem (*Schizachyrium scoparium (Michx) Nash*) is a C_4 warm season perennial grass that grows 45 to 130 cm tall, and is recognized by its blue-green vegetation that forms a bunch, senescing into reddish colored foliage. Little bluestem is a dominant species in the tallgrass and mixed-grass prairie. Little bluestem is adapted to many different soil types with growth beginning in late spring and persisting throughout the summer with flowering occurring in late summer (Tyrl et al. 2008). It is also very well adapted to growing season disturbances like fire and grazing. Little bluestem is a good food source for livestock and grazing wildlife, such as, elk *(Cervus Canadensis)*. It also provides cover for ground nesting birds and small mammals and is especially important for bobwhite quail habitat. It also can be used as a source of cover for white-tailed deer in areas with little to no grazing pressure (N'Guessan and Hartnett 2011).

Scribner's panicum (*Dichanthelium oligosanthes var. scribnerianum (Nash) Gould*)) is a cool season C_3 perennial grass that is widely distributed throughout the eastern Great Plains (Ott and Hartnett 2012). Scribner's panicum grows 15 to 60 cm tall and has two growth forms and two flowering periods. The first growth form is produced in the spring with the leaves lanceolate, not fascicled, and the margins are postulate-ciliate; and the inflorescence a large and open

panicle above the leaves. The second growth form occurs in the fall with the leaves narrower, fascicled, and margins glabrous; the inflorescence is a small panicle and partially hidden by the leaves (Tyrl et al. 2008). It occurs in loam and clay-loam prairie soils is somewhat shade tolerant and increases in abundance following disturbance. Flowering in the spring occurs during late April through June and flowers again from August through October (Gee et al. 1994, Tyrl et al. 2008). The herbage is utilized by livestock and other mammals and is an important food source for white-tailed deer when other green foliage is scarce during the winter months. The caryopses are also an important food source for songbirds and upland game birds (Linex 2019).

METHODS

Site description:

The study site is located on Oklahoma State University's (OSU) Cross Timbers Experimental Range (CTER). The site is approximately 706 ha located in Payne County 13 km southwest of Stillwater, Oklahoma (Study site). The CTER has two major land resources areas (MLRA) R080 and R084. Sampling was conducted on the primary MLRA R084 which consists of a sandy loam savannah ecological site (USDA 2020). This ecological site occurs over sandstone and shale parent materials; the reference vegetation is tallgrass prairie species with a woody overstory, creating a savannah ecotype (NRCS 2020a). The dominant overstory woody plants are post oak (*Quercus stellata)* and blackjack oak *(Quercus marilandica).* The understory is comprised of roughleaf dogwood (*Cornus drummondii*), poison ivy (*Rhus radicans*), buckbrush, redbud (*Cercis Canadensis*), and American elm *(Ulmus americana*). The dominant herbaceous species include little bluestem, indiangrass (*Sorghastrum nutans*), big bluestem

(*Andropogon geradii*), and ragweed. Soil of the sandy loam savannah ecological site on CTER had an average pH 6.11, organic matter 1.47%, CEC 7.30, N 1.13ppm, and K 167.77ppm.

Experimental design:

To evaluate the effects of season of burn on changes in forage quality, the study design specifically included 7 forage and browse species sampled within 3 burn treatments with 3 replicates of each treatment (Figure 1). The 3 burn treatments included dormant (early spring) season burns conducted April 2019, growing season burns conducted in July 2019, and unburned (i.e. control). The sampling sites within each treatment replicate were stratified based on ecological site; all sampling locations occurred within the sandy loam savannah ecological site (NRCS 2020b). Transect locations were identified using Esri ArcMap software. I identified 3 random starting locations within the strata for each replicate of 3 treatments. A random starting direction was selected and an end location was identified based on the random heading, 100 m from the start location. Each of the 3 transects were ≥20 m from the nearest transect within the same replicate, ecological site boundary, and boundary of neighboring treatments to avoid edge effects.

Individual plants of each species of interest were randomly selected along the 3 transects in each treatment as they were encountered. Sampling was conducted once per month from May 2019 through October 2020. Sampling of the control replicates was concluded after August 2020 due to an unplanned burn that made sampling unfeasible in September and October 2020. Forage samples were collected along each transect within each replicate for the 7 plant species. This resulted in 5 samples per replicate, and a total of 15 samples per treatment for each plant species. There were 2 samples collected along 2 transects and 1 sample along the third transect with the

transect having a single sample taken rotated each month. Sampling also alternated starting points along transects each month to help ensure that different individuals were sampled. The samples were collected to mimic the grazing/browsing selection of cattle and white-tailed deer by selectively removing portions of the plants that the animals would most likely consume (Mitchell 2012).

Forage analysis:

To quantify a baseline, pre-treatment forage quality, sampling within unburned and dormant season burn treatments was implemented prior to dormant season burns, the pre-sampling for the growing season burn treatments took place during the July sampling period just prior to growing season burns. Only *Schizachyrium scoparium* and *Dichanthelium oligosanthes* were sampled during the pre-sampling of the control and dormant season treatments because forb and browse species were senesced and unavailable for sufficient sampling in February. A soil sample was taken at both ends of the 3 transects in each replicate, resulting in 6 soil samples per replicate; these 6 samples were combined into one composite sample per replicate. Soil tests results are reported in Appendix C.

Plant samples were transported to Noble Research Institute in Ardmore, Oklahoma for oven drying at 53^{o} C for 24 to 48 hours. Once dried, the samples were ground in a Thomas Model 4 Wiley table top mill (Thomas Scientific Swedesboro, NJ) with a 1mm screen, with 56.7 g of the ground forage bagged, labeled and sent for analysis (Noble Research Institute Ag Services and Resources Core Research Forage Sample Processing SOP 1.0 R0), in the near infrared spectroscopy (NIRS) lab using a Foss ds2500 (Foss Analytics, Denmark). Using prediction models developed by the NIRS Feed and Forage Consortium

(https://www.nirsconsortium.com). The results consisted of protein, acid detergent fiber, neutral detergent fiber, calcium, phosphorus, potassium, magnesium, ash, fat, lignin, total digestible nutrients, relative feed value, and relative forage quality.

Data were analyzed using the statistical computing program R version 3.6.3 (Rstudio, Team, 2020). Using R, I calculated descriptive statistics to obtain sample means, standard deviation, minimum and maximum values, standard error, variance, and coefficient of variation for each of the 7 plant species at the replicate and treatment levels. I considered plant species absent for sampling (e.g. due to treatment effect or being dormant/senesced) to be unavailable for animal use, so interpretations were not made in these instances. I found there was little to no variability among samples of replicates within a treatment for each plant species, which was expected because the sampling design resulted in all transects being located within one ecological site, and all forage samples were carefully sampled to mimic what an animal would select. This is in contrast to grab sampling, or the inclusion of multiple forms of a plant at various stages of production, which can influence variability in nutrient estimates across samples. Because I controlled for potentially extraneous sources of variation, all samples were included in the calculation of a composite mean for crude protein and TDN for the *t*-test analyses (Appendix A and B). A one-sample *t*-test was used to test monthly nutrient quality for each of the 7 plant species against the monthly nutrient requirements of: spring calving cows, fall calving cows, and female and male white-tailed deer (Table 1). This may raise concerns about the need to consider Bonferroni corrections to control for Type I error rates across multiple statistical analyses. However, I chose not to perform Bonferroni corrections because a) there are numerous mathematical, logical, and practical arguments against Bonferroni corrections in ecology (Moran 2003) the goal was testing each month's vegetation samples against that month's nutritional

threshold level, not to amass 'significant' p-values, and c) *t*-tests within each plant and animal species were temporally replicated such that I sought general temporal patterns in the data which partially controls for individual Type I errors in any single analysis. Using the means for plant crude protein and TDN, considering animal nutritional requirements. I inferred that nutritional requirements were met when plant nutritional means were greater than animal needs, coupled with a significant *p*-value from the *t*-test (Appendix A and B).

RESULTS

Ragweed

During this study, ragweed was available for sampling 62.5% (10 of 16 months), 66% (12 of 18 months), and 53% (8 of 15 months) of months in the CT, DS, and GS treatments, respectively (Figure 2 and 3). Ragweed ranged in crude protein content from 15.4 to 25.8% and TDN content from 56.1 to 69.0% over all months and treatments (Appendix A and B). Crude protein peaked (25.8%) in May 2019 one month after the DS burn treatment whereas TDN peaked (69%) in October 2019 six months after the DS burn treatment. Ragweed was lowest in crude protein and TDN in June each year with the lowest crude protein (15.4%) and TDN (56.1 %) in June 2020 fourteen months after the DS burn treatment (Figure 2 and 3). Percentage of time that ragweed met animal requirements within each season of burn is reported in Table 2.

Ragweed met crude protein requirements of spring and fall calving cows (Table 1) in all months and treatments available for sampling (i.e. May - October) both years (Figure 2, Appendix A). Ragweed also met TDN requirements for fall calving cows (Table 1) all months and treatments whereas spring calving cows TDN requirements were in all months except for the

CT treatment May 2019 and the CT and DS treatments June 2020 (Figure 3, Appendix B). Female white-tailed deer crude protein requirements (Table 1) were also met by ragweed (>15.4%) in all months and treatments available for sampling (i.e. May - October) both years. Male white-tailed deer CP requirements were met as well except for within the DS treatment June 2020 male deer needed 16% CP during June (Table 1) and ragweed was only 15.4% a deficit of 0.6% (Figure 2, Appendix A). Ragweed also met female deer TDN requirements (Table 1) except in the CT and DS treatments June 2019 and the CT treatment July 2019 as well as all treatments June – July 2020 (Figure 3, Appendix B). However, male white-tailed deer TDN requirements were met by ragweed (>56.1%) in all months and treatments (Figure 3, Appendix B).

Croton

During this study, croton was available for sampling 25% (4 of 16 months), 33% (6 of 18 months), and 27% (4 of 15 months) of months in the CT, DS, and GS treatments, respectively (Figure 4 and 5). Croton ranged in crude protein content from 10.2 to 18.8% and TDN content from 48.4 to 63% over all months and treatments (Appendix A and B). Croton peaked in crude protein (18.8%) and TDN (63.1%) in July 2019 three months after the DS burn treatment. Croton was lowest in crude protein (10.2%) in October 2019 six months after the DS burn treatment and TDN (48.4%) in October 2020 fifteen months after the GS burn treatment (Figure 4 and 5). Percentage of time that croton met animal requirements within each season of burn is reported in Table 2.

Crude protein requirements of spring calving cows (Table 1) were met by croton (>10.2%) except in the DS burn treatment August 2020 (Figure 4, Appendix A). Fall calving

cow crude protein requirements (Table 1) were also met by croton (>11.5%) except within the DS burn treatment October 2019 and August 2020 (Figure 4, Appendix A). In addition, croton met TDN requirements of spring calving cows (Table 1) during September - October 2019 within the CT treatment and the DS treatment July 2019 and September – October 2019 and August – October 2020 within the GS burn treatment (Figure 5, Appendix B). Fall calving cow TDN requirements (Table 1) were also met by croton (>54.5%) within the DS burn treatment July – August 2019 and the GS burn treatment July – August 2020 (Figure 5, Appendix B).

Female white-tailed deer crude protein requirements (Table 1) were met by croton (>12.9%) in September 2019 within the CT treatment as well as July – September 2019 in the DS burn treatment and during September 2020 in the DS and GS burn treatments (Figure 4, Appendix A); all other month, year, and treatments did not meet requirements. Croton (>15.2%) also met male white-tailed deer crude protein requirements (Table 1) during September 2019 in the CT treatment and within the DS burn treatment July 2019 and September 2020; all other month, year, and treatments did not meet requirements (Figure 4, Appendix A). Croton did not meet TDN requirements of female deer in any month sampled whereas male deer TDN requirements (Table 1) were met during July – August 2019 within the DS burn treatment (Figure 5, Appendix B).

Slender lespedeza

During this study, slender lespedeza was available for sampling during this study 62.5% (10 of 16 months), 66.7% (12 of 18 months), and 53% (8 of 15 months) of months in the CT, DS and GS treatments, respectively (Figure 6 and 7). Slender lespedeza ranged in crude protein content from 9 to 19.1% and TDN content from 50.6 to 59% over all months and treatments (Appendix

A and B). Crude protein peaked (19.09%) in May 2019 one month after the DS burn treatment whereas TDN peaked (59%) in September 2019 two months after the GS burn treatment. Slender lespedeza was lowest in crude protein (8.99%) and TDN (50.6%) in October 2020 fifteen months after the GS burn treatment (Figure 6 and 7). Percentage of time that slender lespedeza met animal requirements within each season of burn is reported in Table 2.

Slender lespedeza met crude protein requirements of spring calving cows (Table 1) except in the GS burn treatment August 2020 (Figure 6, Appendix A). Slender lespedeza (> 10.6%) also met fall calving cows crude protein requirements (Table1) except within the CT treatment October 2019 and the DS and GS treatments October 2020 (Figure 6, Appendix A). Additionally, slender lespedeza (>50.6%) met spring calving cow TDN requirements (Table 1) in the DS burn treatment August 2019 and within all treatments September – October 2019 and August – October 2020 (Figure 7). Fall calving cows TDN requirements (Table 1) were met by slender lespedeza (>51.8%) in May 2019 within the CT treatment as well as in the CT and DS burn treatments July – August 2019 and all treatments May – August 2020 (Figure 7).

Female white-tailed deer crude protein requirements (Table 1) were met by slender lespedeza (>11.8%) during May of both years in the CT and DS burn treatments, within the DS and GS burn treatments October 2019, as well as, in all treatments September 2019 (Figure 6). Male white-tailed deer crude protein requirements (Table 1) were only met by slender lespedeza (>13.1%) during May 2019 in the DS burn treatment and October 2019 within the GS burn treatment in addition to all treatments September 2019 and May 2020 (Figure 6). Slender lespedeza did not meet female deer TDN requirements (Table 1) in any months sampled (Figure 7, Appendix B). Whereas, slender lespedeza (>55.1%) did meet TDN requirements of male deer (Table 1) in the CT treatment May and August 2020, and within the DS burn treatment May of

both years, July 2019, June 2020, and August of both years; as well as in the GS burn treatment during May, July, and August 2020 (Figure 7).

Buckbrush

During this study, buckbrush was available for sampling 75% (12 of 16 months), 72% (13 of 18 months), and 47% (7 of 15 months) of months in the CT, DS, and GS treatments, respectively (Figure 8 and 9). Buckbrush ranged in crude protein content from 12.1 to 26.9% and TDN content from 61.7 to 72.7% over all months and treatments (Appendix A and B). Crude protein (26.9%) and TDN (72.7%) peaked in April 2020 nine months after the GS burn treatment. Buckbrush was lowest in crude protein (12.1%) in October 2020 eighteen months after the DS burn treatment whereas TDN (61.7%) was lowest in August 2019 within the CT treatment (Figure 8 and 9). Percentage of time that buckbrush met animal requirements within each season of burn is reported in Table 2.

Spring and fall calving cow crude protein and TDN requirements (Table 1) were met by buckbrush in all treatments and months sampled (Figure 8 and 9). Buckbrush also met female white-tailed deer crude protein requirements (Table 1) with the exception of July 2020 within all treatments and August 2020 in the GS burn treatment (Figure 8, Appendix A). Additionally, female deer TDN requirements (Table 1) were met by buckbrush except for in the CT treatment June – July 2019 and during July 2020 within the CT and GS burn treatments (Figure 9, Appendix B). Male white-tailed deer crude protein requirements (Table 1) were met by buckbrush except within the CT treatment July – August of both years, the DS burn treatment August 2019 and July – October 2020, and the GS burn treatment July – August 2020 (Figure 8, Appendix A). Buckbrush met male deer TDN requirements (Table 1) during all months and treatments (Figure 9).

Greenbriar

During this study, greenbriar was available for sampling 75% (12 of 16 months), 72% (13 of 18 months), and 40% (6 of 15 months) of months in the CT, DS, and GS treatments, respectively (Figure 10 and 11). Greenbriar ranged in crude protein content from 10.06 to 27.18% and TDN content from 57.6 to 71.8% over all months and treatments (Appendix A and B). Crude protein (27.2%) and TDN (71.8%) peaked in May 2020 ten months after the DS burn treatment. Greenbriar was lowest in crude protein (10.1%) in October 2020 eighteen months after the DS burn treatment whereas TDN (57.6%) was lowest in July 2020 within the CT treatment (Figure 10 and 11). Percentage of time that greenbriar met animal requirements within each season of burn is reported in Table 2.

Greenbriar met spring calving cows crude protein requirements (Table 1) during all months and treatments sampled. TDN requirements were also met except in June 2020 within the CT treatment (Figure 10 and 11, Appendix A and B). Fall calving cow crude protein and TDN requirements (Table 1) were met by greenbriar as well with the exception of October 2020 in the DS burn treatment where crude protein requirements were not met (Figure 10 and 11, Appendix A and B).

Female white-tailed deer crude protein requirements were met by greenbriar in the CT treatment (>14.2%) May 2019, September – November 2019, and May 2020 and within the DS burn treatment (>14.1%) June 2019, September – November 2019, and May – July 2020 (Figure 10, Appendix A). As well as in the GS burn treatment (>12.1%) May – June 2020 and September – October 2020 (Figure 10, Appendix A). Additionally, female deer TDN requirements (Table 1) were met by greenbriar except during June – August 2019 within the CT and DS burn treatments and all treatments June – July 2020 and during August 2020 in the GS

burn treatment (Figure 11, Appendix B). Crude protein requirements of male white-tailed deer (Table 1) were met by greenbriar (>14.4%) during May 2019 in the CT treatment and during June – July 2019 within the DS burn treatment, as well as, the CT and DS treatments October – December 2019 and DS and GS in May 2020 (Figure 10, Appendix A). Greenbriar met TDN requirements of male deer (Table 1) during all months and treatments sampled (Figure 11, Appendix B).

Little bluestem

During this study, little bluestem was available for sampling 100% (16 of 16 months), 100% (18 of 18 months), and 100% (15 of 15 months) of months in the CT, DS, and GS treatments, respectively (Figure 12 and 13). Little bluestem ranged in crude protein content from 2.6 to 17.3% and TDN content from 27.4 to 56.8% over all months and treatments (Appendix A and B). Crude protein (17.3%) and TDN (56.8%) peaked in May 2019 one month after the DS burn treatment. Little bluestem was lowest in crude protein (2.6%) in May 2019 within the CT treatment whereas TDN (27.4%) was lowest in February 2020 seven months after the GS burn treatment (Figure 12 and 13). Percentage of time that little bluestem met animal requirements within each season of burn is reported in Table 2.

Spring calving cow crude protein requirements (Table 1) were only met by little bluestem (>8.3%) during May – June 2019 and September 2019 within the DS burn treatment; and during September – October 2019 in the GS burn treatment (Figure 12, Appendix A). TDN requirements of spring calving cows (Table 1) were only met by little bluestem during October 2019 in the GS burn treatment (Figure 13, Appendix B). Little bluestem met fall calving cow crude protein requirements (Table 1) in the DS burn treatment May – August 2019 and April –

May 2020. Along with the CT treatment during June 2020 and the GS burn treatment during August 2019 (Figure 12, Appendix A). Fall calving cow TDN requirements (Table 1) were only met by little bluestem (>46.6%) in the DS burn treatment during June of both years and May 2020 (Figure 13, Appendix B). Female and male white-tailed deer crude protein requirements (Table 1) were only met by little bluestem in the DS burn treatment during May 2019 (Figure 12, Appendix A). Female and male deer TDN requirements (Table 1) were not met by little bluestem except for male deer May 2019 within the DS burn treatment. (Figure 13, Appendix B).

Scribner's panicum

During this study Scribner's panicum was available for sampling 100% (16 of 16 months), 100% (18 of 18 months), and 100% (15 of 15 months) of months in the CT, DS, and GS treatments, respectively (Figure 14 and 15). Scribner's panicum ranged in crude protein content from 3.4% to 18.6% and TDN content from 24.2 to 60.6% over all months and treatments (Appendix A and B). Crude protein (18.6%) and TDN (60.6%) peaked in May 2019 one month after the DS burn treatment. Scribner's panicum was lowest in crude protein (3.4%) in March 2020 eight months after the GS burn treatment whereas TDN (24.2%) was lowest in February 2020 seven months after the GS burn treatment (Figure 14 and 15). Percentage of time that Scribner's panicum met animal requirements within each season of burn is reported in Table 2.

Scribner's panicum met crude protein requirements of spring calving cows (Table 1) in the CT treatment (CP >6.8%) during May – June 2019, August – December 2019, and April – May 2020. Within the DS burn treatment (CP >6.6%) May – June 2019, October – December 2019, April – May 2020, and October 2020; as well as, in the GS burn treatment (CP >10.9%) August – October 2019 and April 2020 (Figure 14, Appendix A). Additionally, TDN

requirements of spring calving cows (Table 1) were met by Scribner's panicum in the CT treatment (TDN > 48.3%) during October and November 2019 and in the DS burn treatment (TDN > 49.1%) May 2019, October – November 2019, April 2020, and October 2020. As well as in the GS burn treatment (TDN > 49.1%) during October of both years (Figure 15, Appendix B). Fall calving cows crude protein requirements (Table 1) were met by Scribner's panicum during May – September 2019 and March – June 2020 within the CT treatment (CP > 8%). During May – August 2019 and April – May 2020 in the DS burn treatment (CP > 8.5%) and within the GS burn treatment (CP > 9.5%) August 2019 and April – May 2020 (Figure 14, Appendix A). Scribner's met fall calving cows TDN requirements (Table 1) in the DS treatment May 2019 and the CT and DS burn treatments (TDN > 51%) July 2019 and May – June 2020 and within the GS treatment (TDN > 47.3%) April – June 2020 (Figure 15, Appendix B).

Female white-tailed deer crude protein requirements (Table 1) were only met by Scribner's in the CT treatment during May 2019 (15.2%) and April 2020 (14.6%) and within the DS burn treatment May 2019 (18.6%) (Figure 14, Appendix A). Scribner's only met female deer TDN requirements (Table 1) during May 2019 (60.6%) in the DS burn treatment (Figure 15, Appendix B). Male white-tailed deer crude protein requirements (Table 1) were only met during May 2019 (18.6%) within the DS burn treatment (Figure 14, Appendix A). And TDN requirements of male deer were only met during May 2019 (57.1%) in the CT treatment and within all treatments during April 2020 (56.3 – 59.7%) (Figure 15, Appendix B).

DISCUSSION

Dormant and growing season prescribed fire did improve forage quality (i.e. crude protein, TDN) of the 7 studied plant species helping to meet the animal nutrient requirements.

However, the implementation of season of burn did not extend the amount of time all plant species were capable of meeting animal nutrient requirements with the exception of little bluestem. Animal nutrient requirements fluctuate with physiological stages (i.e. gestation, lactation) making management of forage quality sufficient for meeting nutrient requirements a challenge (Grings et al. 2005). Management of nutritional quality is important for cows and female white-tailed deer because nutrition helps determine their body condition, production (i.e. meat, milk), off-spring health, and reproduction (D'occhio et al. 2019). Similarly, nutrient quality is important for male white-tailed deer not only for their maintenance but in attempting to maximize their genetic potential for body mass and antler growth (Fulbright and Ortega-Santos 2013).

Managers with multiple enterprises such as livestock and wildlife constantly are trying to balance the needs of each animal in terms of habitat and food. When it comes to food, domestic cattle and white-tailed deer are classified differently. Cows are primarily grazers, feeding mainly on grasses, but do consume forbs and shrubs depending on environment (Holechek et al. 2011). Whereas white-tailed deer are concentrate selectors or browsers, focusing more on forbs and browse (Henke et al. 1988). Although, cattle primarily utilize grasses compared to forbs and browse if they have access to a diversity of plants, then they will most likely get their nutritional requirements from the plants they have available regardless of functional group (George et al. 2001a, Fuhlendorf et al. 2009). For instance, the forb and browse species in this study met nutrient requirements of both spring and fall calving cows the majority of months regardless of treatment, meaning that if cows utilize forbs and browse it would help meet nutritional needs. Cattle consumption of forbs and browse would likely increase when quality grass is unavailable and when forbs and browse are young and more palatable, such as early in the growing season or

following a fire (Odadi et al. 2013). It has been reported in other studies that forbs and shrubs have made up 20 – 39% of cattle diets suggesting that the amount of forbs and browse cattle will consume is highly depended on their environment (Holechek et al. 2011). Similarly, white-tailed deer will utilize grasses in the fall and winter when forbs and browse availability decreases and cool season grasses are readily available and in a green vegetative state (Gee et al. 1994).

Spring calving cows, and female and male white-tailed deer all have their highest nutrient demands during the spring and summer months. During this time spring calving cows are lactating and female deer are in late gestation and lactating, while male deer requirements are elevated due to antler development. Fall calving cows do not have their highest nutrient demands until September – February making management of fall calving cows more difficult due to plants being senesced or of lower quality during lactation. Forbs and browse are readily available and show high levels of crude protein and TDN during the months of lactation for female deer and antler development for male deer. Furthermore, grasses are predominantly available and at their highest quality during lactation of spring calving cows. Considering season of burn, dormant season burns can further increase crude protein during lactation and antler development, but growing season burns conflict directly with the needs of spring calving cows and deer during lactation and antler development, removing much of the available biomass and nutrients (Howe 2011). Therefore, managers need to consider the size and heterogeneity of burn patches so that spring calving cows and deer always have readily available, nutritious forage.

Cows need quality forage in order to be productive meaning they maintain themselves, reproduce, and raise a healthy calf. Maintenance requirements refer to the nutrients necessary for normal bodily functions such as respiration and movement, while reproductive requirements are in addition to maintenance needs and steadily increase during gestation with lactation

requirements being the highest after parturition (Cunningham et al. 2005). If a cow has inadequate nutrition, reproduction and lactation will be sacrificed in order to maintain and survive. In this study the grasses did increase in nutrient quality following the dormant season and growing season burns. Furthermore, the incorporation of both dormant season and growing season burns was able to extend the amount of time that little bluestem was capable of meeting spring calving cow nutrient requirements. This is supported by previous research that has studied fire-grazing interactions and that ungulates preferably select sites that have been most recently burned indicating that quality increases following fire (Allred et al. 2011, Sensening et al. 2010).

This study indicates that dormant and growing season burns do have the ability to increase forage nutrient quality, with variable responses among plant species. However, there was no evidence to suggest that the incorporation of both dormant and growing season burns will extend the amount of time forage quality will meet animal needs with the exception of little bluestem. Dormant season burns showed to be the best option aimed at managing forage quality for cows and white-tailed deer, whereas the growing season burns had a temporally negative effect for deer due to rendering the forb and browse species unavailable. There are other beneficial applications of growing season burns though such as managing woody encroachment, manage certain weed species, and provide wildlife habitat (Cronan et al. 2015, Decker and Harmon-Threatt 2019).

Balancing the needs of multiple animal species is a difficult challenge, especially when trying to implement management practices that will benefit both animals. Although cattle and white-tailed deer forage differently there are still some dietary overlap that occurs depending on the time of year (Fulbright and Ortega-Santos 2013). Diet overlap between cattle and deer has been shown to be lowest during the summer when grasses are abundant for cattle and greatest

during the winter when grasses are dormant and lower quality (Jenks et al. 1996). Signifying that browse species and cool season forbs and grasses become highly valuable during the winter months for cattle and deer to meet nutritional requirements.

CONCLUSIONS

Cattle and white-tailed deer are two of the most ecologically and economically important species in North America and through proper management the services and goods provided by these two species can be sustainable (Hines et al. 2021). For land managers to develop an integrated approach to multiple enterprises such as cattle and white-tailed deer they will need to incorporate livestock production into the management of natural resources (Herrero et al. 2009). Findings from this study will aid in the management and understanding of how different season of burns affect nutrient quality of commonly utilized forages of both cattle and deer. Showing that careful considerations need to be made when determining when, if, and how to implement burns; because each season of burn has its pros and cons when managing for cattle and white-tailed deer simultaneously.

Although this study only evaluated a select few plant species, the responses they exhibited gives good insight into how other plant species within the same functional group could respond to the same treatment. In this study the dormant season burns were the most beneficial to all plant species in terms of nutrient quality. The growing season burns even though they raised nutrient quality of some plant species had a greater negative effect when considering plant species availability to cattle and deer.

REFERENCES

Allred B.W., S.D. Fuhlendorf, D.M. Engle, and R.D. Elmore. 2011. Ungulate preference for burned patches reveals strength of fire-grazing interaction. Ecology and Evolution. 1(2): 132-144.

Anderson, R.C. 2006. Evolution and origin of the central grassland of North America: climate, fire, and mammalian grazers. Journal of the Torrey Botanical Society. 133(4):626-647.

Bowman D.M.J.S., J. Balch, P. Artaxo, W. J. Bond, M. A. Cochrane, C.M. D'Antonio, R. DeFries, F.H. Johnston, J.E. Keeley, M.A. Krawchuk, C. A. Kull, M. Mack, M.A. Moritz, S. Pyne, C.I. Roos, A.C. Scott, N.S. Sodhi, and T.W. Swetnam. 2011. The human dimension of fire regime on Earth. Journal of Biogeography. 38(12): 2223-2236.

Brockway D.G., R.G. Gatewood, and R.B. Paris. 2002. Restoring fire as an ecological process in shortgrass ecosystems: initial effects of prescribed burning during the dormant and growing seasons. Journal of Environmental Management. 65: 135-52.

Campbell R.R. 1989. The influence of advancing season on diet quality, intake and rumen fermentation of cattle grazing tallgrass prairie.

Clark S.L., S.W. Hallgren, D.M. Engle, and D.W. Stahle. 2007. The historic fire regime on the edge of the prairie: a case study from the Cross Timbers of Oklahoma. Proceedings of the Tall Timbers Fire Ecology Conference. 23: 40-49.

Cronan J.B., C.S. Wright, and M. Petrova. 2015. Effects of dormant and growing season burning on surface fuels and potential fire behavior in northern Florida longleaf pine (Pinus palustris) flatwoods. Forest Ecology and Management. 354: 318-333.

Cunningham M., M.A. Latour, and D. Acker. 2005. Animal science and industry (7th ed.). Pearson Prentice Hall.

Decker B.L. and A.N. Harmon-Threatt. 2019. Growing or dormant season burns: the effects of burn season on bee and plant communities. Biodiversity and Conservation. 28(13): 3621-3631.

Dickson, T. L., B. A., Hayes, and T.B. Bragg 2019. Effects of 34 years of experimentally manipulated burn seasons and frequencies on prairie plant composition. *Rangeland Ecology and Management, 72*(1): 82.

D'Occhio M.J., P.S. Baruselli, and G. Campanile. 2019. Influence of nutrition, body condition, and metabolic status on reproduction in female beef cattle: A review. Theriogenology. 125: 277-284.

Ellsworth L.M. and J.B. Kauffman. 2017. Plant community response to prescribed fire varies by pre-fire condition and season of burn in mountain big sagebrush ecosystems. Journal of Arid Environments 144: 74-80.

Engle D.M. and T.G. Bidwell. 2001. The response of central North American prairies to seasonal fire. Journal of Range Management. 54: 2-10.

Farney J.K., PAS, C.B. Rensink, W.H. Fick, D. Shoup, and G.A. Miliken. 2017. Patch burning on tall-grass native prairie does not negatively affect stocker performance or pasture composition. The Professional Animal Scientist. 33: 549-554.

Fuhlendorf S.D. and D.M. Engle. 2004. Application of the fire-grazing interaction to restore a shifting mosaic on tallgrass prairie. Journal of Applied Ecology. 41: 604-614.

Fuhlendorf, S.D., D.M. Engle, C.M. O'Meilia, J.R. Weir, and D.C. Cummings. 2009. Does herbicide weed control increase livestock production on non-equilibrium rangeland? Agriculture, Ecosystems and Environment. 132(1-2): 1-6.

Fuhlendorf S.D., D.M. Engle, J. Kerby, and R. Hamilton. 2008. Pyric herbivory: Rewilding landscapes through the recoupling of fire and grazing. 23(3): 588-598.

Fuhlendorf S.D., W.C. Harrell, D.M. Engle, R.G. Hamilton, C.A. Davis, and D.M. Leslie Jr. 2006. Should heterogeneity be the basis for conservation? Grassland bird response to fire and grazing. Ecological Society of America. 16(5): 1706-1716.

Fulbright T.E. and J.A. Ortega-Santos. 2013. White-tailed deer habitat: ecology and management on rangelands. Texas A&M University Press.

Gee K.L., M.D. Porter, S. Demarais, F.C. Bryant, and G.V. Vreede. 1994. White-tailed deer their foods and management in the cross timbers. The Samuel Roberts Noble Foundation.

George M., G. Nader, and J. Dunbar. 2001a. Balancing beef cow nutrient requirements and seasonal forage quality on annual rangeland. UC Agriculture and Natural Resources. 8021.

George M., G. Nader, and N. McDougald. 2001b. Annual rangeland forage quality. UC Agriculture and Natural Resources. 8022.

Grings E.E., R.E. Short, K.D. Klement, T.W. Geary, M.D. MacNeil, M.R. Haferkamp, and R.K. Heitschmidt. 2005. Calving system and weaning afe effects on cow and preweaning calf performance in northern Great Plains 1,2. Journal of Animal Science. 83(11): 2671-2683.

Guoyao, Wu. 2014. Dietary requirements of synthesizable amino acids by animals: a paradigm shift in protein nutrition. Journal of Animal Science and biotechnology. 5(1): 115.

Henke S., S. Demarais, and J. Pfister. 1988. Digestive capacity and diets of white-tailed deer and exotic ruminants. The journal of wildlife management. 52(4): 595-598.

Hensley G. 2010. Fire effects on habitat quality for white-tailed deer (Odocoileus virginianus) within the cross timbers ecoregion. ProQuest Dissertations Publishing.

Herrero M., P.K. Thorton, P. Gerber, and R.S. Reid. 2009. Livestock, livelihoods and the environment: understanding the trade-offs. Current Opinion in Environmental Sustainability. 1(2): 111-120.

Hines S.L., T.E. Fulbright, A.J. Ortega-S, S.L. Webb, D.G. Hewitt, and T.W. Boutton. 2021. Compatibility of dual enterprises for cattle and deer in North America: a quantitative review. Rangeland Ecology and Management. 74: 21-31.

Holechek J., R.D. Pieper, and C.H. Herbel. 2011. Range management: principles and practices (6^{th} ed.) Prentice Hall.

Howe, H.F. 2011. Fire season and prairie forb richness in a 21-y experiment. Ecoscience. 18(4): 317-328.

ITIS. International Taxonomic Information System. https://www.itis.gov/servlet/SingleRpt/SingleRpt. Accessed (4/15/2020)

Jenks, J.A., D.M. Leslie Jr., R.L. Lochmiller, M.A. Melchiors, and F.T. McCollum III. 1996. Competition in sympatric white-tailed deer and cattle populations in southern pine forests of Oklahoma and Arkansas, USA. Acta Theriolgica. 41: 287-306.

Lashley M.A. and C.A. Harper. 2012. The effects of extreme drought on native forage nutritional quality and white-tailed deer diet selection. Southeastern Naturalist. 11(4):699-710.

Linex, R. 2019. Scribner's dichanthelium. Ranch and Rural Living. 100(6), 5-6.

Matocha, E.M., P.A. Baumann, and M.A. Matocha. 2013. Western Ragweed *(Ambrosia psilostachya)* control and bermudagrass response to diflufenzopyr tank-mix combinations. Weed Technology, 27(4): 757-761.

McGranahan D.A., T.J. Hovick, R.D. Elmore, D.M. Engle, and S.D. Fuhlendorf. 2018. Moderate patchiness optimizes heterogeneity, stability, and beta diversity in mesic grassland. Ecology and Evolution. 8(10): 5008-5015.

McShane, B.B., D. Gal, A. Gelman, C. Robert, and J.L. Tackett. 2019. Abandon statistical significance. The American Statistician. 73(1) 235-245.

Mitchell S.L. 2012. Seasonal dynamics of nutritional quality during drought of four browse species preferred by White-tailed deer in the rolling plains of Texas. Texas Tech University. 34-36

Mitich W.L. 1996. Ragweeds *Ambrosia spp*.: The hay fever weeds. Weed Technology, 10(1): 236-240.

Moran, M. 2003. Arguuments for rejecting the sequential Bonferroni in ecological studies. Oikos. 100(2): 403-405.

National Research Council (U.S). 1996. Nutrient requirements of beef cattle. National Academies Press. 7th rev.

N'Guessan, M., and D. Hartnett. 2011. Differential responses to defoliation frequency in little bluestem (*Schizachyrium scoparium*) in tallgrass prairie implications for herbivory tolerance and avoidance. Plant Ecology, 212(8): 1275-1285

NIRS Feed and Forage Consortium.

https://www.nirsconsortium.com. Accessed (1/5/2020)

NRCS. Ecological Site Description.

https://esis.sc.egov.usda.gov/ESDReport/fsReport.aspx?approved=yes&repType=regular&id=R084AY075OK. Accessed (1/5/2020)a

NRCS. Web Soil Survey.

http://websoilsurvey.sc.egov.usda.gov/. Accessed (1/5/2020)b

Odadi, Karachi M.K., S.A. Abdulrazak, and T.P. Young. 2013. Protein supplementation reduces non-grass foraging by a primary grazer. Ecological Applications. 23(2): 455-463.

Oklahoma State University Extension Service. Nutrient Requirements of Beef Cattle.

http://pods.dasnr.okstate.edu/docushare/dsweb/Get/Document-1921/E-974web.pdf. Accessed (5/23/2020)

Ott P.J. and D.C. Hartnett. 2012. Higher-order bud production increases tillering capacity in the perennial caespitose grass scribner's panicum *(Dicanthelium oligosanthes)*. Botany. 90(9): 884-890.

Rasmussen G.A., C.J. Scifres, and D.L. Drawe. 1983. Huisache growth, browse quality, and use following burning. Journal of Range Management. 36(3): 337-342.

Raynor E.J., A. Joern, J.B. Nippert, and J.M. Briggs. 2016. Foraging decisions underlying restricted space use: effects of fire and forage maturation on large herbivore nutrient uptake. 6(16): 5843-5853.

RStudio Team, 2020. RStudio: Integrated Development for R. RStudio. Version 1.2.5033. Available at: http://www.rstudio.com/. Accessed 12 December 2020.

Scasta, J.D. 2014. Implications of pyric-herbivory on central North American grassland ecology. Management and Production. Oklahoma State University.

Scasta, J.D., D. Engle, R. Harr, and D. Debinski. 2014. Fire induced reproductive mechanisms of a Symphoricarpos caprifoliaceae shrub after dormant season burning. Botanical Studies. 55(1): 1-10.

Schutzenhofer M.R., T.J. Valone, and T.M. Knight. 2009. Herbivory and population dynamics of invasive and native lespedeza. Oecologia. 161(1): 57-66.

Sensening R.L., M.W. Demment, and E.A. Laca. 2010. Allometric scaling predicts preferences for burned patches in a guild of eastern African grazers. Ecology (Durham) 91(10): 2898-2907.

Soper R.B., R.L. Lochmiller, D.M. Leslie Jr, and D.M. Engle. 1993a. Condition and diet quality of white-tailed deer in response to vegetation management in central Oklahoma. Proceeding of the Oklahoma Academy of Science. 73: 53-61

Soper R.B., R.L. Lochmiller, D.M. Leslie Jr, and D.M. Engle. 1993b. Nutritional quality of browse after brush management on cross timbers rangeland. Journal and Range Management. 46: 399-410

Stevens R., B. Deville, F. Motal, and K. Shankles. 2000. Quality of native plant forage species important to white-tailed deer and goats in south central Oklahoma. The Noble Foundation. NF-WF-04-02.

Tyrl R.J., T.G. Bidwell, R.E. Masters, and R.D. Elmore. 2008. Field guide to Oklahoma plants second edition. Oklahoma State University.

USDA. Web Soil Survey. https://websoilsurvey.sc.egov.usda.gov/App/WebSoilSurvey.aspx.

(Accessed (11/18/2020)

Van Ee, B., P.E. Berry, and S. Ginzbarg. 2009. An assessment of the varieties of *Croton glandulous* euphorbiaceae in the united states. Harvard Papers in Botany. 14(1): 45-59.

Vermeire L.T. and M.L. Russell. 2018. Seasonal timing of fire alters biomass and species composition of northern mixed prairie. Rangeland Ecology and Management. 71(6): 714-720.

Vermeire L.T., R.B. Mitchell, S.D. Fuhlendorf, and R.L. Gillen. 2004. Patch burning effects on grazing distribution. Journal of Range Management. 57: 248-252.

TABLES AND FIGURES

Table 1: Average monthly crude protein and total digestible nutrients (TDN) requirements for female and male white-tailed deer (doe and buck) and spring and fall calving cows. Values for cattle were based on mature weight of 544 kg with a body condition of 5 with spring calving cow calving Mar.1 and fall calving cow calving Sept. 1. Averages take into account different stages of gestation and lactation for cows and female deer, as well as, antler growth and rut for male deer. Sources: (Stevens et al. 2000, National Research Council 1996)

Month	Species	% CP	% TDN
January	Spring calving cow	7	49.3
January	Fall calving cow	9.3	56.2
January	White-tailed deer female (Doe)	13	57
January	White-tailed deer male (Buck)	8.5	51
February	Spring calving cow	7.3	52.3
February	Fall calving cow	8.5	54.7
February	White-tailed deer female (Doe)	13	57
February	White-tailed deer male (Buck)	8.5	51
March	Spring calving cow	8.8	56.2
March	Fall calving cow	7.9	53.4
March	White-tailed deer female (Doe)	13	57
March	White-tailed deer male (Buck)	8.5	51
April	Spring calving cow	10.1	58.7
April	Fall calving cow	5.9	44.9
April	White-tailed deer female (Doe)	14	58
April	White-tailed deer male (Buck)	16	55
May	Spring calving cow	10.7	59.9
May	Fall calving cow	6.2	45.8
May	White-tailed deer female (Doe)	15	59
May	White-tailed deer male (Buck)	16	55
June	Spring calving cow	9.9	57.6
June	Fall calving cow	6.5	47.1
June	White-tailed deer female (Doe)	15	64
June	White-tailed deer male (Buck)	16	55
July	Spring calving cow	9.3	56.2
July	Fall calving cow	7	49.3

July	White-tailed deer female (Doe)	14	64
July	White-tailed deer male (Buck)	16	55
August	Spring calving cow	8.5	54.7
August	Fall calving cow	7.3	52.3
August	White-tailed deer female (Doe)	13	61
August	White-tailed deer male (Buck)	16	55
September	Spring calving cow	7.9	53.4
September	Fall calving cow	8.8	56.2
September	White-tailed deer female (Doe)	11	61
September	White-tailed deer male (Buck)	13	60
October	Spring calving cow	5.9	44.9
October	Fall calving cow	10.1	58.7
October	White-tailed deer female (Doe)	11	61
October	White-tailed deer male (Buck)	13	60
November	Spring calving cow	6.18	45.8
November	Fall calving cow	10.69	59.9
November	White-tailed deer female (Doe)	8.5	51
November	White-tailed deer male (Buck)	13	60
December	Spring calving cow	6.5	47.1
December	Fall calving cow	9.93	57.6
December	White-tailed deer female (Doe)	8.5	51
December	White-tailed deer male (Buck)	13	60

Table 2: Percentage of time that plants met crude protein (CP) and total digestible nutrients (TDN) of spring and fall calving cows and female and male white-tailed deer per season of burn. CT = control "unburned", DS = dormant season burn, and GS = growing season burn.

		Spring Cow		Fall Cow		Female Deer		Male Deer	
Plant	Treatment	CP	TDN	CP	TDN	CP	TDN	CP	TDN
Ragweed	CT	62.5%	43.8%	62.5%	62.5%	62.5%	37.5%	56.3%	56.3%
Ragweed	DS	67.0%	61.1%	67.0%	66.7%	67.0%	56.3%	61.0%	61.1%
Ragweed	GS	53.3%	53.3%	53.3%	53.3%	53.3%	40.0%	46.7%	46.7%
Croton	CT	25.0%	12.5%	25.0%	0.0%	6.3%	0.0%	6.3%	0.0%
Croton	DS	27.8%	22.2%	22.2%	11.1%	22.2%	0.0%	11.1%	11.1%
Croton	GS	26.7%	20.0%	26.7%	13.3%	6.7%	0.0%	0.0%	0.0%
Slender lespedeza	CT	62.5%	12.5%	56.3%	43.8%	18.3%	0.0%	6.3%	12.5%
Slender lespedeza	DS	67.0%	27.8%	61.1%	33.3%	22.2%	0.0%	5.6%	16.7%
Slender lespedeza	GS	46.7%	33.3%	46.7%	26.7%	13.3%	0.0%	13.3%	13.3%
Buckbrush	CT	75.0%	75.0%	75.0%	75.0%	68.8%	56.3%	50.0%	75.0%
Buckbrush	DS	72.0%	72.2%	72.0%	72.2%	72.0%	72.2%	44.4%	72.2%
Buckbrush	GS	46.7%	46.7%	46.7%	46.7%	33.3%	40.0%	26.7%	46.7%

Greenbriar	CT	75.0%	68.8%	75.0%	75.0%	37.5%	37.5%	31.3%	75.0%
Greenbriar	DS	72.2%	72.2%	66.7%	72.2%	44.4%	50.0%	33.3%	72.2%
Greenbriar	GS	40.0%	40.0%	40.0%	40.0%	26.7%	26.7%	6.7%	40.0%
Little bluestem	CT	0.0%	0.0%	6.3%	0.0%	0.0%	0.0%	0.0%	0.0%
Little bluestem	DS	16.7%	0.0%	33.3%	16.7%	5.6%	0.0%	5.6%	5.5%
Little bluestem	GS	13.3%	6.7%	6.7%	0.0%	0.0%	0.0%	0.0%	0.0%
Scribner's Panicum	CT	56.3%	12.5%	50.0%	18.8%	12.5%	0.0%	0.0%	12.5%
Scribner's Panicum	DS	44.4%	27.8%	33.3%	22.2%	5.6%	0.0%	5.6%	5.5%
Scribner's Panicum	GS	26.7%	13.3%	20.0%	20.0%	0.0%	0.0%	0.0%	6.7%

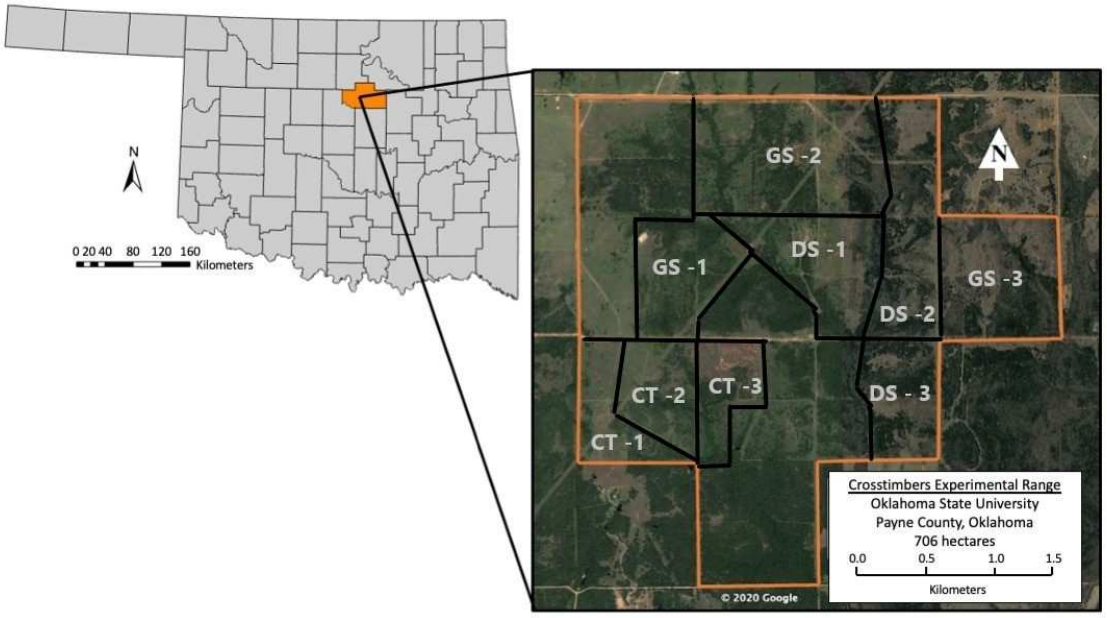

Figure 1: Map showing the location and arrangement of the 3 treatments and their replicates on Oklahoma State University's Cross Timbers Experimental Range, Payne County, Oklahoma, approximately 706 ha 13 km southwest of Stillwater, Oklahoma. CT = control "unburned", DS = dormant season burn, and GS = growing season burn. The numbers represent the replicate of each treatment.

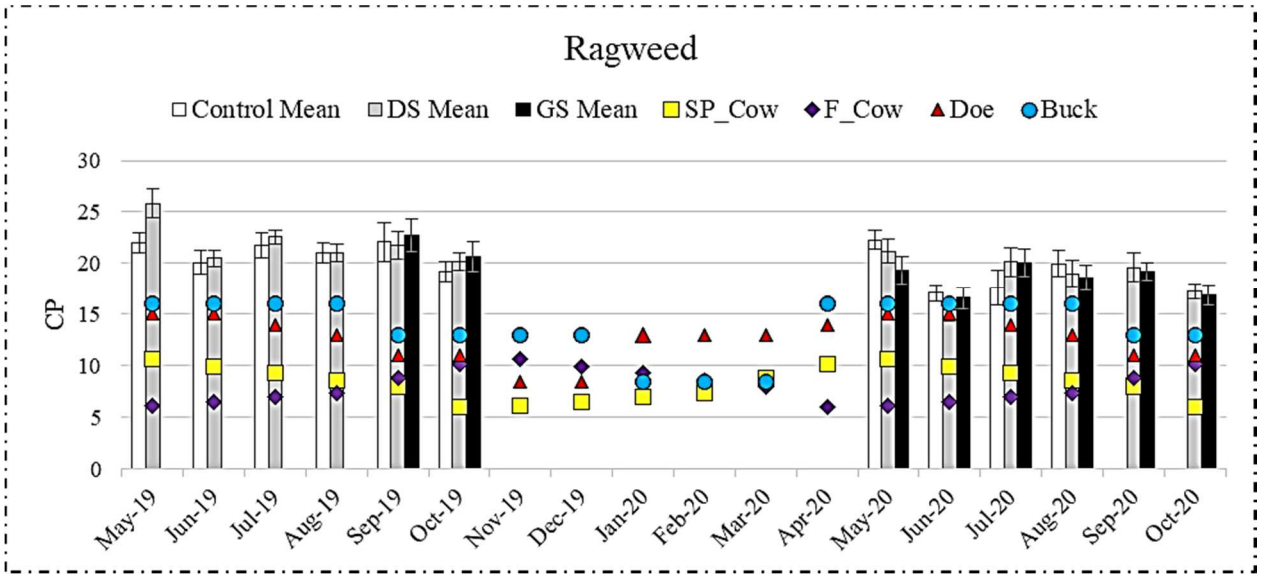

Figure 2: Mean monthly crude protein (± 95%CI) of ragweed within the 3 burn treatments (control, dormant season [DS], and growing season [GS]) at Oklahoma State University's (OSU) Cross Timbers Experimental Range (CTER) in Payne County, Oklahoma. Means and CI were calculated across all replicates for each treatment month. Reference points (colored shapes) indicate monthly nutrient requirements of spring [SP_Cow] and fall [F_Cow] calving cows, and for female [Doe] and male [Buck] white-tailed deer. DS burns were conducted in April 2019 and GS burns in July 2019. Sampling within the treatments was started one month post burn. Months missing treatment data (i.e., no bar) are due to plants being absent following the treatment burn or being dormant/senesced during that month.

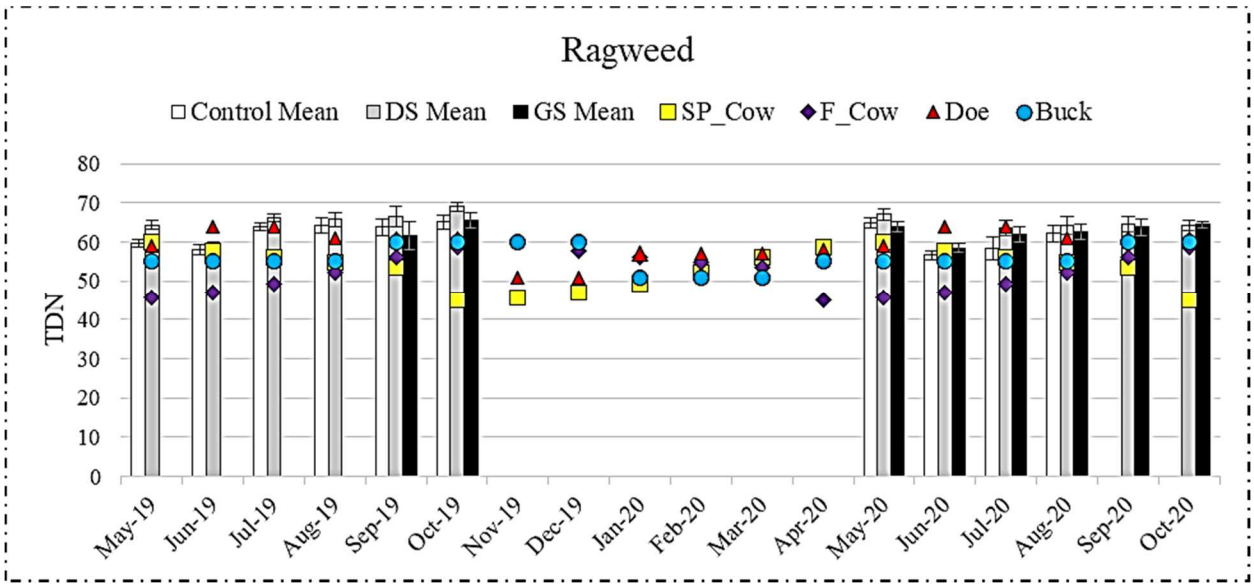

Figure 3: Mean monthly TDN (± 95%CI) of ragweed within the 3 burn treatments (control, dormant season [DS], and growing season [GS]) at Oklahoma State University's (OSU) Cross Timbers Experimental Range (CTER) in Payne County, Oklahoma. Means and CI were calculated across all replicates for each treatment month. Reference

points (colored shapes) indicate monthly nutrient requirements spring [SP_Cow] and fall [F_Cow] calving cows, and for female [Doe] and male [Buck] white-tailed deer. DS burns were conducted in April 2019 and GS burns in July 2019. Sampling within the treatments was started one month post burn. Months missing treatment data (i.e., no bar) are due to plants being absent following the treatment burn or being dormant/senesced during that month.

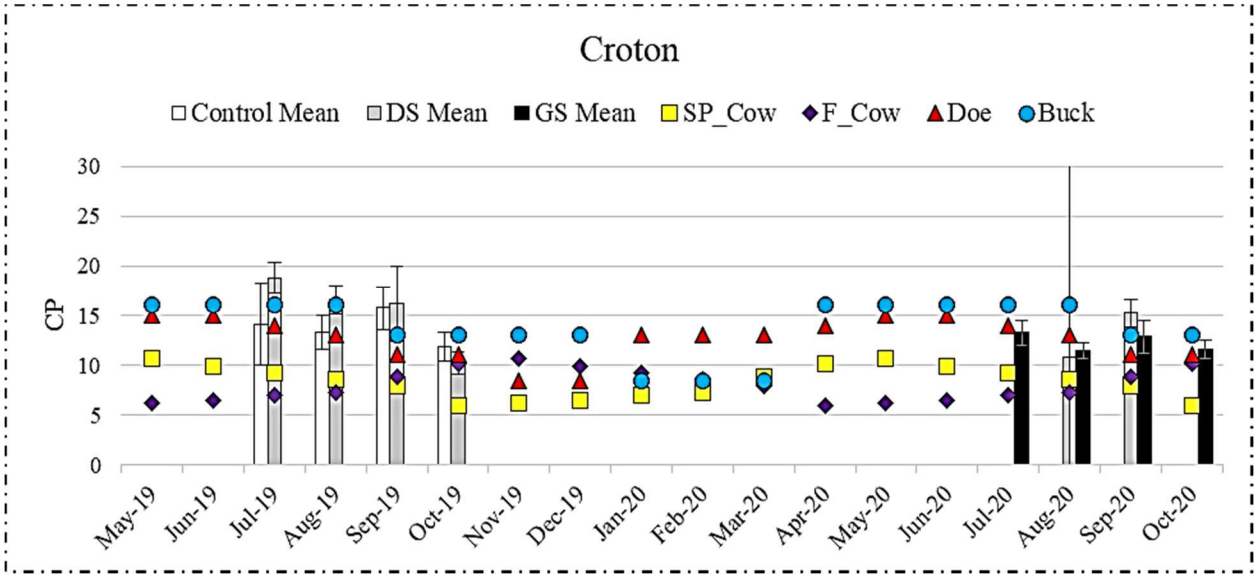

Figure 4: Mean monthly crude protein (± 95%CI) of croton within the 3 burn treatments (control, dormant season [DS], and growing season [GS]) at Oklahoma State University's (OSU) Cross Timbers Experimental Range (CTER) in Payne County, Oklahoma. Means and CI were calculated across all replicates for each treatment month. Reference points (colored shapes) indicate monthly nutrient requirements of spring [SP_Cow] and fall [F_Cow] calving cows, and for female [Doe] and male [Buck] white-tailed deer. DS burns were conducted in April 2019 and GS burns in July 2019. Sampling within the treatments was started one month post burn. Months missing treatment data (i.e., no bar) are due to plants being absent following the treatment burn or being dormant/senesced during that month.

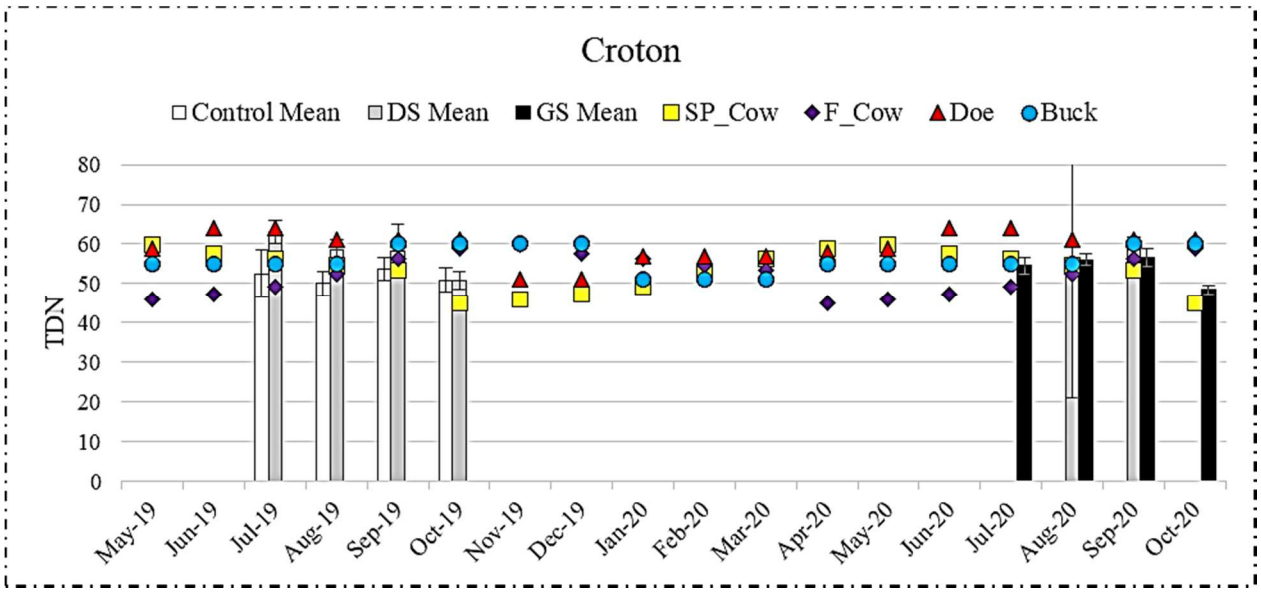

Figure 5: Mean monthly TDN (± 95%CI) of croton within the 3 burn treatments (control, dormant season [DS], and growing season [GS]) at Oklahoma State University's (OSU) Cross Timbers Experimental Range (CTER) in

Payne County, Oklahoma. Means and CI were calculated across all replicates for each treatment month. Reference points (colored shapes) indicate monthly nutrient requirements of spring [SP_Cow] and fall [F_Cow] calving cows, and for female [Doe] and male [Buck] white-tailed deer. DS burns were conducted in April 2019 and GS burns in July 2019. Sampling within the treatments was started one month post burn. Months missing treatment data (i.e., no bar) are due to plants being absent following the treatment burn or being dormant/senesced during that month.

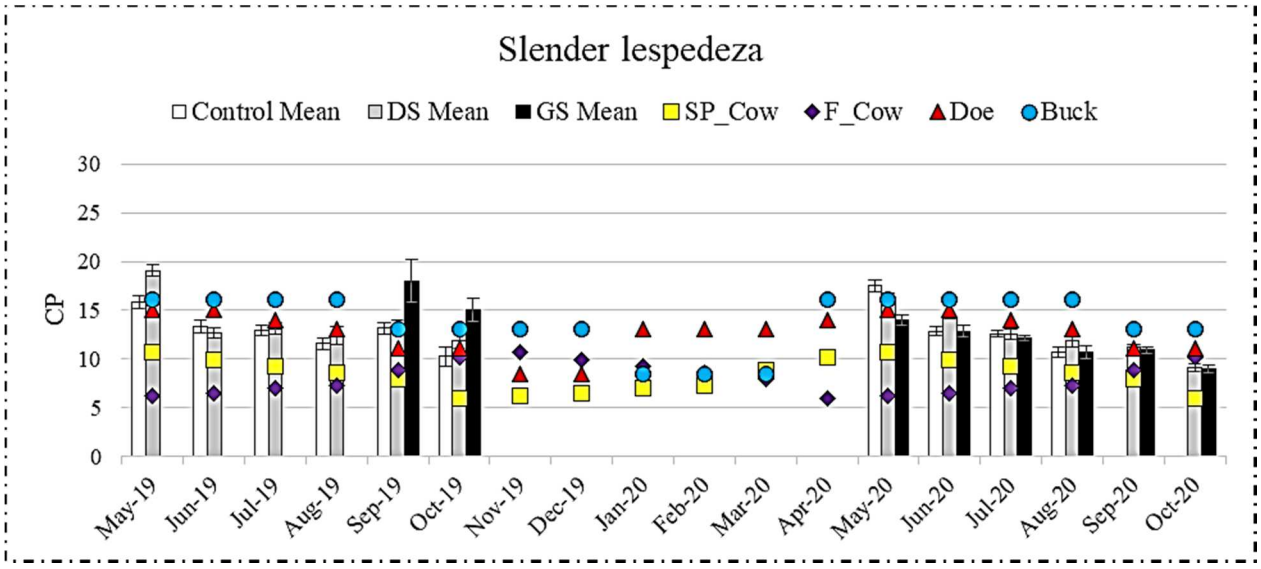

Figure 6: Mean monthly crude protein (± 95%CI) of slender lespedeza within the 3 burn treatments (control, dormant season [DS], and growing season [GS]) at Oklahoma State University's (OSU) Cross Timbers Experimental Range (CTER) in Payne County, Oklahoma. Means and CI were calculated across all replicates for each treatment month. Reference points (colored shapes) indicate monthly nutrient requirements of spring [SP_Cow] and fall [F_Cow] calving cows, and for female [Doe] and male [Buck] white-tailed deer. DS burns were conducted in April 2019 and GS burns in July 2019. Sampling within the treatments was started one month post burn. Months missing treatment data (i.e., no bar) are due to plants being absent following the treatment burn or being dormant/senesced during that month.

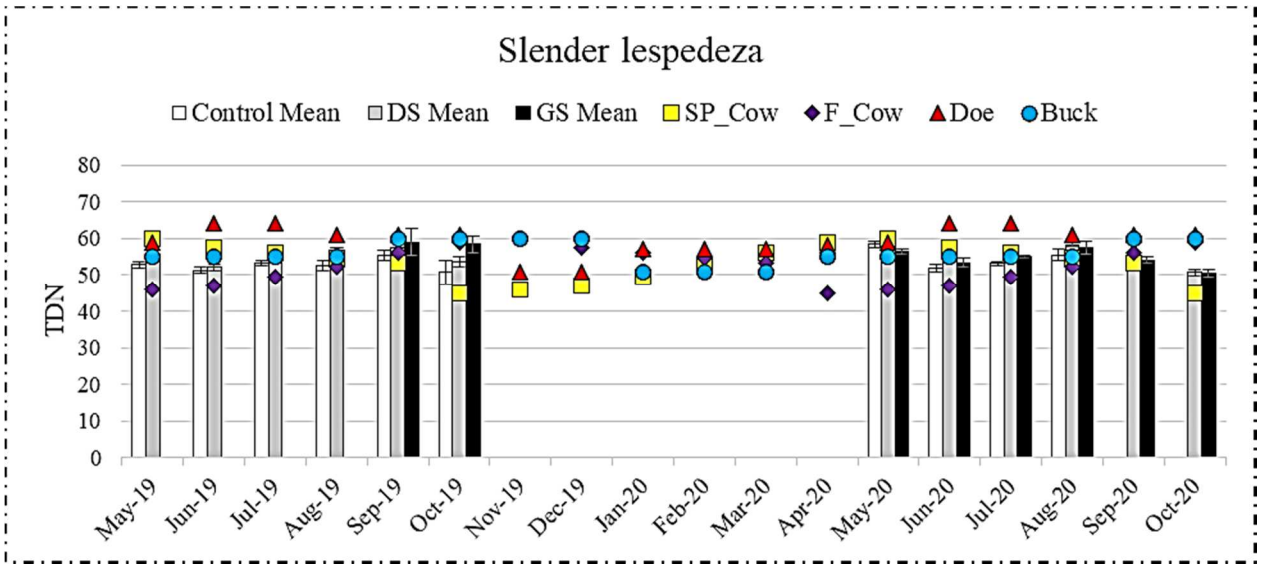

Figure 7: Mean monthly TDN (± 95%CI) of slender lespedeza within the 3 burn treatments (control, dormant season [DS], and growing season [GS]) at Oklahoma State University's (OSU) Cross Timbers Experimental Range (CTER) in Payne County, Oklahoma. Means and CI were calculated across all replicates for each treatment month.

Reference points (colored shapes) indicate monthly nutrient requirements of spring [SP_Cow] and fall [F_Cow] calving cows, and for female [Doe] and male [Buck] white-tailed deer. DS burns were conducted in April 2019 and GS burns in July 2019. Sampling within the treatments was started one month post burn. Months missing treatment data (i.e., no bar) are due to plants being absent following the treatment burn or being dormant/senesced during that month.

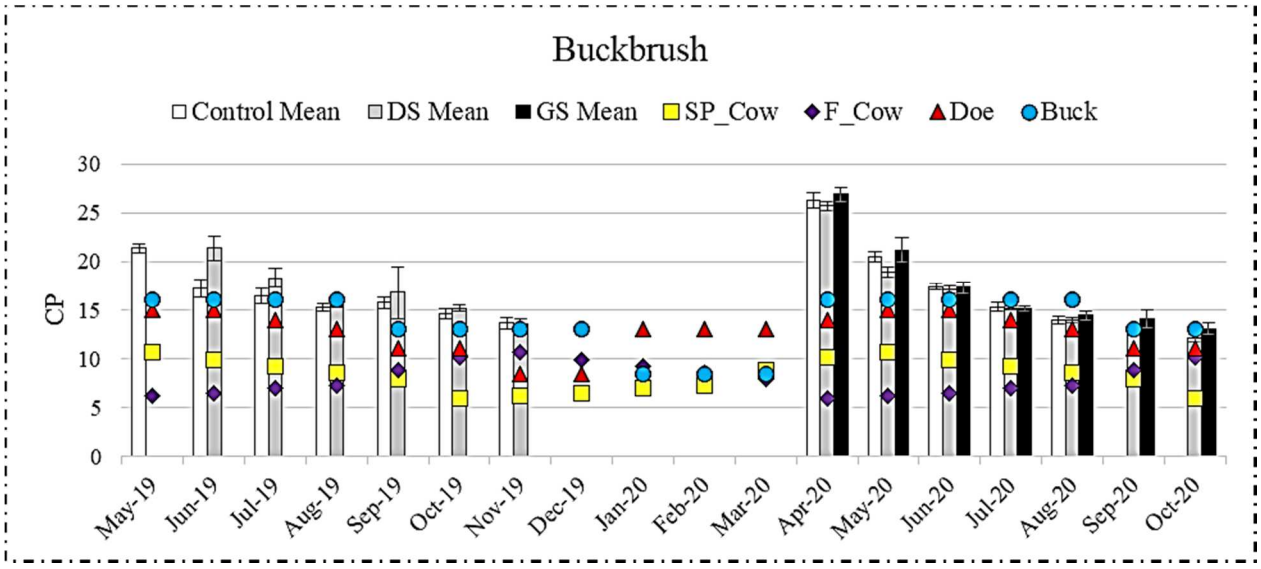

Figure 8: Mean monthly crude protein (± 95%CI) of buckbrush within the 3 burn treatments (control, dormant season [DS], and growing season [GS]) at Oklahoma State University's (OSU) Cross Timbers Experimental Range (CTER) in Payne County, Oklahoma. Means and CI were calculated across all replicates for each treatment month. Reference points (colored shapes) indicate monthly nutrient requirements spring [SP_Cow] and fall [F_Cow] calving cows, and for female [Doe] and male [Buck] white-tailed deer. DS burns were conducted in April 2019 and GS burns in July 2019. Sampling within the treatments was started one month post burn. Months missing treatment data (i.e., no bar) are due to plants being absent following the treatment burn or being dormant/senesced during that month.

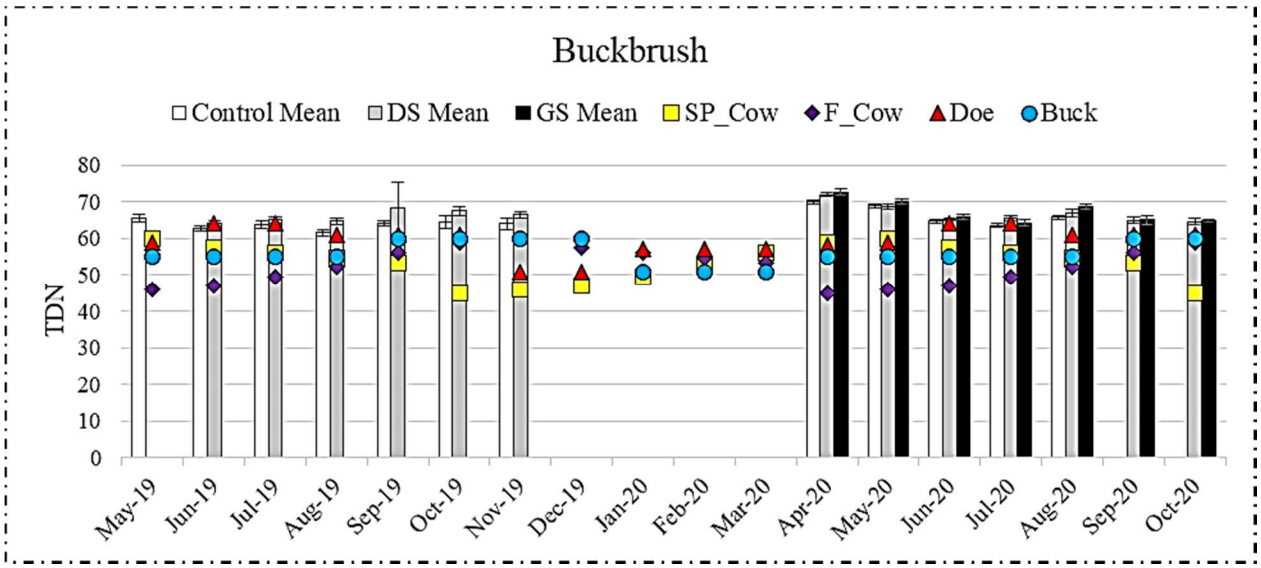

Figure 9: Mean monthly TDN (± 95%CI) of buckbrush within the 3 burn treatments (control, dormant season [DS], and growing season [GS]) at Oklahoma State University's (OSU) Cross Timbers Experimental Range (CTER) in Payne County, Oklahoma. Means and CI were calculated across all replicates for each treatment month.

Reference points (colored shapes) indicate monthly nutrient requirements of spring [SP_Cow] and fall [F_Cow] calving cows, and for female [Doe] and male [Buck] white-tailed deer. DS burns were conducted in April 2019 and GS burns in July 2019. Sampling within the treatments was started one month post burn. Months missing treatment data (i.e., no bar) are due to plants being absent following the treatment burn or being dormant/senesced during that month.

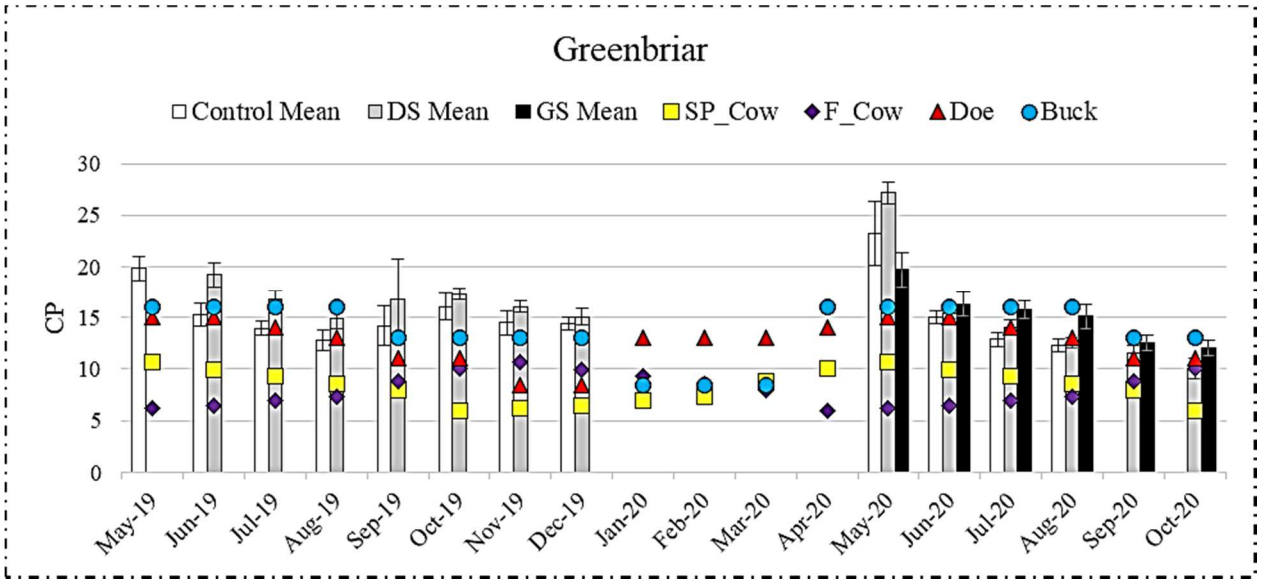

Figure 10: Mean monthly crude protein (± 95%CI) of greenbriar within the 3 burn treatments (control, dormant season [DS], and growing season [GS]) at Oklahoma State University's (OSU) Cross Timbers Experimental Range (CTER) in Payne County, Oklahoma. Means and CI were calculated across all replicates for each treatment month. Reference points (colored shapes) indicate monthly nutrient requirements of spring [SP_Cow] and fall [F_Cow] calving cows, and for female [Doe] and male [Buck] white-tailed deer. DS burns were conducted in April 2019 and GS burns in July 2019. Sampling within the treatments was started one month post burn. Months missing treatment data (i.e., no bar) are due to plants being absent following the treatment burn or being dormant/senesced during that month.

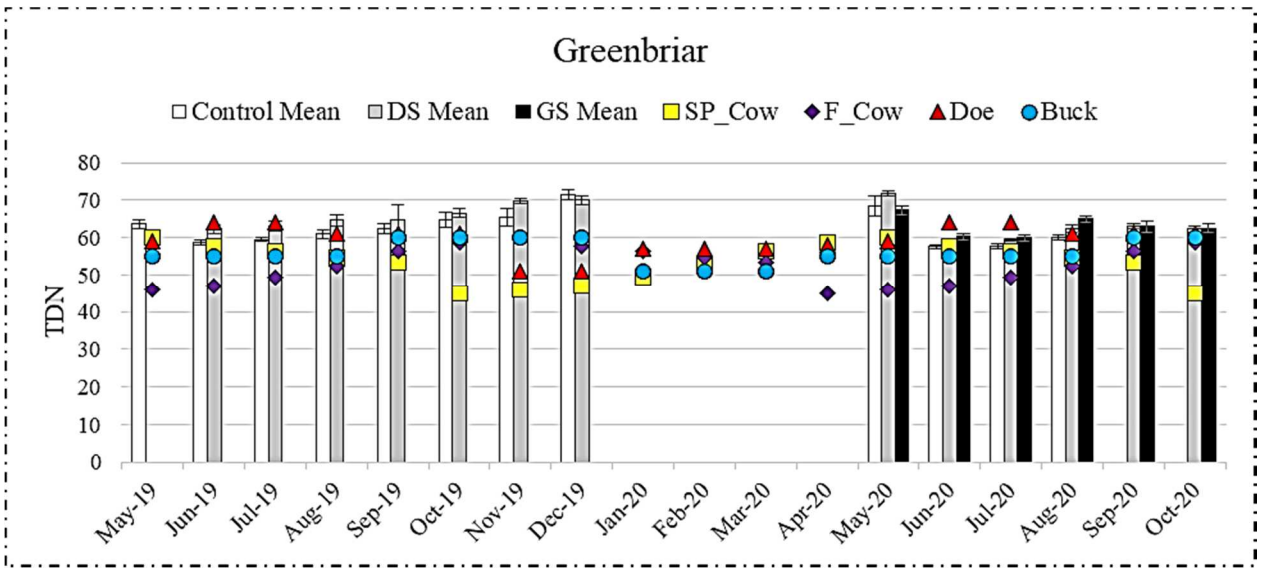

Figure 11: Mean monthly TDN (± 95%CI) of greenbriar within the 3 burn treatments (control, dormant season [DS], and growing season [GS]) at Oklahoma State University's (OSU) Cross Timbers Experimental Range (CTER)

in Payne County, Oklahoma. Means and CI were calculated across all replicates for each treatment month. Reference points (colored shapes) indicate monthly nutrient requirements of spring [SP_Cow] and fall [F_Cow] calving cows, and for female [Doe] and male [Buck] white-tailed deer. DS burns were conducted in April 2019 and GS burns in July 2019. Sampling within the treatments was started one month post burn. Months missing treatment data (i.e., no bar) are due to plants being absent following the treatment burn or being dormant/senesced during that month.

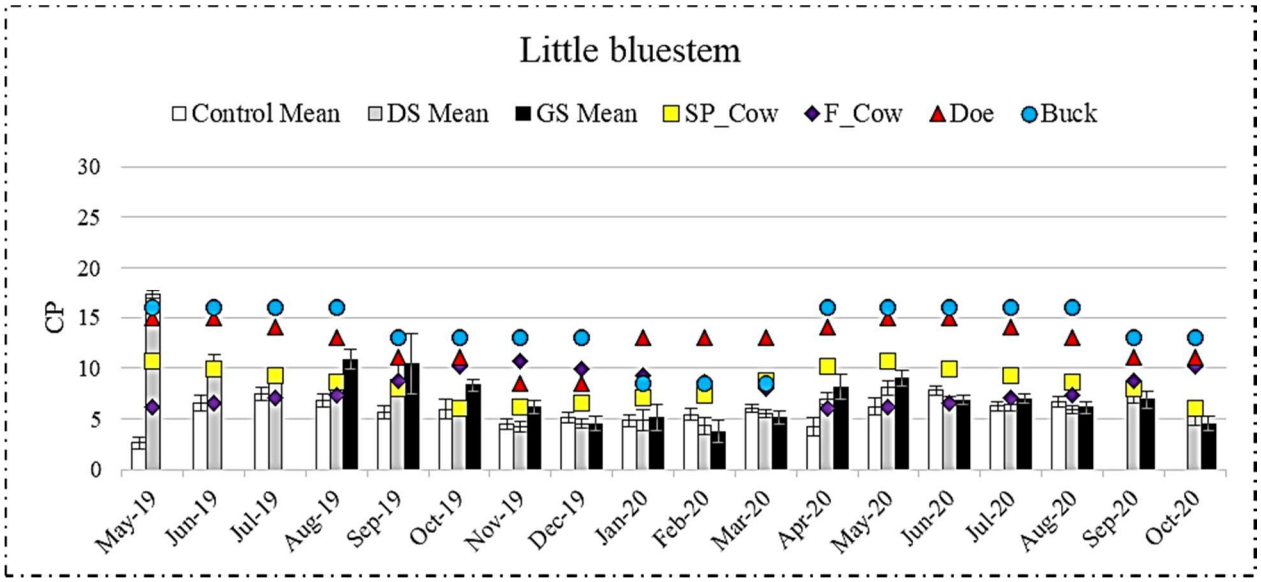

Figure 12: Mean monthly crude protein (± 95%CI) of little bluestem within the 3 burn treatments (control, dormant season [DS], and growing season [GS]) at Oklahoma State University's (OSU) Cross Timbers Experimental Range (CTER) in Payne County, Oklahoma. Means and CI were calculated across all replicates for each treatment month. Reference points (colored shapes) indicate monthly nutrient requirements of spring [SP_Cow] and fall [F_Cow] calving cows, and for female [Doe] and male [Buck] white-tailed deer. DS burns were conducted in April 2019 and GS burns in July 2019. Sampling within the treatments was started one month post burn. Months missing treatment data (i.e., no bar) are due to plants being absent following the treatment burn or being dormant/senesced during that month.

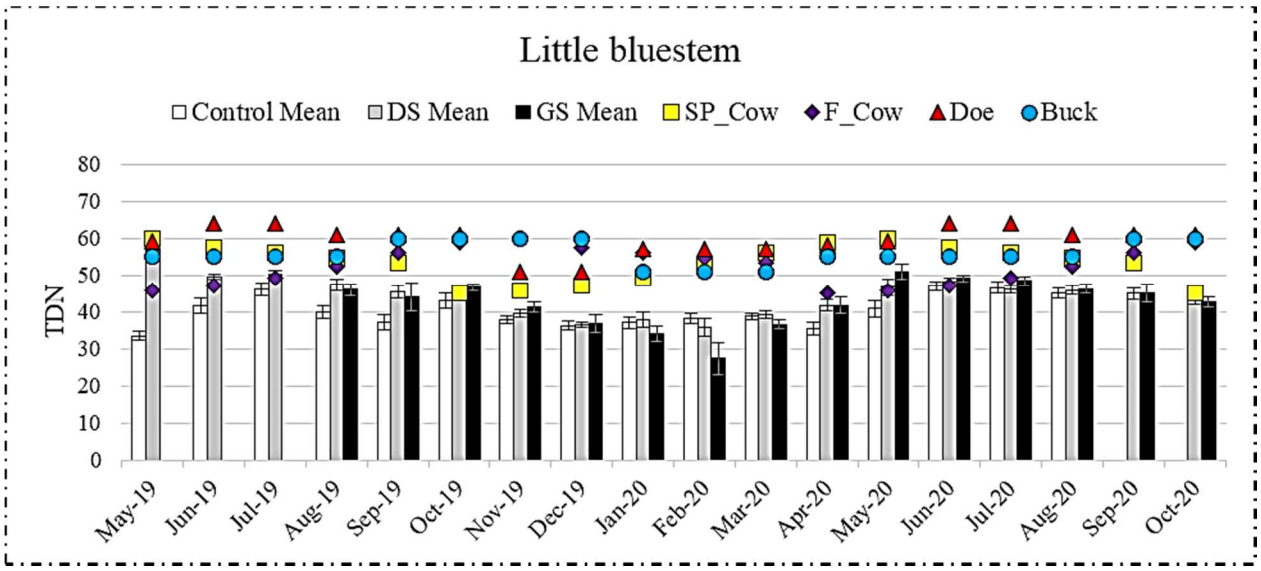

Figure 13: Mean monthly TDN (± 95%CI) of little bluestem within the 3 burn treatments (control, dormant season [DS], and growing season [GS]) at Oklahoma State University's (OSU) Cross Timbers Experimental Range (CTER) in Payne County, Oklahoma. Means and CI were calculated across all replicates for each treatment month. Reference points (colored shapes) indicate monthly nutrient requirements spring [SP_Cow] and fall [F_Cow] calving cows, and for female [Doe] and male [Buck] white-tailed deer. DS burns were conducted in April 2019 and GS burns in July 2019. Sampling within the treatments was started one month post burn. Months missing treatment data (i.e., no bar) are due to plants being absent following the treatment burn or being dormant/senesced during that month.

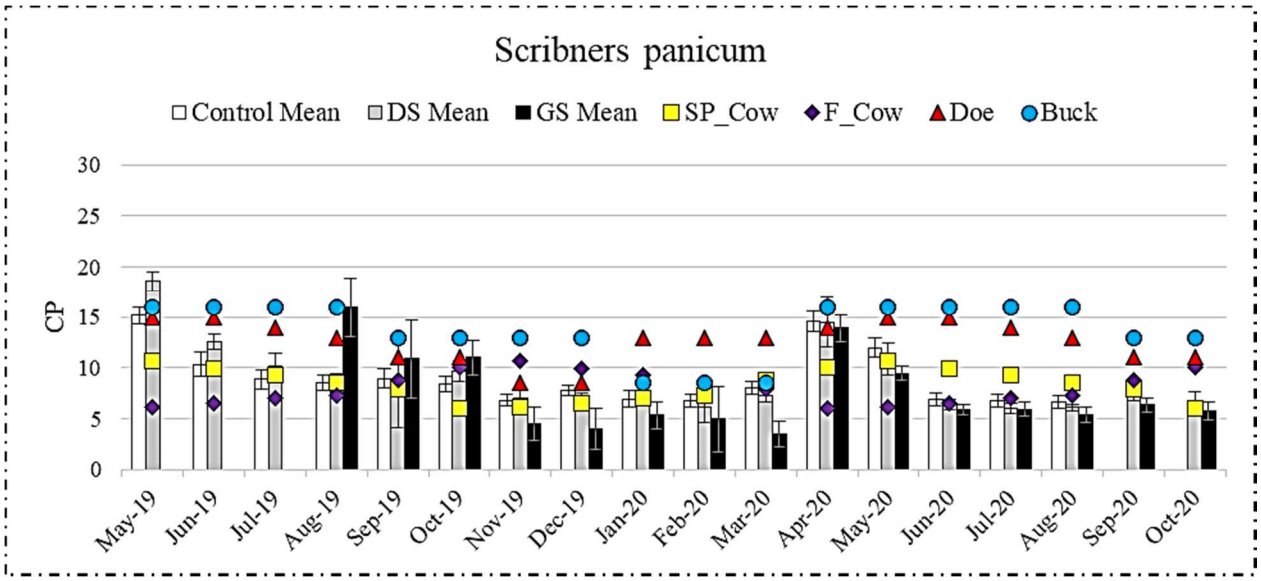

Figure 14: Mean monthly crude protein (± 95%CI) of Scribner's panicum within the 3 burn treatments (control, dormant season [DS], and growing season [GS]) at Oklahoma State University's (OSU) Cross Timbers Experimental Range (CTER) in Payne County, Oklahoma. Means and CI were calculated across all replicates for each treatment month. Reference points (colored shapes) indicate monthly nutrient requirements of spring and fall calving cows, and for female and male white-tailed deer. DS burns were conducted in April 2019 and GS burns in July 2019. Sampling within the treatments was started one month post burn. Months missing treatment data (i.e., no bar) are due to plants being absent following the treatment burn or being dormant/senesced during that month.

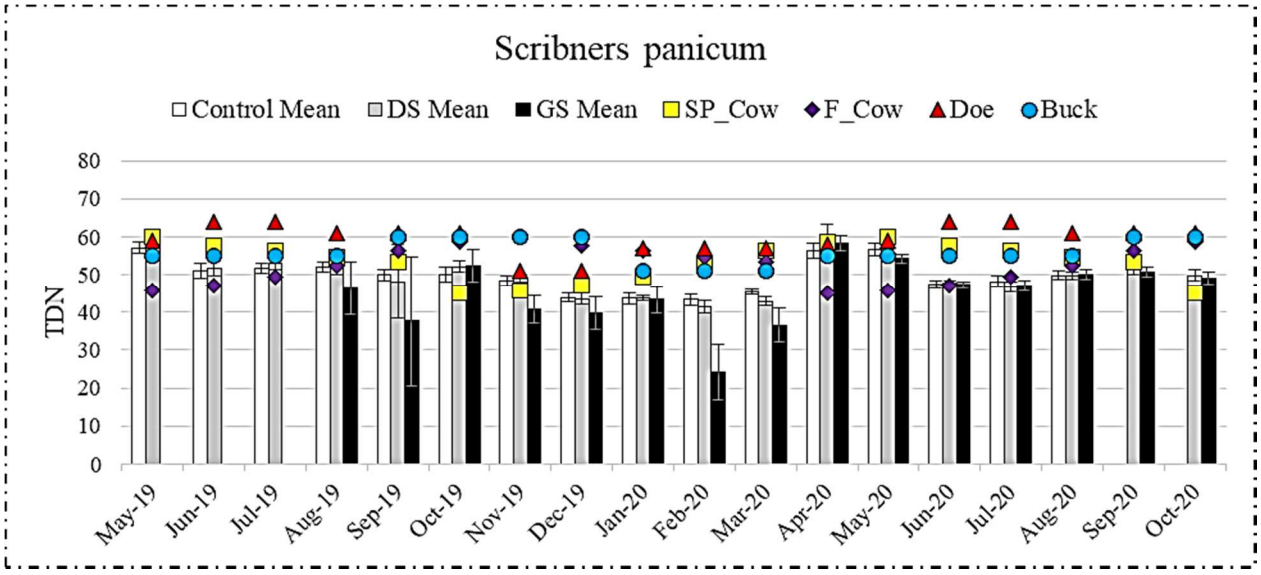

Figure 15: Mean monthly TDN (± 95%CI) of Scribner's panicum within the 3 burn treatments (control, dormant season [DS], and growing season [GS]) at Oklahoma State University's (OSU) Cross Timbers Experimental Range (CTER) in Payne County, Oklahoma. Means and CI were calculated across all replicates for each treatment month. Reference points (colored shapes) indicate monthly nutrient requirements of spring [SP_Cow] and fall [F_Cow] calving cows, and for female [Doe] and male [Buck] white-tailed deer. DS burns were conducted in April 2019 and GS burns in July 2019. Sampling within the treatments was started one month post burn. Months missing treatment data (i.e., no bar) are due to plants being absent following the treatment burn or being dormant/senesced during that month.

APPENDICES

Appendix A. Crude protein data by date, treatment (control [CT], dormant season [DS], and growing season [GS]), plant species, and animal requirement (value). Showing the mean and CIs for each and the difference between the mean and animal nutrient requirement value. Positive difference means the plants mean crude protein was higher than the animal's requirement value; negative difference means the plants mean crude protein was lower than animal's requirement value.

				Spring Cow		Fall Cow		Female Deer		Male Deer	
Date	Plant	Treatment	Mean (Lower, Upper CI)	Value	Difference[1]	Value	Difference[1]	Value	Difference[1]	Value	Difference[1]
5/6/2019	Ragweed	CT	22.05 (21.07, 23.02)	10.69	11.36*	6.18	15.87*	15.00	7.05*	16.00	6.05*
5/6/2019	Ragweed	DS	25.84 (24.45, 27.22)	10.69	15.15*	6.18	19.66*	15.00	10.84*	16.00	9.84*
6/10/2019	Ragweed	CT	20.11 (18.92, 21.29)	9.93	10.18*	6.50	13.61*	15.00	5.11*	16.00	4.11*
6/10/2019	Ragweed	DS	20.49 (19.7, 21.27)	9.93	10.56*	6.50	13.99*	15.00	5.49*	16.00	4.49*
7/9/2019	Ragweed	CT	21.76 (20.6, 22.93)	9.25	12.51*	7.00	14.76*	14.00	7.76*	16.00	5.76*
7/9/2019	Ragweed	DS	22.57 (21.87, 23.27)	9.25	13.32*	7.00	15.57*	14.00	8.57*	16.00	6.57*
8/12/2019	Ragweed	CT	21.03 (20.08, 21.99)	8.54	12.49*	7.30	13.73*	13.00	8.03*	16.00	5.03*
8/12/2019	Ragweed	DS	21.05 (20.18, 21.91)	8.54	12.51*	7.30	13.75*	13.00	8.05*	16.00	5.05*
9/10/2019	Ragweed	CT	22.08 (20.17, 23.98)	7.92	14.16*	8.78	13.3*	11.00	11.08*	13.00	9.08*
9/10/2019	Ragweed	DS	21.73 (20.4, 23.07)	7.92	13.81*	8.78	12.95*	11.00	10.73*	13.00	8.73*
9/10/2019	Ragweed	GS	22.77 (21.21, 24.33)	7.92	14.85*	8.78	13.99*	11.00	11.77*	13.00	9.77*
10/11/2019	Ragweed	CT	19.18 (18.19, 20.16)	5.99	13.19*	10.10	9.08*	11.00	8.18*	13.00	6.18*
10/11/2019	Ragweed	DS	20.14 (19.27, 21.01)	5.99	14.15*	10.10	10.04*	11.00	9.14*	13.00	7.14*

10/11/2019	Ragweed	GS	20.64 (19.2, 22.07)	5.99	14.65*	10.10	10.54*	11.00	9.64*	13.00	7.64*
5/7/2020	Ragweed	CT	22.31 (21.36, 23.26)	10.69	11.62*	6.18	16.13*	15.00	7.31*	16.00	6.31*
5/7/2020	Ragweed	DS	21.18 (20, 22.35)	10.69	10.49*	6.18	15*	15.00	6.18*	16.00	5.18*
5/7/2020	Ragweed	GS	19.34 (17.98, 20.7)	10.69	8.65*	6.18	13.16*	15.00	4.34*	16.00	3.34*
6/8/2020	Ragweed	CT	17.08 (16.3, 17.86)	9.93	7.15*	6.50	10.58*	15.00	2.08*	16.00	1.08*
6/8/2020	Ragweed	DS	15.35 (14.34, 16.36)	9.93	5.42*	6.50	8.85*	15.00	0.35*	16.00	-0.65
6/8/2020	Ragweed	GS	16.58 (15.55, 17.6)	9.93	6.65*	6.50	10.08*	15.00	1.58*	16.00	0.58
7/3/2020	Ragweed	CT	17.63 (15.96, 19.31)	9.25	8.38*	7.00	10.63*	14.00	3.63*	16.00	1.63
7/3/2020	Ragweed	DS	20.14 (18.75, 21.52)	9.25	10.89*	7.00	13.14*	14.00	6.14*	16.00	4.14*
7/3/2020	Ragweed	GS	20.02 (18.68, 21.36)	9.25	10.77*	7.00	13.02*	14.00	6.02*	16.00	4.02*
8/8/2020	Ragweed	CT	19.95 (18.65, 21.25)	8.54	11.41*	7.30	12.65*	13.00	6.95*	16.00	3.95*
8/8/2020	Ragweed	DS	18.98 (17.67, 20.28)	8.54	10.44*	7.30	11.68*	13.00	5.98*	16.00	2.98*
8/8/2020	Ragweed	GS	18.61 (17.36, 19.85)	8.54	10.07*	7.30	11.31*	13.00	5.61*	16.00	2.61*
9/8/2020	Ragweed	DS	19.61 (18.21, 21.02)	7.92	11.69*	8.78	10.83*	11.00	8.61*	13.00	6.61*
9/8/2020	Ragweed	GS	19.25 (18.4, 20.1)	7.92	11.33*	8.78	10.47*	11.00	8.25*	13.00	6.25*
10/8/2020	Ragweed	DS	17.19 (16.46, 17.93)	5.99	11.2*	10.10	7.09*	11.00	6.19*	13.00	4.19*
10/8/2020	Ragweed	GS	16.84 (15.87, 17.8)	5.99	10.85*	10.10	6.74*	11.00	5.84*	13.00	3.84*
7/9/2019	Croton	CT	14.14 (10.07, 18.22)	9.25	4.89*	7.00	7.14*	14.00	0.14	16.00	-1.86
7/9/2019	Croton	DS	18.79 (17.16, 20.41)	9.25	9.54*	7.00	11.79*	14.00	4.79*	16.00	2.79*
8/12/2019	Croton	CT	13.29 (11.54, 15.03)	8.54	4.75*	7.30	5.99*	13.00	0.29	16.00	-2.71*
8/12/2019	Croton	DS	16.59 (15.12, 18.06)	8.54	8.05*	7.30	9.29*	13.00	3.59*	16.00	0.59
9/10/2019	Croton	CT	15.72 (13.56, 17.87)	7.92	7.8*	8.78	6.94*	11.00	4.72*	13.00	2.72*
9/10/2019	Croton	DS	16.15 (12.37, 19.93)	7.92	8.23*	8.78	7.37*	11.00	5.15*	13.00	3.15
10/11/2019	Croton	CT	11.87 (10.42, 13.32)	5.99	5.88*	10.10	1.77*	11.00	0.87	13.00	-1.13
10/11/2019	Croton	DS	10.23 (9.09, 11.36)	5.99	4.24*	10.10	0.13	11.00	-0.77	13.00	-2.77*
7/3/2020	Croton	GS	13.23 (11.96, 14.5)	9.25	3.98*	7.00	6.23*	14.00	-0.77*	16.00	-2.77*
8/8/2020	Croton	DS	10.75 (-12.12, 33.62)	8.54	2.21	7.30	3.45	13.00	-2.25	16.00	-5.25

8/8/2020	Croton	GS	11.48 (10.65, 12.3)	8.54	2.94*	7.30	4.18*	13.00	-1.52*	16.00	-4.52*
9/8/2020	Croton	DS	15.22 (13.85, 16.59)	7.92	7.3*	8.78	6.44*	11.00	4.22*	13.00	2.22*
9/8/2020	Croton	GS	12.86 (11.25, 14.47)	7.92	4.94*	8.78	4.08*	11.00	1.86*	13.00	-0.14
10/8/2020	Croton	GS	11.6 (10.73, 12.47)	5.99	5.61*	10.10	1.5*	11.00	0.6	13.00	-1.4*
5/6/2019	Slender lespedeza	CT	15.75 (15.11, 16.39)	10.69	5.06*	6.18	9.57*	15.00	0.75*	16.00	-0.25*
5/6/2019	Slender lespedeza	DS	19.09 (18.48, 19.71)	10.69	8.4*	6.18	12.91*	15.00	4.09*	16.00	3.09*
6/10/2019	Slender lespedeza	CT	13.33 (12.66, 13.99)	9.93	3.4*	6.50	6.83*	15.00	-1.67	16.00	-2.67*
6/10/2019	Slender lespedeza	DS	12.62 (12.05, 13.18)	9.93	2.69*	6.50	6.12*	15.00	-2.38	16.00	-3.38*
7/9/2019	Slender lespedeza	CT	12.88 (12.38, 13.38)	9.25	3.63*	7.00	5.88*	14.00	-1.12*	16.00	-3.12*
7/9/2019	Slender lespedeza	DS	13.09 (12.54, 13.65)	9.25	3.84*	7.00	6.09*	14.00	-0.91*	16.00	-2.91*
8/12/2019	Slender lespedeza	CT	11.54 (10.94, 12.13)	8.54	3*	7.30	4.24*	13.00	-1.46*	16.00	-4.46*
8/12/2019	Slender lespedeza	DS	12.35 (11.44, 13.26)	8.54	3.81*	7.30	5.05*	13.00	-0.65*	16.00	-3.65*
9/10/2019	Slender lespedeza	CT	13.1 (12.51, 13.69)	7.92	5.18*	8.78	4.32*	11.00	2.1*	13.00	0.1
9/10/2019	Slender lespedeza	DS	13.31 (12.71, 13.91)	7.92	5.39*	8.78	4.53*	11.00	2.31*	13.00	0.31
9/10/2019	Slender lespedeza	GS	17.99 (15.77, 20.21)	7.92	10.07*	8.78	9.21*	11.00	6.99*	13.00	4.99*
10/11/2019	Slender lespedeza	CT	10.23 (9.23, 11.22)	5.99	4.24*	10.10	0.13	11.00	-0.78	13.00	-2.78*
10/11/2019	Slender lespedeza	DS	11.82 (11.03, 12.61)	5.99	5.83*	10.10	1.72*	11.00	0.82*	13.00	-1.18*
10/11/2019	Slender lespedeza	GS	15.04 (13.87, 16.21)	5.99	9.05*	10.10	4.94*	11.00	4.04*	13.00	2.04*
5/7/2020	Slender lespedeza	CT	17.44 (16.79, 18.09)	10.69	6.75*	6.18	11.26*	15.00	2.44*	16.00	1.44*
5/7/2020	Slender lespedeza	DS	16.24 (15.79, 16.69)	10.69	5.55*	6.18	10.06*	15.00	1.24*	16.00	0.24
5/7/2020	Slender lespedeza	GS	13.98 (13.43, 14.52)	10.69	3.29*	6.18	7.8*	15.00	-1.02*	16.00	-2.02*
6/8/2020	Slender lespedeza	CT	12.83 (12.31, 13.35)	9.93	2.9*	6.50	6.33*	15.00	-2.17*	16.00	-3.17*
6/8/2020	Slender lespedeza	DS	14.24 (14.09, 14.39)	9.93	4.31*	6.50	7.74*	15.00	-0.76*	16.00	-1.76*
6/8/2020	Slender lespedeza	GS	12.78 (12.19, 13.36)	9.93	2.85*	6.50	6.28*	15.00	-2.22*	16.00	-3.22*
7/3/2020	Slender lespedeza	CT	12.53 (12.22, 12.85)	9.25	3.28*	7.00	5.53*	14.00	-1.47*	16.00	-3.47*
7/3/2020	Slender lespedeza	DS	12.55 (12.02, 13.08)	9.25	3.3*	7.00	5.55*	14.00	-1.45*	16.00	-3.45*
7/3/2020	Slender lespedeza	GS	12.11 (11.8, 12.42)	9.25	2.86*	7.00	5.11*	14.00	-1.89*	16.00	-3.89*

8/8/2020	Slender lespedeza	CT	10.64 (10.1, 11.18)	8.54	2.1*	7.30	3.34*	13.00	-2.36*	16.00	-5.36*
8/8/2020	Slender lespedeza	DS	11.85 (11.15, 12.56)	8.54	3.31*	7.30	4.55*	13.00	-1.15*	16.00	-4.15*
8/8/2020	Slender lespedeza	GS	10.67 (10.04, 11.31)	8.54	2.13	7.30	3.37*	13.00	-2.33*	16.00	-5.33*
9/8/2020	Slender lespedeza	DS	11.14 (10.8, 11.49)	7.92	3.22*	8.78	2.36*	11.00	0.14	13.00	-1.86*
9/8/2020	Slender lespedeza	GS	10.89 (10.58, 11.2)	7.92	2.97*	8.78	2.11*	11.00	-0.11	13.00	-2.11*
10/8/2020	Slender lespedeza	DS	9.1 (8.68, 9.51)	5.99	3.11*	10.10	-1	11.00	-1.9*	13.00	-3.9*
10/8/2020	Slender lespedeza	GS	8.99 (8.57, 9.41)	5.99	3*	10.10	-1.11	11.00	-2.01*	13.00	-4.01*
5/6/2019	Buckbrush	CT	21.39 (20.92, 21.86)	10.69	10.7*	6.18	15.21*	15.00	6.39*	16.00	5.39*
6/10/2019	Buckbrush	CT	17.24 (16.3, 18.17)	9.93	7.31*	6.50	10.74*	15.00	2.24*	16.00	1.24*
6/10/2019	Buckbrush	DS	21.42 (20.17, 22.66)	9.93	11.49*	6.50	14.92*	15.00	6.42*	16.00	5.42*
7/9/2019	Buckbrush	CT	16.43 (15.66, 17.2)	9.25	7.18*	7.00	9.43*	14.00	2.43*	16.00	0.43
7/9/2019	Buckbrush	DS	18.32 (17.31, 19.34)	9.25	9.07*	7.00	11.32*	14.00	4.32*	16.00	2.32*
8/12/2019	Buckbrush	CT	15.27 (14.83, 15.7)	8.54	6.73*	7.30	7.97*	13.00	2.27*	16.00	-0.73*
8/12/2019	Buckbrush	DS	15.75 (15.23, 16.26)	8.54	7.21*	7.30	8.45*	13.00	2.75*	16.00	-0.25
9/10/2019	Buckbrush	CT	15.73 (15.16, 16.3)	7.92	7.81*	8.78	6.95*	11.00	4.73*	13.00	2.73*
9/10/2019	Buckbrush	DS	16.77 (14.11, 19.42)	7.92	8.85*	8.78	7.99*	11.00	5.77*	13.00	3.77*
10/11/2019	Buckbrush	CT	14.65 (14.13, 15.18)	5.99	8.66*	10.10	4.55*	11.00	3.65*	13.00	1.65*
10/11/2019	Buckbrush	DS	15.19 (14.82, 15.55)	5.99	9.2*	10.10	5.09*	11.00	4.19*	13.00	2.19*
11/13/2019	Buckbrush	CT	13.63 (13.02, 14.23)	6.18	7.45*	10.69	2.94*	8.50	5.13*	13.00	0.63*
11/13/2019	Buckbrush	DS	13.59 (13.13, 14.05)	6.18	7.41*	10.69	2.9*	8.50	5.09*	13.00	0.59*
4/10/2020	Buckbrush	CT	26.25 (25.45, 27.05)	10.10	16.15*	5.99	20.26*	14.00	12.25*	16.00	10.25*
4/10/2020	Buckbrush	DS	25.7 (25.26, 26.14)	10.10	15.6*	5.99	19.71*	14.00	11.7*	16.00	9.7*
4/10/2020	Buckbrush	GS	26.89 (26.18, 27.59)	10.10	16.79*	5.99	20.9*	14.00	12.89*	16.00	10.89*
5/7/2020	Buckbrush	CT	20.5 (20.01, 20.98)	10.69	9.81*	6.18	14.32*	15.00	5.5*	16.00	4.5*
5/7/2020	Buckbrush	DS	18.91 (18.38, 19.43)	10.69	8.22*	6.18	12.73*	15.00	3.91*	16.00	2.91*
5/7/2020	Buckbrush	GS	21.17 (19.91, 22.43)	10.69	10.48*	6.18	14.99*	15.00	6.17*	16.00	5.17*
6/8/2020	Buckbrush	CT	17.41 (17.06, 17.76)	9.93	7.48*	6.50	10.91*	15.00	2.41*	16.00	1.41*

6/8/2020	Buckbrush	DS	17.09 (16.66, 17.52)	9.93	7.16*	6.50	10.59*	15.00	2.09*	16.00	1.09*
6/8/2020	Buckbrush	GS	17.31 (16.76, 17.87)	9.93	7.38*	6.50	10.81*	15.00	2.31*	16.00	1.31*
7/3/2020	Buckbrush	CT	15.29 (14.84, 15.74)	9.25	6.04*	7.00	8.29*	14.00	1.29	16.00	-0.71*
7/3/2020	Buckbrush	DS	15.15 (14.95, 15.35)	9.25	5.9*	7.00	8.15*	14.00	1.15	16.00	-0.85*
7/3/2020	Buckbrush	GS	15.13 (14.86, 15.4)	9.25	5.88*	7.00	8.13*	14.00	1.13	16.00	-0.87*
8/8/2020	Buckbrush	CT	13.93 (13.57, 14.29)	8.54	5.39*	7.30	6.63*	13.00	0.93*	16.00	-2.07*
8/8/2020	Buckbrush	DS	13.92 (13.65, 14.2)	8.54	5.38*	7.30	6.62*	13.00	0.92*	16.00	-2.08*
8/8/2020	Buckbrush	GS	14.42 (13.95, 14.89)	8.54	5.88*	7.30	7.12*	13.00	1.42	16.00	-1.58*
9/8/2020	Buckbrush	DS	12.93 (12.44, 13.41)	7.92	5.01*	8.78	4.15*	11.00	1.93*	13.00	-0.07
9/8/2020	Buckbrush	GS	14.08 (13.21, 14.96)	7.92	6.16*	8.78	5.3*	11.00	3.08*	13.00	1.08*
10/8/2020	Buckbrush	DS	12.11 (11.66, 12.55)	5.99	6.12*	10.10	2.01*	11.00	1.11*	13.00	-0.89*
10/8/2020	Buckbrush	GS	13.05 (12.44, 13.65)	5.99	7.06*	10.10	2.95*	11.00	2.05*	13.00	0.05
5/6/2019	Greenbriar	CT	19.82 (18.69, 20.95)	10.69	9.13*	6.18	13.64*	15.00	4.82*	16.00	3.82*
6/10/2019	Greenbriar	CT	15.26 (14.11, 16.41)	9.93	5.33*	6.50	8.76*	15.00	0.26*	16.00	-0.74
6/10/2019	Greenbriar	DS	19.21 (18.03, 20.38)	9.93	9.28*	6.50	12.71*	15.00	4.21*	16.00	3.21*
7/9/2019	Greenbriar	CT	13.96 (13.25, 14.67)	9.25	4.71*	7.00	6.96*	14.00	-0.04	16.00	-2.04*
7/9/2019	Greenbriar	DS	16.81 (16.03, 17.59)	9.25	7.56*	7.00	9.81*	14.00	2.81*	16.00	0.81*
8/12/2019	Greenbriar	CT	12.78 (11.82, 13.74)	8.54	4.24*	7.30	5.48*	13.00	-0.22	16.00	-3.22*
8/12/2019	Greenbriar	DS	14.93 (13.94, 15.93)	8.54	6.39*	7.30	7.63*	13.00	1.93	16.00	-1.07*
9/10/2019	Greenbriar	CT	14.18 (12.23, 16.12)	7.92	6.26*	8.78	5.4*	11.00	3.18*	13.00	1.18
9/10/2019	Greenbriar	DS	16.81 (12.9, 20.71)	7.92	8.89*	8.78	8.03*	11.00	5.81*	13.00	3.81
10/11/2019	Greenbriar	CT	16.07 (14.73, 17.41)	5.99	10.08*	10.10	5.97*	11.00	5.07*	13.00	3.07*
10/11/2019	Greenbriar	DS	17.32 (16.76, 17.87)	5.99	11.33*	10.10	7.22*	11.00	6.32*	13.00	4.32*
11/13/2019	Greenbriar	CT	14.51 (13.31, 15.7)	6.18	8.33*	10.69	3.82*	8.50	6.01*	13.00	1.51*
11/13/2019	Greenbriar	DS	16.08 (15.49, 16.67)	6.18	9.9*	10.69	5.39*	8.50	7.58*	13.00	3.08*
12/9/2019	Greenbriar	DS	15.06 (14.23, 15.89)	6.50	8.56*	9.93	5.13*	8.50	6.56	13.00	2.06*
12/9/2019	Greenbriar	CT	14.42 (13.76, 15.07)	6.50	7.92*	9.93	4.49*	8.50	5.92	13.00	1.42*

5/7/2020	Greenbriar	CT	23.26 (20.17, 26.35)	10.69	12.57*	6.18	17.08*	15.00	8.26*	16.00	7.26*
5/7/2020	Greenbriar	DS	27.18 (26.09, 28.26)	10.69	16.49*	6.18	21*	15.00	12.18*	16.00	11.18*
5/7/2020	Greenbriar	GS	19.69 (18.07, 21.32)	10.69	9*	6.18	13.51*	15.00	4.69*	16.00	3.69*
6/8/2020	Greenbriar	CT	15.07 (14.45, 15.69)	9.93	5.14*	6.50	8.57*	15.00	0.07	16.00	-0.93*
6/8/2020	Greenbriar	DS	15.45 (14.89, 16)	9.93	5.52*	6.50	8.95*	15.00	0.45*	16.00	-0.55
6/8/2020	Greenbriar	GS	16.29 (15.11, 17.46)	9.93	6.36*	6.50	9.79*	15.00	1.29*	16.00	0.29
7/3/2020	Greenbriar	CT	12.88 (12.18, 13.58)	9.25	3.63*	7.00	5.88*	14.00	-1.12*	16.00	-3.12*
7/3/2020	Greenbriar	DS	14.06 (13.39, 14.72)	9.25	4.81*	7.00	7.06*	14.00	0.06*	16.00	-1.94*
7/3/2020	Greenbriar	GS	15.83 (14.96, 16.69)	9.25	6.58*	7.00	8.83*	14.00	1.83	16.00	-0.17
8/8/2020	Greenbriar	CT	12.29 (11.7, 12.89)	8.54	3.75*	7.30	4.99*	13.00	-0.71*	16.00	-3.71*
8/8/2020	Greenbriar	DS	12.54 (11.98, 13.1)	8.54	4*	7.30	5.24*	13.00	-0.46	16.00	-3.46*
8/8/2020	Greenbriar	GS	15.14 (13.95, 16.32)	8.54	6.6*	7.30	7.84*	13.00	2.14	16.00	-0.86
9/8/2020	Greenbriar	DS	11.57 (10.86, 12.28)	7.92	3.65*	8.78	2.79*	11.00	0.57	13.00	-1.43*
9/8/2020	Greenbriar	GS	12.57 (11.85, 13.3)	7.92	4.65*	8.78	3.79*	11.00	1.57*	13.00	-0.43
10/8/2020	Greenbriar	DS	10.06 (9.11, 11.01)	5.99	4.07*	10.10	-0.04*	11.00	-0.94	13.00	-2.94*
10/8/2020	Greenbriar	GS	12.05 (11.33, 12.76)	5.99	6.06*	10.10	1.95*	11.00	1.05*	13.00	-0.95*
5/6/2019	Little bluestem	CT	2.59 (2.06, 3.13)	10.69	-8.1*	6.18	-3.59*	15.00	-12.41*	16.00	-13.41*
5/6/2019	Little bluestem	DS	17.31 (16.91, 17.72)	10.69	6.62*	6.18	11.13*	15.00	2.31*	16.00	1.31*
6/10/2019	Little bluestem	CT	6.54 (5.78, 7.3)	9.93	-3.39*	6.50	0.04	15.00	-8.46*	16.00	-9.46*
6/10/2019	Little bluestem	DS	10.49 (9.68, 11.31)	9.93	0.56*	6.50	3.99*	15.00	-4.51*	16.00	-5.51*
7/9/2019	Little bluestem	CT	7.42 (6.75, 8.09)	9.25	-1.83*	7.00	0.42	14.00	-6.58*	16.00	-8.58*
7/9/2019	Little bluestem	DS	9.21 (8.61, 9.81)	9.25	-0.04	7.00	2.21*	14.00	-4.79*	16.00	-6.79*
8/12/2019	Little bluestem	CT	6.8 (6.2, 7.39)	8.54	-1.74	7.30	-0.5*	13.00	-6.2*	16.00	-9.2*
8/12/2019	Little bluestem	DS	8.22 (7.38, 9.05)	8.54	-0.32*	7.30	0.92*	13.00	-4.78*	16.00	-7.78*
8/12/2019	Little bluestem	GS	10.84 (9.84, 11.85)	8.54	2.3	7.30	3.54*	13.00	-2.16*	16.00	-5.16*
9/10/2019	Little bluestem	CT	5.68 (5.04, 6.31)	7.92	-2.24	8.78	-3.1*	11.00	-5.32*	13.00	-7.32*
9/10/2019	Little bluestem	DS	8.8 (7.21, 10.4)	7.92	0.88*	8.78	0.02	11.00	-2.2	13.00	-4.2*

9/10/2019	Little bluestem	GS	10.4 (7.43, 13.37)	7.92	2.48*	8.78	1.62	11.00	-0.6	13.00	-2.6
10/11/2019	Little bluestem	CT	5.93 (4.97, 6.89)	5.99	-0.06	10.10	-4.17*	11.00	-5.07*	13.00	-7.07*
10/11/2019	Little bluestem	DS	6.03 (5.3, 6.76)	5.99	0.04	10.10	-4.07*	11.00	-4.97*	13.00	-6.97*
10/11/2019	Little bluestem	GS	8.3 (7.72, 8.88)	5.99	2.31*	10.10	-1.8*	11.00	-2.7*	13.00	-4.7*
11/13/2019	Little bluestem	CT	4.49 (4, 4.99)	6.18	-1.69*	10.69	-6.2*	8.50	-4.01*	13.00	-8.51*
11/13/2019	Little bluestem	DS	4.17 (3.65, 4.7)	6.18	-2.01*	10.69	-6.52*	8.50	-4.33*	13.00	-8.83*
11/13/2019	Little bluestem	GS	6.16 (5.54, 6.79)	6.18	-0.02*	10.69	-4.53*	8.50	-2.34*	13.00	-6.84*
12/9/2019	Little bluestem	CT	5.1 (4.54, 5.66)	6.50	-1.4*	9.93	-4.83*	8.50	-3.4*	13.00	-7.9*
12/9/2019	Little bluestem	DS	4.5 (4.07, 4.93)	6.50	-2*	9.93	-5.43*	8.50	-4*	13.00	-8.5*
12/9/2019	Little bluestem	GS	4.51 (3.82, 5.21)	6.50	-1.99*	9.93	-5.42*	8.50	-3.99*	13.00	-8.49*
1/8/2020	Little bluestem	CT	4.84 (4.27, 5.4)	7.00	-2.16*	9.25	-4.41*	13.00	-8.16*	8.50	-3.66*
1/8/2020	Little bluestem	DS	4.86 (3.83, 5.89)	7.00	-2.14*	9.25	-4.39*	13.00	-8.14*	8.50	-3.64*
1/8/2020	Little bluestem	GS	5.16 (3.87, 6.45)	7.00	-1.84*	9.25	-4.09	13.00	-7.84*	8.50	-3.34*
2/10/2020	Little bluestem	CT	5.38 (4.8, 5.96)	7.30	-1.92*	8.54	-3.16*	13.00	-7.62*	8.50	-3.12*
2/10/2020	Little bluestem	DS	4.28 (3.48, 5.08)	7.30	-3.02*	8.54	-4.26*	13.00	-8.72*	8.50	-4.22*
2/10/2020	Little bluestem	GS	3.74 (2.6, 4.88)	7.30	-3.56*	8.54	-4.8*	13.00	-9.26*	8.50	-4.76*
3/6/2020	Little bluestem	CT	6.07 (5.68, 6.46)	8.78	-2.71*	7.92	-1.85*	13.00	-6.93*	8.50	-2.43*
3/6/2020	Little bluestem	DS	5.5 (5.15, 5.85)	8.78	-3.28*	7.92	-2.42*	13.00	-7.5*	8.50	-3*
3/6/2020	Little bluestem	GS	5.16 (4.51, 5.81)	8.78	-3.62*	7.92	-2.76*	13.00	-7.84*	8.50	-3.34*
4/10/2020	Little bluestem	CT	4.21 (3.34, 5.07)	10.10	-5.89*	5.99	-1.78*	14.00	-9.79*	16.00	-11.79*
4/10/2020	Little bluestem	DS	6.96 (6.38, 7.54)	10.10	-3.14	5.99	0.97*	14.00	-7.04*	16.00	-9.04*
4/10/2020	Little bluestem	GS	8.14 (6.95, 9.32)	10.10	-1.96	5.99	2.15	14.00	-5.86*	16.00	-7.86
5/7/2020	Little bluestem	CT	6.16 (5.33, 6.99)	10.69	-4.53*	6.18	-0.02*	15.00	-8.84*	16.00	-9.84*
5/7/2020	Little bluestem	DS	8.02 (7.32, 8.73)	10.69	-2.67	6.18	1.84*	15.00	-6.98*	16.00	-7.98*
5/7/2020	Little bluestem	GS	9.05 (8.27, 9.83)	10.69	-1.64	6.18	2.87	15.00	-5.95*	16.00	-6.95*
6/8/2020	Little bluestem	CT	7.76 (7.35, 8.18)	9.93	-2.17*	6.50	1.26*	15.00	-7.24*	16.00	-8.24*
6/8/2020	Little bluestem	DS	6.76 (6.29, 7.24)	9.93	-3.17*	6.50	0.26	15.00	-8.24*	16.00	-9.24*

6/8/2020	Little bluestem	GS	6.85 (6.37, 7.32)	9.93	-3.08*	6.50	0.35	15.00	-8.15*	16.00	-9.15*
7/3/2020	Little bluestem	CT	6.22 (5.74, 6.7)	9.25	-3.03*	7.00	-0.78	14.00	-7.78*	16.00	-9.78*
7/3/2020	Little bluestem	DS	6.37 (5.74, 6.99)	9.25	-2.88*	7.00	-0.63	14.00	-7.63*	16.00	-9.63*
7/3/2020	Little bluestem	GS	6.98 (6.49, 7.47)	9.25	-2.27*	7.00	-0.02	14.00	-7.02*	16.00	-9.02*
8/8/2020	Little bluestem	CT	6.61 (6.09, 7.14)	8.54	-1.93*	7.30	-0.69*	13.00	-6.39*	16.00	-9.39*
8/8/2020	Little bluestem	DS	5.87 (5.46, 6.27)	8.54	-2.67*	7.30	-1.43	13.00	-7.13*	16.00	-10.13*
8/8/2020	Little bluestem	GS	6.08 (5.54, 6.63)	8.54	-2.46*	7.30	-1.22	13.00	-6.92*	16.00	-9.92*
9/8/2020	Little bluestem	DS	7.16 (6.54, 7.77)	7.92	-0.76*	8.78	-1.62*	11.00	-3.84*	13.00	-5.84*
9/8/2020	Little bluestem	GS	6.89 (6.02, 7.75)	7.92	-1.03*	8.78	-1.89*	11.00	-4.11*	13.00	-6.11*
10/8/2020	Little bluestem	DS	5.31 (4.28, 6.35)	5.99	-0.68*	10.10	-4.79*	11.00	-5.69*	13.00	-7.69*
10/8/2020	Little bluestem	GS	4.53 (3.79, 5.26)	5.99	-1.46*	10.10	-5.57*	11.00	-6.47*	13.00	-8.47*
5/6/2019	Scribner's panicum	CT	15.18 (14.35, 16.01)	10.69	4.49*	6.18	9*	15.00	0.18*	16.00	-0.82*
5/6/2019	Scribner's panicum	DS	18.59 (17.66, 19.51)	10.69	7.9*	6.18	12.41*	15.00	3.59*	16.00	2.59*
6/10/2019	Scribner's panicum	CT	10.34 (9.12, 11.56)	9.93	0.41*	6.50	3.84*	15.00	-4.66*	16.00	-5.66*
6/10/2019	Scribner's panicum	DS	12.54 (11.79, 13.29)	9.93	2.61*	6.50	6.04*	15.00	-2.46	16.00	-3.46*
7/9/2019	Scribner's panicum	CT	8.87 (7.92, 9.82)	9.25	-0.38	7.00	1.87*	14.00	-5.13*	16.00	-7.13*
7/9/2019	Scribner's panicum	DS	10.22 (9.07, 11.38)	9.25	0.97	7.00	3.22*	14.00	-3.78*	16.00	-5.78*
8/12/2019	Scribner's panicum	CT	8.54 (7.83, 9.24)	8.54	0*	7.30	1.24*	13.00	-4.46*	16.00	-7.46*
8/12/2019	Scribner's panicum	DS	8.52 (7.64, 9.4)	8.54	-0.02*	7.30	1.22*	13.00	-4.48*	16.00	-7.48*
8/12/2019	Scribner's panicum	GS	15.97 (13.08, 18.86)	8.54	7.43*	7.30	8.67*	13.00	2.97	16.00	-0.03
9/10/2019	Scribner's panicum	CT	8.94 (7.98, 9.9)	7.92	1.02*	8.78	0.16*	11.00	-2.06	13.00	-4.06*
9/10/2019	Scribner's panicum	DS	8.43 (4.08, 12.78)	7.92	0.51	8.78	-0.35	11.00	-2.57	13.00	-4.57*
9/10/2019	Scribner's panicum	GS	10.87 (7.07, 14.66)	7.92	2.95*	8.78	2.09	11.00	-0.14	13.00	-2.14
10/11/2019	Scribner's panicum	CT	8.38 (7.62, 9.14)	5.99	2.39*	10.10	-1.72*	11.00	-2.62*	13.00	-4.62*
10/11/2019	Scribner's panicum	DS	9.61 (8.6, 10.62)	5.99	3.62*	10.10	-0.49	11.00	-1.39*	13.00	-3.39*
10/11/2019	Scribner's panicum	GS	11.01 (9.33, 12.68)	5.99	5.02*	10.10	0.91	11.00	0.01	13.00	-1.99*
11/13/2019	Scribner's panicum	CT	6.78 (6.21, 7.34)	6.18	0.6*	10.69	-3.91*	8.50	-1.72*	13.00	-6.22*

11/13/2019	Scribner's panicum	DS	7.03 (6.33, 7.72)	6.18	0.85*	10.69	-3.66*	8.50	-1.47*	13.00	-5.97*
11/13/2019	Scribner's panicum	GS	4.48 (2.81, 6.15)	6.18	-1.7*	10.69	-6.21*	8.50	-4.02*	13.00	-8.52*
12/9/2019	Scribner's panicum	CT	7.83 (7.33, 8.32)	6.50	1.33*	9.93	-2.1*	8.50	-0.67*	13.00	-5.17*
12/9/2019	Scribner's panicum	DS	6.77 (6, 7.53)	6.50	0.27*	9.93	-3.16	8.50	-1.73*	13.00	-6.23*
12/9/2019	Scribner's panicum	GS	4 (2.05, 5.96)	6.50	-2.5*	9.93	-5.93*	8.50	-4.5*	13.00	-9*
1/8/2020	Scribner's panicum	CT	6.96 (6.15, 7.76)	7.00	-0.04*	9.25	-2.29	13.00	-6.04*	8.50	-1.54*
1/8/2020	Scribner's panicum	DS	6.92 (6.41, 7.42)	7.00	-0.08*	9.25	-2.33*	13.00	-6.08*	8.50	-1.58*
1/8/2020	Scribner's panicum	GS	5.34 (4.04, 6.64)	7.00	-1.66*	9.25	-3.91	13.00	-7.66*	8.50	-3.16*
2/10/2020	Scribner's panicum	CT	6.76 (6.13, 7.38)	7.30	-0.54*	8.54	-1.78	13.00	-6.24*	8.50	-1.74*
2/10/2020	Scribner's panicum	DS	6.12 (4.66, 7.59)	7.30	-1.18*	8.54	-2.42	13.00	-6.88*	8.50	-2.38*
2/10/2020	Scribner's panicum	GS	4.99 (1.77, 8.21)	7.30	-2.31*	8.54	-3.55	13.00	-8.01*	8.50	-3.51*
3/6/2020	Scribner's panicum	CT	8.02 (7.38, 8.66)	8.78	-0.76*	7.92	0.1*	13.00	-4.98*	8.50	-0.48*
3/6/2020	Scribner's panicum	DS	7.27 (6.68, 7.85)	8.78	-1.51*	7.92	-0.65	13.00	-5.73*	8.50	-1.23*
3/6/2020	Scribner's panicum	GS	3.44 (2.18, 4.7)	8.78	-5.34*	7.92	-4.48*	13.00	-9.56*	8.50	-5.06*
4/10/2020	Scribner's panicum	CT	14.58 (13.56, 15.59)	10.10	4.48*	5.99	8.59*	14.00	0.58*	16.00	-1.42*
4/10/2020	Scribner's panicum	DS	14.48 (12.03, 16.92)	10.10	4.38*	5.99	8.49*	14.00	0.48	16.00	-1.52*
4/10/2020	Scribner's panicum	GS	13.91 (12.62, 15.2)	10.10	3.81*	5.99	7.92*	14.00	-0.09	16.00	-2.09*
5/7/2020	Scribner's panicum	CT	11.99 (11.1, 12.89)	10.69	1.3*	6.18	5.81*	15.00	-3.01*	16.00	-4.01*
5/7/2020	Scribner's panicum	DS	10.91 (9.34, 12.47)	10.69	0.22*	6.18	4.73*	15.00	-4.09*	16.00	-5.09*
5/7/2020	Scribner's panicum	GS	9.46 (8.75, 10.17)	10.69	-1.23*	6.18	3.28*	15.00	-5.54*	16.00	-6.54*
6/8/2020	Scribner's panicum	CT	6.92 (6.3, 7.55)	9.93	-3.01*	6.50	0.42	15.00	-8.08*	16.00	-9.08*
6/8/2020	Scribner's panicum	DS	6.39 (5.83, 6.96)	9.93	-3.54*	6.50	-0.11*	15.00	-8.61*	16.00	-9.61*
6/8/2020	Scribner's panicum	GS	5.87 (5.35, 6.39)	9.93	-4.06*	6.50	-0.63*	15.00	-9.13*	16.00	-10.13*
7/3/2020	Scribner's panicum	CT	6.81 (6.19, 7.43)	9.25	-2.44*	7.00	-0.19	14.00	-7.19*	16.00	-9.19*
7/3/2020	Scribner's panicum	DS	6 (5.47, 6.53)	9.25	-3.25*	7.00	-1	14.00	-8*	16.00	-10*
7/3/2020	Scribner's panicum	GS	5.94 (5.23, 6.65)	9.25	-3.31*	7.00	-1.06	14.00	-8.06*	16.00	-10.06*
8/8/2020	Scribner's panicum	CT	6.62 (5.98, 7.26)	8.54	-1.92*	7.30	-0.68*	13.00	-6.38*	16.00	-9.38*

8/8/2020	Scribner's panicum	DS	6.1 (5.75, 6.45)	8.54	-2.44*	7.30	-1.2	13.00	-6.9*	16.00	-9.9*
8/8/2020	Scribner's panicum	GS	5.38 (4.64, 6.13)	8.54	-3.16*	7.30	-1.92*	13.00	-7.62*	16.00	-10.62*
9/8/2020	Scribner's panicum	DS	7.33 (6.8, 7.86)	7.92	-0.59*	8.78	-1.45*	11.00	-3.67*	13.00	-5.67*
9/8/2020	Scribner's panicum	GS	6.34 (5.68, 7)	7.92	-1.58	8.78	-2.44*	11.00	-4.66*	13.00	-6.66*
10/8/2020	Scribner's panicum	DS	6.64 (5.64, 7.63)	5.99	0.65*	10.10	-3.46*	11.00	-4.36*	13.00	-6.36*
10/8/2020	Scribner's panicum	GS	5.75 (4.83, 6.68)	5.99	-0.24*	10.10	-4.35*	11.00	-5.25*	13.00	-7.25*

Appendix B. TDN data by date, treatment (control [CT], dormant season [DS], and growing season [GS]), plant species, and animal requirement (value). Showing the mean and CIs for each and the difference between the mean and animal nutrient requirement value. Positive difference means the plants mean TDN was higher than the animal's requirement value; negative difference means the plants mean TDN was lower than animal's requirement value.

[1]*Indicates statistically significant at $\alpha < 0.05$

				Spring Cow		Fall Cow		Female Deer		Male Deer	
Date	Plant	Treatment	Mean (Lower, Upper CI)	Value	Difference[1]	Value	Difference[1]	Value	Difference[1]	Value	Difference[1]
5/6/2019	Ragweed	CT	59.6 (58.61, 60.6)	59.90	-0.3*	45.80	13.8*	59.00	0.6*	55.00	4.6
5/6/2019	Ragweed	DS	64.29 (63.13, 65.45)	59.90	4.39*	45.80	18.49*	59.00	5.29*	55.00	9.29*
6/10/2019	Ragweed	CT	58.01 (56.78, 59.25)	57.60	0.41*	47.10	10.91*	64.00	-5.99*	55.00	3.01*
6/10/2019	Ragweed	DS	59.21 (58.51, 59.91)	57.60	1.61*	47.10	12.11*	64.00	-4.79*	55.00	4.21*
7/9/2019	Ragweed	CT	63.89 (62.92, 64.86)	56.20	7.69*	49.30	14.59*	64.00	-0.11	55.00	8.89*
7/9/2019	Ragweed	DS	66.17 (65.24, 67.09)	56.20	9.97*	49.30	16.87*	64.00	2.17*	55.00	11.17*
8/12/2019	Ragweed	CT	64.19 (62.3, 66.08)	54.70	9.49*	52.30	11.89*	61.00	3.19*	55.00	9.19*
8/12/2019	Ragweed	DS	65.82 (64, 67.63)	54.70	11.12*	52.30	13.52*	61.00	4.82*	55.00	10.82*
9/10/2019	Ragweed	CT	63.79 (61.63, 65.95)	53.40	10.39*	56.20	7.59*	61.00	2.79*	60.00	3.79*
9/10/2019	Ragweed	DS	66.49 (63.78, 69.19)	53.40	13.09*	56.20	10.29*	61.00	5.49*	60.00	6.49*
9/10/2019	Ragweed	GS	61.56 (57.91, 65.21)	53.40	8.16*	56.20	5.36*	61.00	0.56*	60.00	1.56
10/11/2019	Ragweed	CT	65.06 (63.2, 66.91)	44.90	20.16*	58.70	6.36*	61.00	4.06*	60.00	5.06*
10/11/2019	Ragweed	DS	69.03 (67.93, 70.14)	44.90	24.13*	58.70	10.33*	61.00	8.03*	60.00	9.03*
10/11/2019	Ragweed	GS	65.54 (63.56, 67.52)	44.90	20.64*	58.70	6.84*	61.00	4.54*	60.00	5.54*
5/7/2020	Ragweed	CT	64.98 (63.72, 66.24)	59.90	5.08*	45.80	19.18*	59.00	5.98*	55.00	9.98*
5/7/2020	Ragweed	DS	67.1 (65.59, 68.61)	59.90	7.2*	45.80	21.3*	59.00	8.1*	55.00	12.1*
5/7/2020	Ragweed	GS	63.88 (62.55, 65.21)	59.90	3.98*	45.80	18.08*	59.00	4.88*	55.00	8.88*
6/8/2020	Ragweed	CT	56.57 (55.36, 57.78)	57.60	-1.03	47.10	9.47*	64.00	-7.43*	55.00	1.57*
6/8/2020	Ragweed	DS	56.08 (54.55, 57.6)	57.60	-1.52	47.10	8.98*	64.00	-7.92*	55.00	1.08
6/8/2020	Ragweed	GS	58.46 (57.29, 59.64)	57.60	0.86*	47.10	11.36*	64.00	-5.54*	55.00	3.46*
7/3/2020	Ragweed	CT	58.46 (55.57, 61.35)	56.20	2.26	49.30	9.16*	64.00	-5.54	55.00	3.46*
7/3/2020	Ragweed	DS	63.55 (61.5, 65.6)	56.20	7.35*	49.30	14.25*	64.00	-0.45	55.00	8.55*
7/3/2020	Ragweed	GS	62.03 (60.08, 63.98)	56.20	5.83*	49.30	12.73*	64.00	-1.97*	55.00	7.03*
8/8/2020	Ragweed	CT	62.15 (60.11, 64.18)	54.70	7.45*	52.30	9.85*	61.00	1.15*	55.00	7.15*
8/8/2020	Ragweed	DS	64.12 (61.9, 66.34)	54.70	9.42*	52.30	11.82*	61.00	3.12*	55.00	9.12*
8/8/2020	Ragweed	GS	62.67 (60.7, 64.65)	54.70	7.97*	52.30	10.37*	61.00	1.67*	55.00	7.67*
9/8/2020	Ragweed	DS	64.47 (62.48, 66.45)	53.40	11.07*	56.20	8.27*	61.00	3.47*	60.00	4.47*
9/8/2020	Ragweed	GS	63.8 (61.66, 65.94)	53.40	10.4*	56.20	7.6*	61.00	2.8*	60.00	3.8*
10/8/2020	Ragweed	DS	64.13 (62.82, 65.44)	44.90	19.23*	58.70	5.43*	61.00	3.13*	60.00	4.13*

10/8/2020	Ragweed	GS	64.41 (63.59, 65.23)	44.90	19.51*	58.70	5.71*	61.00	3.41*	60.00	4.41*
7/9/2019	Croton	CT	52.55 (46.71, 58.38)	56.20	-3.65	49.30	3.25	64.00	-11.45*	55.00	-2.45
7/9/2019	Croton	DS	63.03 (60.16, 65.9)	56.20	6.83*	49.30	13.73*	64.00	-0.97	55.00	8.03*
8/12/2019	Croton	CT	50 (46.92, 53.08)	54.70	-4.7	52.30	-2.3*	61.00	-11*	55.00	-5
8/12/2019	Croton	DS	58.69 (56.13, 61.25)	54.70	3.99	52.30	6.39*	61.00	-2.31	55.00	3.69*
9/10/2019	Croton	CT	53.69 (50.82, 56.56)	53.40	0.29*	56.20	-2.51*	61.00	-7.31	60.00	-6.31*
9/10/2019	Croton	DS	58.23 (51.4, 65.06)	53.40	4.83*	56.20	2.03	61.00	-2.77*	60.00	-1.77
10/11/2019	Croton	CT	50.93 (47.79, 54.07)	44.90	6.03*	58.70	-7.77*	61.00	-10.07*	60.00	-9.07*
10/11/2019	Croton	DS	50.84 (48.48, 53.19)	44.90	5.94*	58.70	-7.86*	61.00	-10.16*	60.00	-9.16*
7/3/2020	Croton	GS	54.49 (52.53, 56.46)	56.20	-1.71*	49.30	5.19*	64.00	-9.51*	55.00	-0.51
8/8/2020	Croton	DS	53.94 (21.16, 86.72)	54.70	-0.76	52.30	1.64	61.00	-7.06	55.00	-1.06
8/8/2020	Croton	GS	55.97 (54.53, 57.41)	54.70	1.27*	52.30	3.67*	61.00	-5.03*	55.00	0.97
9/8/2020	Croton	DS	60.26 (58.66, 61.86)	53.40	6.86*	56.20	4.06	61.00	-0.74	60.00	0.26
9/8/2020	Croton	GS	56.48 (54.2, 58.76)	53.40	3.08*	56.20	0.28	61.00	-4.52*	60.00	-3.52*
10/8/2020	Croton	GS	48.36 (47.1, 49.62)	44.90	3.46*	58.70	-10.34*	61.00	-12.64*	60.00	-11.64*
5/6/2019	Slender lespedeza	CT	52.88 (52.05, 53.71)	59.90	-7.02	45.80	7.08*	59.00	-6.12*	55.00	-2.12*
5/6/2019	Slender lespedeza	DS	55.35 (54.49, 56.22)	59.90	-4.55*	45.80	9.55	59.00	-3.65*	55.00	0.35*
6/10/2019	Slender lespedeza	CT	51.32 (50.32, 52.31)	57.60	-6.28*	47.10	4.22	64.00	-12.68*	55.00	-3.68*
6/10/2019	Slender lespedeza	DS	52.15 (51.29, 53.01)	57.60	-5.45*	47.10	5.05	64.00	-11.85*	55.00	-2.85*
7/9/2019	Slender lespedeza	CT	53.31 (52.47, 54.15)	56.20	-2.89*	49.30	4.01*	64.00	-10.69*	55.00	-1.69*
7/9/2019	Slender lespedeza	DS	55.1 (54.15, 56.05)	56.20	-1.1*	49.30	5.8*	64.00	-8.9*	55.00	0.1
8/12/2019	Slender lespedeza	CT	52.6 (51.27, 53.92)	54.70	-2.1*	52.30	0.3*	61.00	-8.4*	55.00	-2.4*
8/12/2019	Slender lespedeza	DS	56.13 (54.94, 57.33)	54.70	1.43*	52.30	3.83*	61.00	-4.87*	55.00	1.13
9/10/2019	Slender lespedeza	CT	55.42 (53.91, 56.93)	53.40	2.02*	56.20	-0.78*	61.00	-5.58*	60.00	-4.58*
9/10/2019	Slender lespedeza	DS	57.4 (55.61, 59.2)	53.40	4*	56.20	1.2	61.00	-3.6*	60.00	-2.6*
9/10/2019	Slender lespedeza	GS	59.03 (55.23, 62.83)	53.40	5.63*	56.20	2.83	61.00	-1.97*	60.00	-0.97
10/11/2019	Slender lespedeza	CT	50.65 (47.49, 53.82)	44.90	5.75*	58.70	-8.05*	61.00	-10.35*	60.00	-9.35*

10/11/2019	Slender lespedeza	DS	53.59 (52.31, 54.86)	44.90	8.69*	58.70	-5.11*	61.00	-7.41*	60.00	-6.41*
10/11/2019	Slender lespedeza	GS	58.39 (56.05, 60.73)	44.90	13.49*	58.70	-0.31	61.00	-2.61*	60.00	-1.61
5/7/2020	Slender lespedeza	CT	58.38 (57.57, 59.19)	59.90	-1.52*	45.80	12.58*	59.00	-0.62*	55.00	3.38*
5/7/2020	Slender lespedeza	DS	57.9 (57.35, 58.46)	59.90	-2*	45.80	12.1*	59.00	-1.1*	55.00	2.9*
5/7/2020	Slender lespedeza	GS	56.29 (55.56, 57.01)	59.90	-3.61*	45.80	10.49*	59.00	-2.71*	55.00	1.29*
6/8/2020	Slender lespedeza	CT	51.79 (50.67, 52.91)	57.60	-5.81*	47.10	4.69*	64.00	-12.21*	55.00	-3.21*
6/8/2020	Slender lespedeza	DS	55.08 (54.61, 55.55)	57.60	-2.52*	47.10	7.98*	64.00	-8.92*	55.00	0.08
6/8/2020	Slender lespedeza	GS	53.35 (52.09, 54.61)	57.60	-4.25*	47.10	6.25*	64.00	-10.65*	55.00	-1.65*
7/3/2020	Slender lespedeza	CT	53.17 (52.61, 53.72)	56.20	-3.03*	49.30	3.87*	64.00	-10.83*	55.00	-1.83*
7/3/2020	Slender lespedeza	DS	54.89 (54.18, 55.6)	56.20	-1.31*	49.30	5.59*	64.00	-9.11*	55.00	-0.11
7/3/2020	Slender lespedeza	GS	55.07 (54.6, 55.53)	56.20	-1.13*	49.30	5.77*	64.00	-8.93*	55.00	0.07
8/8/2020	Slender lespedeza	CT	55.5 (53.94, 57.07)	54.70	0.8	52.30	3.2*	61.00	-5.5	55.00	0.5*
8/8/2020	Slender lespedeza	DS	58.34 (57.75, 58.93)	54.70	3.64	52.30	6.04*	61.00	-2.66	55.00	3.34*
8/8/2020	Slender lespedeza	GS	57.58 (55.83, 59.34)	54.70	2.88*	52.30	5.28*	61.00	-3.42	55.00	2.58*
9/8/2020	Slender lespedeza	DS	53.95 (52.91, 54.99)	53.40	0.55*	56.20	-2.25*	61.00	-7.05*	60.00	-6.05*
9/8/2020	Slender lespedeza	GS	54.05 (53.19, 54.91)	53.40	0.65*	56.20	-2.15*	61.00	-6.95*	60.00	-5.95*
10/8/2020	Slender lespedeza	DS	50.73 (49.83, 51.63)	44.90	5.83*	58.70	-7.97*	61.00	-10.27*	60.00	-9.27*
10/8/2020	Slender lespedeza	GS	50.61 (49.59, 51.62)	44.90	5.71*	58.70	-8.09*	61.00	-10.39*	60.00	-9.39*
5/6/2019	Buckbrush	CT	65.42 (64.44, 66.39)	59.90	5.52*	45.80	19.62*	59.00	6.42*	55.00	10.42*
6/10/2019	Buckbrush	CT	62.82 (62.05, 63.58)	57.60	5.22*	47.10	15.72*	64.00	-1.18*	55.00	7.82*
6/10/2019	Buckbrush	DS	64.15 (63.32, 64.97)	57.60	6.55*	47.10	17.05*	64.00	0.15*	55.00	9.15*
7/9/2019	Buckbrush	CT	63.77 (62.67, 64.86)	56.20	7.57*	49.30	14.47*	64.00	-0.23	55.00	8.77*
7/9/2019	Buckbrush	DS	65.02 (64.06, 65.97)	56.20	8.82*	49.30	15.72*	64.00	1.02*	55.00	10.02*
8/12/2019	Buckbrush	CT	61.6 (60.68, 62.52)	54.70	6.9*	52.30	9.3*	61.00	0.6*	55.00	6.6*
8/12/2019	Buckbrush	DS	64.76 (63.91, 65.6)	54.70	10.06*	52.30	12.46*	61.00	3.76*	55.00	9.76*
9/10/2019	Buckbrush	CT	64.1 (63.32, 64.87)	53.40	10.7*	56.20	7.9*	61.00	3.1*	60.00	4.1*
9/10/2019	Buckbrush	DS	68.14 (61.01, 75.26)	53.40	14.74*	56.20	11.94*	61.00	7.14*	60.00	8.14*

10/11/2019	Buckbrush	CT	64.49 (62.75, 66.23)	44.90	19.59*	58.70	5.79*	61.00	3.49*	60.00	4.49*
10/11/2019	Buckbrush	DS	67.49 (66.35, 68.62)	44.90	22.59*	58.70	8.79*	61.00	6.49*	60.00	7.49*
11/13/2019	Buckbrush	CT	63.95 (62.27, 65.62)	45.80	18.15*	59.90	4.05*	51.00	12.95*	60.00	3.95*
11/13/2019	Buckbrush	DS	66.42 (65.66, 67.18)	45.80	20.62*	59.90	6.52*	51.00	15.42*	60.00	6.42*
4/10/2020	Buckbrush	CT	69.9 (69.29, 70.5)	58.70	11.2*	44.90	25*	58.00	11.9*	55.00	14.9*
4/10/2020	Buckbrush	DS	71.91 (71.38, 72.44)	58.70	13.21*	44.90	27.01*	58.00	13.91*	55.00	16.91*
4/10/2020	Buckbrush	GS	72.67 (71.84, 73.5)	58.70	13.97*	44.90	27.77*	58.00	14.67*	55.00	17.67*
5/7/2020	Buckbrush	CT	68.88 (68.43, 69.32)	59.90	8.98*	45.80	23.08*	59.00	9.88*	55.00	13.88*
5/7/2020	Buckbrush	DS	68.68 (68.13, 69.24)	59.90	8.78*	45.80	22.88*	59.00	9.68*	55.00	13.68*
5/7/2020	Buckbrush	GS	70.14 (69.5, 70.78)	59.90	10.24*	45.80	24.34*	59.00	11.14*	55.00	15.14*
6/8/2020	Buckbrush	CT	64.71 (64.29, 65.14)	57.60	7.11*	47.10	17.61*	64.00	0.71*	55.00	9.71*
6/8/2020	Buckbrush	DS	65.28 (64.94, 65.63)	57.60	7.68*	47.10	18.18*	64.00	1.28*	55.00	10.28*
6/8/2020	Buckbrush	GS	65.89 (65.13, 66.66)	57.60	8.29*	47.10	18.79*	64.00	1.89*	55.00	10.89*
7/3/2020	Buckbrush	CT	63.49 (63.01, 63.97)	56.20	7.29*	49.30	14.19*	64.00	-0.51*	55.00	8.49*
7/3/2020	Buckbrush	DS	65.5 (64.77, 66.23)	56.20	9.3*	49.30	16.2*	64.00	1.5*	55.00	10.5*
7/3/2020	Buckbrush	GS	64.24 (63.28, 65.2)	56.20	8.04*	49.30	14.94*	64.00	0.24	55.00	9.24*
8/8/2020	Buckbrush	CT	65.7 (65.22, 66.17)	54.70	11*	52.30	13.4*	61.00	4.7*	55.00	10.7*
8/8/2020	Buckbrush	DS	66.99 (66.02, 67.97)	54.70	12.29*	52.30	14.69*	61.00	5.99*	55.00	11.99*
8/8/2020	Buckbrush	GS	68.63 (68.05, 69.21)	54.70	13.93*	52.30	16.33*	61.00	7.63*	55.00	13.63*
9/8/2020	Buckbrush	DS	64.94 (63.96, 65.92)	53.40	11.54*	56.20	8.74*	61.00	3.94*	60.00	4.94*
9/8/2020	Buckbrush	GS	64.99 (63.79, 66.2)	53.40	11.59*	56.20	8.79*	61.00	3.99*	60.00	4.99*
10/8/2020	Buckbrush	DS	64.6 (63.73, 65.48)	44.90	19.7*	58.70	5.9*	61.00	3.6*	60.00	4.6*
10/8/2020	Buckbrush	GS	64.83 (64.47, 65.18)	44.90	19.93*	58.70	6.13*	61.00	3.83*	60.00	4.83*
5/6/2019	Greenbriar	CT	63.61 (62.39, 64.84)	59.90	3.71*	45.80	17.81*	59.00	4.61*	55.00	8.61*
6/10/2019	Greenbriar	CT	58.71 (57.95, 59.48)	57.60	1.11*	47.10	11.61*	64.00	-5.29*	55.00	3.71*
6/10/2019	Greenbriar	DS	62.31 (61.09, 63.53)	57.60	4.71*	47.10	15.21*	64.00	-1.69*	55.00	7.31*
7/9/2019	Greenbriar	CT	59.51 (58.91, 60.11)	56.20	3.31*	49.30	10.21*	64.00	-4.49*	55.00	4.51*

7/9/2019	Greenbriar	DS	63.09 (61.78, 64.41)	56.20	6.89*	49.30	13.79*	64.00	-0.91	55.00	8.09*
8/12/2019	Greenbriar	CT	60.91 (59.78, 62.03)	54.70	6.21*	52.30	8.61*	61.00	-0.09*	55.00	5.91*
8/12/2019	Greenbriar	DS	64.57 (63.15, 66)	54.70	9.87*	52.30	12.27*	61.00	3.57*	55.00	9.57*
9/10/2019	Greenbriar	CT	62.49 (61.12, 63.86)	53.40	9.09*	56.20	6.29*	61.00	1.49*	60.00	2.49*
9/10/2019	Greenbriar	DS	64.82 (60.99, 68.66)	53.40	11.42*	56.20	8.62*	61.00	3.82*	60.00	4.82*
10/11/2019	Greenbriar	CT	64.83 (62.78, 66.88)	44.90	19.93*	58.70	6.13*	61.00	3.83*	60.00	4.83*
10/11/2019	Greenbriar	DS	66.53 (65.37, 67.69)	44.90	21.63*	58.70	7.83*	61.00	5.53*	60.00	6.53*
11/13/2019	Greenbriar	CT	65.51 (63.21, 67.82)	45.80	19.71*	59.90	5.61*	51.00	14.51*	60.00	5.51*
11/13/2019	Greenbriar	DS	69.76 (69, 70.52)	45.80	23.96*	59.90	9.86*	51.00	18.76*	60.00	9.76*
12/9/2019	Greenbriar	DS	70.01 (68.84, 71.18)	47.10	22.91*	57.60	12.41*	51.00	19.01*	60.00	10.01*
12/9/2019	Greenbriar	CT	71.41 (70.13, 72.69)	47.10	24.31*	57.60	13.81*	51.00	20.41*	60.00	11.41*
5/7/2020	Greenbriar	CT	68.44 (65.9, 70.98)	59.90	8.54*	45.80	22.64*	59.00	9.44*	55.00	13.44*
5/7/2020	Greenbriar	DS	71.77 (70.96, 72.58)	59.90	11.87*	45.80	25.97*	59.00	12.77*	55.00	16.77*
5/7/2020	Greenbriar	GS	67.38 (66.18, 68.59)	59.90	7.48*	45.80	21.58*	59.00	8.38*	55.00	12.38*
6/8/2020	Greenbriar	CT	57.65 (57.14, 58.16)	57.60	0.05	47.10	10.55*	64.00	-6.35*	55.00	2.65*
6/8/2020	Greenbriar	DS	58.75 (58.2, 59.3)	57.60	1.15*	47.10	11.65*	64.00	-5.25*	55.00	3.75*
6/8/2020	Greenbriar	GS	60.3 (59.41, 61.19)	57.60	2.7*	47.10	13.2*	64.00	-3.7*	55.00	5.3*
7/3/2020	Greenbriar	CT	57.63 (57, 58.25)	56.20	1.43*	49.30	8.33*	64.00	-6.37*	55.00	2.63*
7/3/2020	Greenbriar	DS	59.41 (59.2, 59.63)	56.20	3.21*	49.30	10.11*	64.00	-4.59*	55.00	4.41*
7/3/2020	Greenbriar	GS	59.96 (59.09, 60.82)	56.20	3.76*	49.30	10.66*	64.00	-4.04*	55.00	4.96*
8/8/2020	Greenbriar	CT	60.15 (59.45, 60.85)	54.70	5.45*	52.30	7.85*	61.00	-0.85*	55.00	5.15*
8/8/2020	Greenbriar	DS	62.39 (61.26, 63.53)	54.70	7.69*	52.30	10.09*	61.00	1.39*	55.00	7.39*
8/8/2020	Greenbriar	GS	64.94 (64.12, 65.76)	54.70	10.24*	52.30	12.64*	61.00	3.94*	55.00	9.94*
9/8/2020	Greenbriar	DS	63.02 (62.25, 63.79)	53.40	9.62*	56.20	6.82*	61.00	2.02*	60.00	3.02*
9/8/2020	Greenbriar	GS	62.94 (61.45, 64.42)	53.40	9.54*	56.20	6.74*	61.00	1.94*	60.00	2.94*
10/8/2020	Greenbriar	DS	62.32 (61.49, 63.16)	44.90	17.42*	58.70	3.62*	61.00	1.32*	60.00	2.32*
10/8/2020	Greenbriar	GS	62.52 (61.41, 63.62)	44.90	17.62*	58.70	3.82*	61.00	1.52*	60.00	2.52*

5/6/2019	Little bluestem	CT	33.42 (32.31, 34.53)	59.90	-26.48*	45.80	-12.38*	59.00	-25.58*	55.00	-21.58*
5/6/2019	Little bluestem	DS	56.82 (55.9, 57.74)	59.90	-3.08*	45.80	11.02	59.00	-2.18*	55.00	1.82*
6/10/2019	Little bluestem	CT	41.5 (39.45, 43.55)	57.60	-16.1*	47.10	-5.6*	64.00	-22.5*	55.00	-13.5*
6/10/2019	Little bluestem	DS	49.45 (48.7, 50.19)	57.60	-8.15*	47.10	2.35*	64.00	-14.55*	55.00	-5.55*
7/9/2019	Little bluestem	CT	46.01 (44.33, 47.68)	56.20	-10.19*	49.30	-3.29*	64.00	-17.99*	55.00	-8.99*
7/9/2019	Little bluestem	DS	50.04 (48.85, 51.23)	56.20	-6.16*	49.30	0.74	64.00	-13.96*	55.00	-4.96*
8/12/2019	Little bluestem	CT	39.89 (38.29, 41.5)	54.70	-14.81*	52.30	-12.41*	61.00	-21.11*	55.00	-15.11*
8/12/2019	Little bluestem	DS	47.35 (45.79, 48.92)	54.70	-7.35*	52.30	-4.95	61.00	-13.65*	55.00	-7.65*
8/12/2019	Little bluestem	GS	45.96 (44.38, 47.54)	54.70	-8.74*	52.30	-6.34	61.00	-15.04*	55.00	-9.04*
9/10/2019	Little bluestem	CT	37.22 (35.13, 39.3)	53.40	-16.18*	56.20	-18.98*	61.00	-23.78*	60.00	-22.78*
9/10/2019	Little bluestem	DS	45.47 (43.77, 47.18)	53.40	-7.93	56.20	-10.73*	61.00	-15.53*	60.00	-14.53*
9/10/2019	Little bluestem	GS	44.07 (40.29, 47.85)	53.40	-9.33	56.20	-12.13*	61.00	-16.93*	60.00	-15.93*
10/11/2019	Little bluestem	CT	42.97 (40.92, 45.02)	44.90	-1.93	58.70	-15.73*	61.00	-18.03*	60.00	-17.03*
10/11/2019	Little bluestem	DS	44.44 (43.44, 45.45)	44.90	-0.46	58.70	-14.26*	61.00	-16.56*	60.00	-15.56*
10/11/2019	Little bluestem	GS	46.61 (45.65, 47.57)	44.90	1.71*	58.70	-12.09*	61.00	-14.39*	60.00	-13.39*
11/13/2019	Little bluestem	CT	37.91 (36.88, 38.94)	45.80	-7.89*	59.90	-21.99*	51.00	-13.09*	60.00	-22.09*
11/13/2019	Little bluestem	DS	39.38 (38.29, 40.48)	45.80	-6.42*	59.90	-20.52*	51.00	-11.62*	60.00	-20.62*
11/13/2019	Little bluestem	GS	41.22 (39.77, 42.67)	45.80	-4.58*	59.90	-18.68*	51.00	-9.78*	60.00	-18.78*
12/9/2019	Little bluestem	CT	36.14 (34.97, 37.31)	47.10	-10.96*	57.60	-21.46*	51.00	-14.86*	60.00	-23.86*
12/9/2019	Little bluestem	DS	36.53 (35.86, 37.19)	47.10	-10.57*	57.60	-21.07*	51.00	-14.47*	60.00	-23.47*
12/9/2019	Little bluestem	GS	36.76 (34.47, 39.05)	47.10	-10.34*	57.60	-20.84*	51.00	-14.24*	60.00	-23.24*
1/8/2020	Little bluestem	CT	36.93 (35.45, 38.41)	49.30	-12.37*	56.20	-19.27*	57.00	-20.07*	51.00	-14.07*
1/8/2020	Little bluestem	DS	37.66 (35.55, 39.76)	49.30	-11.64*	56.20	-18.54*	57.00	-19.34*	51.00	-13.34*
1/8/2020	Little bluestem	GS	33.85 (31.79, 35.91)	49.30	-15.45*	56.20	-22.35*	57.00	-23.15*	51.00	-17.15*
2/10/2020	Little bluestem	CT	38.13 (36.79, 39.48)	52.30	-14.17*	54.70	-16.57*	57.00	-18.87*	51.00	-12.87*
2/10/2020	Little bluestem	DS	35.63 (33.3, 37.96)	52.30	-16.67*	54.70	-19.07*	57.00	-21.37*	51.00	-15.37*
2/10/2020	Little bluestem	GS	27.35 (23.06, 31.64)	52.30	-24.95*	54.70	-27.35*	57.00	-29.65*	51.00	-23.65*

3/6/2020	Little bluestem	CT	38.7 (37.9, 39.5)	56.20	-17.5*	53.40	-14.7*	57.00	-18.3*	51.00	-12.3*
3/6/2020	Little bluestem	DS	39.1 (38.05, 40.16)	56.20	-17.1*	53.40	-14.3*	57.00	-17.9*	51.00	-11.9*
3/6/2020	Little bluestem	GS	36.49 (35.24, 37.75)	56.20	-19.71*	53.40	-16.91*	57.00	-20.51*	51.00	-14.51*
4/10/2020	Little bluestem	CT	35.34 (33.55, 37.13)	58.70	-23.36*	44.90	-9.56*	58.00	-22.66*	55.00	-19.66*
4/10/2020	Little bluestem	DS	41.65 (40.09, 43.21)	58.70	-17.05*	44.90	-3.25*	58.00	-16.35*	55.00	-13.35*
4/10/2020	Little bluestem	GS	41.69 (39.4, 43.98)	58.70	-17.01*	44.90	-3.21*	58.00	-16.31*	55.00	-13.31*
5/7/2020	Little bluestem	CT	40.73 (38.46, 42.99)	59.90	-19.17*	45.80	-5.07*	59.00	-18.27*	55.00	-14.27*
5/7/2020	Little bluestem	DS	46.58 (44.21, 48.94)	59.90	-13.32*	45.80	0.78*	59.00	-12.42*	55.00	-8.42*
5/7/2020	Little bluestem	GS	50.84 (48.66, 53.01)	59.90	-9.06*	45.80	5.04	59.00	-8.16*	55.00	-4.16*
6/8/2020	Little bluestem	CT	47.05 (45.83, 48.27)	57.60	-10.55*	47.10	-0.05	64.00	-16.95*	55.00	-7.95*
6/8/2020	Little bluestem	DS	48.1 (47.16, 49.04)	57.60	-9.5*	47.10	1*	64.00	-15.9*	55.00	-6.9*
6/8/2020	Little bluestem	GS	49.05 (48.13, 49.96)	57.60	-8.55*	47.10	1.95	64.00	-14.95*	55.00	-5.95*
7/3/2020	Little bluestem	CT	46.53 (45.02, 48.05)	56.20	-9.67*	49.30	-2.77	64.00	-17.47*	55.00	-8.47*
7/3/2020	Little bluestem	DS	46.18 (45.13, 47.24)	56.20	-10.02*	49.30	-3.12	64.00	-17.82*	55.00	-8.82*
7/3/2020	Little bluestem	GS	48.39 (47.22, 49.57)	56.20	-7.81*	49.30	-0.91*	64.00	-15.61*	55.00	-6.61*
8/8/2020	Little bluestem	CT	45.01 (43.63, 46.4)	54.70	-9.69*	52.30	-7.29*	61.00	-15.99*	55.00	-9.99*
8/8/2020	Little bluestem	DS	45.83 (44.75, 46.91)	54.70	-8.87*	52.30	-6.47	61.00	-15.17*	55.00	-9.17*
8/8/2020	Little bluestem	GS	46.07 (44.86, 47.28)	54.70	-8.63*	52.30	-6.23	61.00	-14.93*	55.00	-8.93*
9/8/2020	Little bluestem	DS	44.87 (43.38, 46.36)	53.40	-8.53	56.20	-11.33*	61.00	-16.13*	60.00	-15.13*
9/8/2020	Little bluestem	GS	45.02 (42.47, 47.56)	53.40	-8.38	56.20	-11.18*	61.00	-15.98*	60.00	-14.98*
10/8/2020	Little bluestem	DS	43.56 (41.82, 45.31)	44.90	-1.34*	58.70	-15.14*	61.00	-17.44*	60.00	-16.44*
10/8/2020	Little bluestem	GS	42.57 (41.16, 43.97)	44.90	-2.33*	58.70	-16.13*	61.00	-18.43*	60.00	-17.43*
5/6/2019	Scribner's panicum	CT	57.09 (55.62, 58.55)	59.90	-2.81*	45.80	11.29	59.00	-1.91*	55.00	2.09*
5/6/2019	Scribner's panicum	DS	60.58 (59.62, 61.53)	59.90	0.68*	45.80	14.78*	59.00	1.58	55.00	5.58
6/10/2019	Scribner's panicum	CT	51.04 (48.96, 53.12)	57.60	-6.56*	47.10	3.94	64.00	-12.96*	55.00	-3.96*
6/10/2019	Scribner's panicum	DS	51.62 (49.58, 53.66)	57.60	-5.98*	47.10	4.52	64.00	-12.38*	55.00	-3.38*
7/9/2019	Scribner's panicum	CT	51.64 (50.4, 52.88)	56.20	-4.56*	49.30	2.34*	64.00	-12.36*	55.00	-3.36*

7/9/2019	Scribner's panicum	DS	53.04 (51.3, 54.78)	56.20	-3.16*	49.30	3.74*	64.00	-10.96*	55.00	-1.96*
8/12/2019	Scribner's panicum	CT	51.99 (50.56, 53.43)	54.70	-2.71*	52.30	-0.31*	61.00	-9.01*	55.00	-3.01*
8/12/2019	Scribner's panicum	DS	52.12 (50.03, 54.21)	54.70	-2.58*	52.30	-0.18*	61.00	-8.88*	55.00	-2.88*
8/12/2019	Scribner's panicum	GS	46.26 (39.32, 53.19)	54.70	-8.45*	52.30	-6.04	61.00	-14.75*	55.00	-8.75*
9/10/2019	Scribner's panicum	CT	49.87 (48.23, 51.5)	53.40	-3.53*	56.20	-6.33*	61.00	-11.13	60.00	-10.13*
9/10/2019	Scribner's panicum	DS	48.2 (38.29, 58.1)	53.40	-5.21	56.20	-8.01	61.00	-12.81	60.00	-11.81*
9/10/2019	Scribner's panicum	GS	37.69 (20.64, 54.73)	53.40	-15.72	56.20	-18.52*	61.00	-23.32	60.00	-22.32*
10/11/2019	Scribner's panicum	CT	50.03 (47.89, 52.17)	44.90	5.13*	58.70	-8.67*	61.00	-10.97*	60.00	-9.97*
10/11/2019	Scribner's panicum	DS	52.07 (50.55, 53.59)	44.90	7.17*	58.70	-6.63*	61.00	-8.93*	60.00	-7.93*
10/11/2019	Scribner's panicum	GS	52.26 (47.94, 56.57)	44.90	7.36*	58.70	-6.44*	61.00	-8.74*	60.00	-7.74*
11/13/2019	Scribner's panicum	CT	48.26 (46.97, 49.55)	45.80	2.46*	59.90	-11.64*	51.00	-2.74*	60.00	-11.74*
11/13/2019	Scribner's panicum	DS	49.1 (48.06, 50.14)	45.80	3.3*	59.90	-10.8*	51.00	-1.9*	60.00	-10.9*
11/13/2019	Scribner's panicum	GS	40.66 (37.03, 44.3)	45.80	-5.14*	59.90	-19.24*	51.00	-10.34*	60.00	-19.34*
12/9/2019	Scribner's panicum	CT	43.82 (42.68, 44.96)	47.10	-3.28*	57.60	-13.78*	51.00	-7.18*	60.00	-16.18*
12/9/2019	Scribner's panicum	DS	43.53 (42.08, 44.98)	47.10	-3.57*	57.60	-14.07*	51.00	-7.47*	60.00	-16.47*
12/9/2019	Scribner's panicum	GS	39.84 (35.57, 44.11)	47.10	-7.26*	57.60	-17.76*	51.00	-11.16*	60.00	-20.16*
1/8/2020	Scribner's panicum	CT	43.66 (42.15, 45.18)	49.30	-5.64*	56.20	-12.54*	57.00	-13.34*	51.00	-7.34*
1/8/2020	Scribner's panicum	DS	43.73 (42.97, 44.48)	49.30	-5.57*	56.20	-12.47*	57.00	-13.27*	51.00	-7.27*
1/8/2020	Scribner's panicum	GS	43.25 (39.84, 46.67)	49.30	-6.05*	56.20	-12.95	57.00	-13.75*	51.00	-7.75*
2/10/2020	Scribner's panicum	CT	43.26 (41.85, 44.67)	52.30	-9.04*	54.70	-11.44*	57.00	-13.74*	51.00	-7.74*
2/10/2020	Scribner's panicum	DS	41.38 (39.78, 42.98)	52.30	-10.92*	54.70	-13.32*	57.00	-15.62*	51.00	-9.62*
2/10/2020	Scribner's panicum	GS	24.24 (16.99, 31.48)	52.30	-28.06*	54.70	-30.46*	57.00	-32.76*	51.00	-26.76*
3/6/2020	Scribner's panicum	CT	45.32 (44.77, 45.88)	56.20	-10.88*	53.40	-8.08*	57.00	-11.68*	51.00	-5.68*
3/6/2020	Scribner's panicum	DS	42.85 (41.74, 43.95)	56.20	-13.35*	53.40	-10.55*	57.00	-14.15*	51.00	-8.15*
3/6/2020	Scribner's panicum	GS	36.58 (32.09, 41.08)	56.20	-19.62*	53.40	-16.82*	57.00	-20.42*	51.00	-14.42*
4/10/2020	Scribner's panicum	CT	56.26 (54.17, 58.35)	58.70	-2.44*	44.90	11.36	58.00	-1.74	55.00	1.26*
4/10/2020	Scribner's panicum	DS	59.65 (55.94, 63.36)	58.70	0.95*	44.90	14.75	58.00	1.65	55.00	4.65*

4/10/2020	Scribner's panicum	GS	58.3 (56.47, 60.14)	58.70	-0.4*	44.90	13.4*	58.00	0.3	55.00	3.3*
5/7/2020	Scribner's panicum	CT	56.55 (54.89, 58.2)	59.90	-3.35*	45.80	10.75*	59.00	-2.45*	55.00	1.55
5/7/2020	Scribner's panicum	DS	55.59 (54.45, 56.73)	59.90	-4.31	45.80	9.79*	59.00	-3.41*	55.00	0.59
5/7/2020	Scribner's panicum	GS	54.21 (53.06, 55.36)	59.90	-5.69	45.80	8.41*	59.00	-4.79*	55.00	-0.79
6/8/2020	Scribner's panicum	CT	47.46 (46.46, 48.45)	57.60	-10.14*	47.10	0.36*	64.00	-16.54*	55.00	-7.54*
6/8/2020	Scribner's panicum	DS	47.67 (46.86, 48.47)	57.60	-9.93*	47.10	0.57*	64.00	-16.33*	55.00	-7.33*
6/8/2020	Scribner's panicum	GS	47.29 (46.4, 48.18)	57.60	-10.31*	47.10	0.19*	64.00	-16.71*	55.00	-7.71*
7/3/2020	Scribner's panicum	CT	48.14 (46.75, 49.53)	56.20	-8.06*	49.30	-1.16	64.00	-15.86*	55.00	-6.86*
7/3/2020	Scribner's panicum	DS	46.81 (45.48, 48.14)	56.20	-9.39*	49.30	-2.49	64.00	-17.19*	55.00	-8.19*
7/3/2020	Scribner's panicum	GS	47.1 (45.87, 48.34)	56.20	-9.1*	49.30	-2.2	64.00	-16.9*	55.00	-7.9*
8/8/2020	Scribner's panicum	CT	49.8 (48.74, 50.87)	54.70	-4.9*	52.30	-2.5*	61.00	-11.2*	55.00	-5.2*
8/8/2020	Scribner's panicum	DS	49.69 (48.72, 50.66)	54.70	-5.01*	52.30	-2.61*	61.00	-11.31*	55.00	-5.31*
8/8/2020	Scribner's panicum	GS	50.11 (48.74, 51.48)	54.70	-4.59*	52.30	-2.19*	61.00	-10.89*	55.00	-4.89*
9/8/2020	Scribner's panicum	DS	52.18 (50.13, 54.22)	53.40	-1.22*	56.20	-4.02*	61.00	-8.82*	60.00	-7.82*
9/8/2020	Scribner's panicum	GS	50.71 (49.4, 52.02)	53.40	-2.69*	56.20	-5.49*	61.00	-10.29*	60.00	-9.29*
10/8/2020	Scribner's panicum	DS	49.82 (48.23, 51.41)	44.90	4.92*	58.70	-8.88*	61.00	-11.18*	60.00	-10.18*
10/8/2020	Scribner's panicum	GS	49.11 (47.48, 50.75)	44.90	4.21*	58.70	-9.59*	61.00	-11.89*	60.00	-10.89*

[1]*Indicates statistically significant at $\alpha < 0.05$

Appendix C. Soils data for each month and treatment. Showing the pH, organic matter, cation exchange capacity, nitrogen, and potassium values. The missing data in the growing season was due to the plots not being sampled until after the growing season burn was conducted in July 2019; the February samples were the pre-sampling data prior to any treatment. Missing data in the control is due to an unplanned burn that caused the sampling of the control treatment to be discontinued following August 2020.

Soils		Control					Dormant					Growing				
Date	Replicate	pH	OM	CEC	N	K	pH	OM	CEC	N	K	pH	OM	CEC	N	K
2/18/2019	1	5.9	1.6	7	1	166	6.5	1.1	6	1	132	5.6	1.5	7	1	146
2/18/2019	2	6.6	1.5	7	1.4	174	6.5	1.2	7	1	136	5.7	1.4	8	1.1	148
2/18/2019	3	7.1	1.3	11	1.2	204	5.8	1	5	1	136	7.1	1.4	11	1.5	154
5/6/2019	1	5.8	1.6	8	1	132	6.2	1	6	1.1	132	-	-	-	-	-
5/6/2019	2	6.1	1	7	1	188	5.8	0.9	6	1	118	-	-	-	-	-
5/6/2019	3	7.1	1.1	12	1.3	176	5.9	1	6	1	148	-	-	-	-	-
6/10/2019	1	5.9	1.7	7	1	114	6.2	1.4	6	1.3	134	-	-	-	-	-
6/10/2019	2	6.3	1.4	6	1	154	5.9	1.2	5	1	124	-	-	-	-	-
6/10/2019	3	7.1	1.4	9	1.4	192	5.8	1.5	5	1	126	-	-	-	-	-
7/9/2019	1	5.8	1.8	8	1	154	5.9	1	6	1	116	5.9	1.5	7	1	128
7/9/2019	2	5.7	1.2	6	1.4	164	6.2	1.2	7	1	146	6	1.4	8	1.2	134
7/9/2019	3	6	1.1	8	1.1	172	5.7	1.2	6	1	120	6.2	1.6	8	1	132
8/12/2019	1	6	2.2	9	2.5	220	6.3	1.2	5	1.9	128	6.6	1.7	8	2.1	198
8/12/2019	2	5.7	1.7	7	1	190	5.8	1.4	5	1.3	154	6.2	1.9	10	1.3	206
8/12/2019	3	6.7	1.8	13	2.8	246	5.9	1.6	6	2.5	136	6.8	1.7	12	1.1	162
9/10/2019	1	5.9	1.9	10	1	218	6.3	1.5	6	1	168	6.8	1.8	10	1.3	200
9/10/2019	2	6.2	2.4	8	1.4	212	6.1	2.2	7	1.1	164	6.1	1.7	8	1.2	172
9/10/2019	3	6.6	3	15	1.8	342	6.1	1.9	9	1.4	186	6.3	1.8	7	1.4	182

10/11/2019	1	7.2	1.3	15	1.2	210	5.7	1.1	4	1	100	6	1.7	7	1	218
10/11/2019	2	5.7	1.5	7	1.5	154	6	1.3	7	1	138	5.6	1.4	7	1.4	186
10/11/2019	3	5.9	1.6	8	1	172	6.2	1.4	7	1	218	6.5	1.6	9	1	204
11/13/2019	1	5.9	1.7	9	1.3	208	6	0.9	5	1	130	5.9	1.4	8	1	174
11/13/2019	2	6.1	1.6	7	1.2	188	5.8	1	6	1.2	160	6.4	1.4	9	1.1	182
11/13/2019	3	6.7	1.6	9	2	242	5.8	1	5	1	132	6.1	1.9	10	1	182
12/9/2019	1	5.8	1.7	8	1	222	5.6	1	5	1	128	5.9	1.5	7	1	174
12/9/2019	2	5.4	1.2	6	1	200	5.7	1.1	5	1	130	5.7	1.7	10	1	242
12/9/2019	3	6.7	1.1	10	1.7	244	5.8	1.3	5	1	186	6.6	1.5	8	1	174
1/8/2020	1	6.3	1.4	9	1	164	5.8	0.9	5	1.1	154	6.1	1.7	7	1.2	176
1/8/2020	2	6	1.2	6	1	186	5.8	1.2	6	1.1	140	5.5	1.5	7	1	166
1/8/2020	3	6.7	1.3	11	1.6	162	6	1.4	6	1.2	146	5.9	1.3	7	1	156
2/10/2020	1	5.7	1.5	9	1	172	5.7	1.1	6	1	172	5.7	1.4	8	1	206
2/10/2020	2	5.7	1	6	1	180	5.8	1	7	1	160	5.6	1.2	8	1	184
2/10/2020	3	6.9	1.4	10	1.3	220	5.8	1	5	1	202	6.5	1.4	9	1	182
3/6/2020	1	6.1	1.6	9	1	208	5.7	1.7	5	1	130	6.2	1.3	7	1	172
3/6/2020	2	6	1	6	1	170	5.9	0.9	6	1	164	5.6	1.3	8	1	194
3/6/2020	3	6.7	1.2	12	1	258	6	1.2	5	1	130	6.4	1.7	9	1	192
4/10/2020	1	5.8	1.6	8	1	168	5.6	0.9	4	1	118	6	1.6	7	1	152
4/10/2020	2	5.7	1.3	6	1	174	5.8	1.2	6	1.4	176	5.7	1.6	6	1	156
4/10/2020	3	6.5	1.2	8	1.1	178	5.8	1.6	5	1	126	6.7	1.6	9	1	164
5/7/2020	1	6.1	1.7	8	1	174	5.8	1	4	1	120	6.1	1.6	7	1	160
5/7/2020	2	6.2	1.5	6	1	184	5.8	1.1	5	1	132	6.2	2	8	1	238
5/7/2020	3	7.1	1	11	1	158	5.9	1.1	4	1	124	7	1.7	11	1	162
6/8/2020	1	5.9	1.7	8	1	172	5.9	1	5	1	114	6.1	1.4	7	1	144
6/8/2020	2	5.8	1.3	6	1	152	6.5	1.7	6	1	172	6	1.7	7	1	178
6/8/2020	3	7.1	1	7	1.1	152	6.3	1.2	4	1	156	6.8	2.3	9	1	172

7/3/2020	1	5.8	1.6	8	1	148	5.9	1.6	5	1	156	6	1.6	7	1	160
7/3/2020	2	5.8	1.3	6	1	120	6	1.3	6	1	116	6.1	1.5	7	1	168
7/3/2020	3	7.1	0.9	10	1	172	6.1	1.2	5	1	110	6.8	1.7	9	1	134
8/8/2020	1	6	1.5	9	1	162	5.6	1.2	4	1	126	6	1.6	7	1	156
8/8/2020	2	6	1.1	6	1	172	6.8	1.5	8	1.2	140	5.6	1.7	8	1	184
8/8/2020	3	6.5	1.5	6	1.5	172	5.7	1.2	4	1	102	7	1.6	13	1	184
9/8/2020	1	-	-	-	-	-	5.5	0.9	5	1.2	120	5.9	1.9	6	1	158
9/8/2020	2	-	-	-	-	-	5.9	1.7	7	2.3	152	5.9	1.3	6	1	150
9/8/2020	3	-	-	-	-	-	5.7	1.2	4	1	132	6.3	1.7	9	1	168
10/8/2020	1	-	-	-	-	-	6.4	1.9	6	1	144	6.8	3.1	8	1	246
10/8/2020	2	-	-	-	-	-	6.4	2.8	7	1	160	6.2	2.7	8	1	268
10/8/2020	3	-	-	-	-	-	6.3	2.4	5	1.3	308	5.7	2.3	6	1	184

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