W 839

Seasonal Hay Feeding for Cattle Production in Tennessee

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Introduction

Despite its wide adaptation, tall fescue presents several managerial challenges including being dormant during the winter and causing fescue toxicosis during the summer. This can reduce cattle conception rates and weight gains (Looper et al., 2010). To overcome tall fescue's shortcomings, it is common for producers to provide a supplemental feed such as hay during periods of low forage production. An alternative to supplemental feed is diversifying forage to extend the grazing season. The incorporation of alternative forages, such as crabgrass, bermudagrass and winter annuals, into a tall fescue system can reduce overgrazing and extend the number of grazing days (Muir, Pitman, and Foster, 2011; Byrnes et al., 2018; Stanley et al., 2018), which would reduce the number of days feeding hay and total hay costs (Ward et al., 2008).

Understanding the advantages of diversifying forages is important as there may be challenges to cool- and warm-season grazing systems. In general, a cool- and warm-season grazing system may require upgrading infrastructure, such as fencing and water sources, and/or require additional labor and management (Gillespie, Kim, and Paudel, 2007; Gillespie et al., 2008; Johnson et al., 2010; Pruitt et al., 2012). Thus, for an economic advantage to be realized, hay cost savings must exceed the costs of establishing and managing cool- and warm-season forages.

Many cattle producers, who primarily feed cattle by grazing pasture and feeding hay, have or will explore methods to reduce hay usage, likely driven by the need for lowering total feed costs, reducing winter feeding labor or other considerations. It is appropriate to consider management practices that achieve the goal of reducing hay usage without interrupting cattle production.

The objective of this research was to determine how forage mixtures, pasture management and grazing management practices influence the number of days hay was fed to cattle by season. This publication reports the findings of a survey to cattle producers regarding grazing management. These findings may help cattle producers in Tennessee identify forage and pasture management practices influencing cost of production or profitability.

Data

A survey of 5,831 Tennessee beef cattle producers was conducted in 2018. The list of producers was obtained from the Tennessee Department of Agriculture based on beef cattle producers who had participated in the Tennessee Agricultural Enhancement Program (TAEP). A total of 1,405 producers responded to the online survey while 367 completed the phone survey.

Producers were asked questions concerning demographics, livestock numbers, farm size, grazing management, and the use of cool-season annuals and warm-season grasses. Producers who grazed warm-season grasses were asked about the grass species used, the perceived effects of warm-season grasses on their beef cattle operation, and their concerns about planting and managing the grasses. Producers not grazing warm-season grass were asked about their willingness to establish warm-season pastures. In addition, producers were asked about supplemental cattle feeding practices, drought impacts on their operation, and the use of hay and corn silage, which included producers indicating the number of days they fed hay in January through March (*Winter*), April through June (*Spring*), July through September (*Summer*), and October through December (*Fall*). Descriptions of the variables analyzed are provided in Table 1.

Respondents provided information on the number of livestock they grazed in 2017, by age and sex of the animal. This information was used to convert number of head into animal units and then divide by acres grazed in 2017 to calculate the stocking rate (*Stock*). We asked producers if they rotated their cattle between pastures or paddocks at least once during the summer in 2017 (*Rotate*). The variable in the study is not the same as rotational grazing but is rotating cattle to a summer pasture to decrease days on hay.

Table 1. Variable Names and Definitions of the Dependent and Independent Variables

Variables	Definition
Dependent Variables	
Winter	Number of days cattle were on hay from January to March
Spring	Number of days cattle were on hay from April to June
Summer	Number of days cattle were on hay from July to September
Fall	Number of days cattle were on hay from October to December
Independent Variables	
Stock	Total animal units divided by total acres grazed
Rotate	=1 if a producer rotates cattle between pastures and paddocks during the summer; zero otherwise
CSG	=1 if a producer exclusively grazed cattle on cool-season perennial grass not interseeded with anything or with a warm-season grass; zero otherwise
DIVC	=1 if a producer grazed cattle on cool-season perennial grass interseeded with a cool-season or winter annual; zero otherwise
DIVW	=1 if a producer grazed cattle on cool-season perennial grass with a warm-season grass; zero otherwise
Fert	=1 if a producer applied fertilizer and/or lime in 2017; zero otherwise
Weed	=1 if a producer sprayed to control weeds in 2017; zero otherwise
Test	=1 if a producer tested soil in 2017; zero otherwise
Redo	=1 if a producer has renovated or converted pasture in the last 10 years; zero otherwise
Cut	= 1 if the producer cut hay in 2017; zero otherwise
INC	Scale variable indicating the percentage of 2017 household income from farming with 1 = less than 20% and 5 = greater than 80%
Age	Producer age in years

Economic Implications

An important economic question for a producer is how to cost effectively feed cattle throughout the year, and the general thought is that grazed forage is less expensive than feeding mechanically harvested forage. Forage species and pasture management influence days feeding hay. However, the effect on hay usage throughout the seasons varies based on forage species and grazing and pasture management. A producer would have to compare the cost of different combinations of forages and practices as well as the influence each have on seasonal hay usage to determine the economically optimal forage mix and pasture management practices.

The seasonality of hay usage is an important consideration because of hay price seasonality and regional differences in supply and demand. This seasonal hay price variation is shown by month from 2008-2018 from a nearby market (Harrisonburg, Virginia) reported by the USDA Agricultural

Marketing Service (2018) (Figure 1). As shown in Figure 1, hay prices increase through the winter months and peak in April. This price action is likely explained by hay demand and usage peaking during the winter months with hay inventories reaching their annual low by April. Therefore, the economically optimal decision of choosing forages and practices that extend the grazing season must balance the costs of the alternative forages and management, quantity of hay used, and the time of year hay is used.

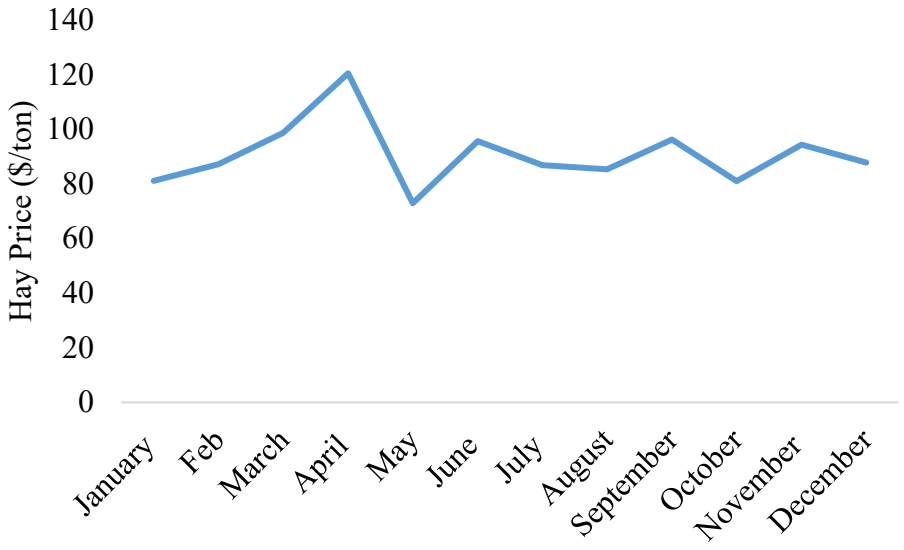

Figure 1. Average Hay Monthly Prices for Good Quality Hay Sold in Harrisonburg, Virginia, from 2008 to 2018

Results

Survey Summary

Based on 2017 hay feeding, survey respondents fed hay to cattle an average of 82 days during the *Winter,* with 85 percent of the respondents reporting feeding hay for 80 or more days (Figure 2). The average days feeding hay for *Spring* was 11, with 94 percent of survey respondents feeding hay less than 30 days and about half feeding hay for 10 days or less. The average number of days survey respondents fed hay during the *Summer* was two, with more than 90 percent of producers feeding hay 10 days or less. The *Fall* season saw an average of 48 days of hay feeding, with 71 percent of respondents feeding hay 20 to 70 days during the *Fall*.

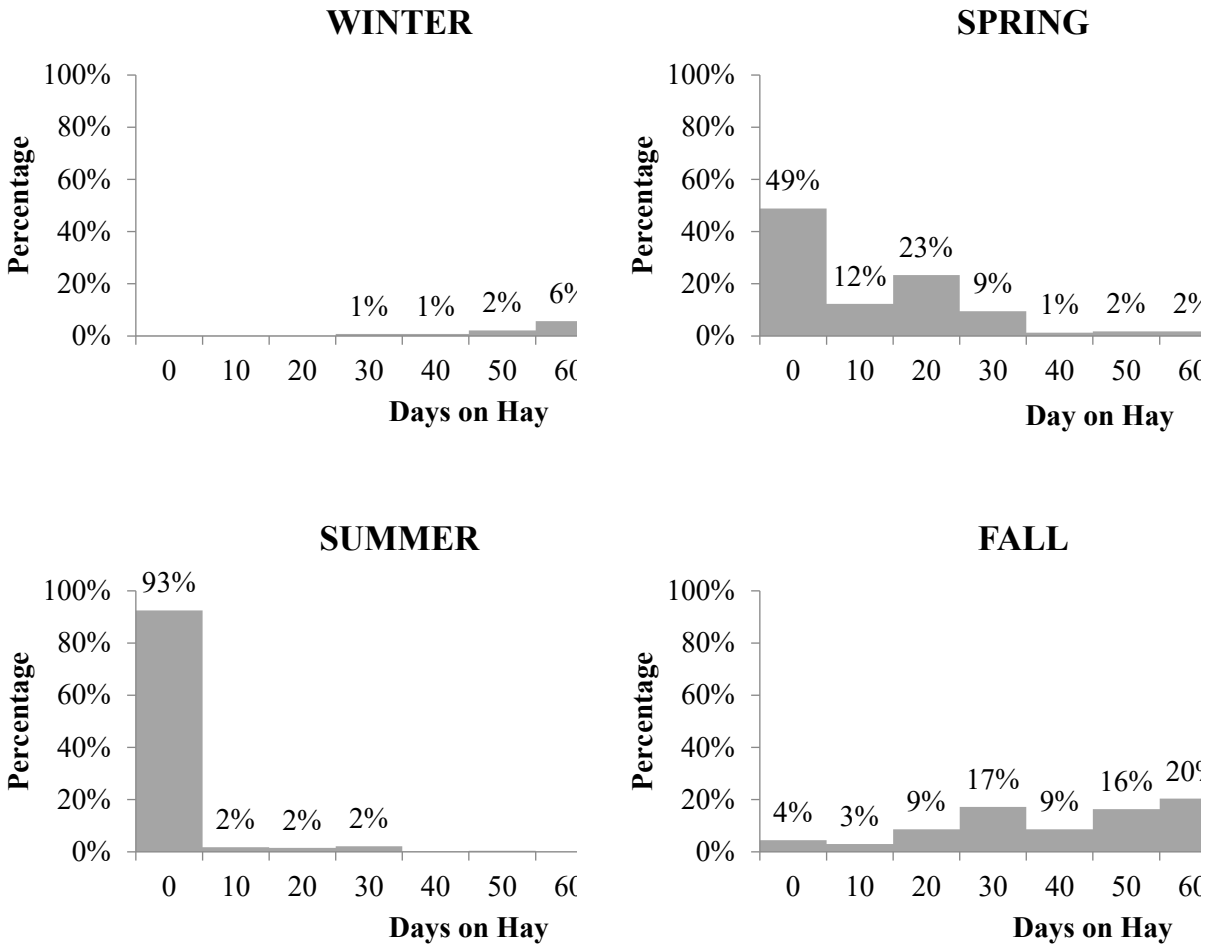

Figure 2. Distribution of Response to Number of Days on Hay by Tennessee Producers in 2017 by Season

The seasonal hay feeding results of survey respondents were expected. Producers utilize hay during the *Winter* when tall fescue is dormant and then transition to grazing in the *Spring* when tall fescue is most productive. Producers responding to the survey did not feed hay in the *Summer,* which is likely due to utilizing excessive spring growth of tall fescue that is later supplemented by volunteer summer grasses such as crabgrass, Johnsongrass and dallisgrass. The *Fall* period is a little less definitive on hay feeding, and this result is likely associated with the ability to stockpile fescue and precipitation.

Table 2 provides summary statistics for the variables analyzed. The average stocking rate (*Stock*) was 0.69 animal units per acre, equating to approximately 1.5 acres per cow-calf pair. Seventy-seven percent of survey respondents rotated cattle between pastures during the 2017 summer (*Rotate*).

Table 2. Summary Statistics of Independent Variables

Variables	Number of Observations	Mean	Standard Deviation	Minimum	Maximum
Stock	1,472	0.69	0.61	0.01	9.58
Rotate	1,570	77%		0	1
CSG	1,760	21%		0	1
DIVC	1,482	55%		0	1
DIVW	1,480	24%		0	1
Fert	1,351	85%		0	1
Weed	1,328	80%		0	1
Test	1,257	62%		0	1
Redo	1,377	38%		0	1
Cut	1,392	87%		0	1
INC	1,310	1.76	1.16	1	5
Age	1,359	57.11	59.70	17	91

In 2017, 21 percent of the respondents exclusively grazed cool-season perennial forage (*CSG*), 55 percent grazed a cool-season perennial forage interseeded with a cool-season annual (*DIVC*), and 24 percent grazed a mixture of cool- and warm-season perennial forages (*DIVW*). This would suggest that most producers are using multiple forage species to extend grazing.

Regarding management practices, 85 percent of respondents applied fertilizer or lime to their pasture, 80 percent sprayed herbicide to manage weeds, and 62 percent performed a soil test (*Test*) in 2017. Thirty-eight percent of the respondents have completely renovated or converted a pasture during the last 10 years (*Redo*). On the hay side, 87 percent of the respondents cut hay in 2017 (*Cut*). The average age (*Age*) of the respondents was 57 years, while the average percentage of total household income from farming (*INC*) was between 20 percent and 40 percent.

Factors Impacting Days Feeding Hay

Table 3 shows marginal effects for the count model by season. An increase in the stocking rate (*Stock*) of one animal unit per acre increased hay feeding during the *Spring* by 3.5 days (17.5 percent). Producers grazing a cool-season perennial grass interseeded with a cool-season annual (*DIVC*) fed hay 4.5 days less (22.5 percent reduction) than producers who only grazed a cool-season perennial grass. The use of herbicides to control weeds (*Weed*) was associated with 2.9 fewer days on hay (14.5 percent) during the *Spring*, relative to those who did not use herbicides.

Table 3. Estimated Marginal Effects for the Count Model by Season

Variables	Winter	Spring	Summer	Fall	Total Change in Days on Hay[a]
Stock	3.157	3.535***[b]	0.296	3.016***	7
Rotate	-0.746	-1.765	9.201	-5.375***	-5
DIVC	0.795	-4.538**	-12.337**	-1.134	-17
DIVW	0.316	-1.183	6.190	-0.726	-
Fert	4.004	-0.971	-6.676	-2.622	-
Weed	-3.778	-2.920**	-10.174	-3.457**	-6
Test	2.938	0.539	-0.891	-2.770*	-3
Redo	1.099	-0.130	7.040	-0.197	-
Cut	-3.714	2.488	1.574	3.983*	4
INC	0.015	0.464	3.548	-0.308	-
Age	0.047	-0.013	0.142	-0.032	-

Note: Single, double and triple asterisks (*, **, ***) represent significance at the 10 percent, 5 percent and 1 percent level.

[a] Total Change in Days on Hay was only calculated for significant marginal effects at the 10 percent, 5 percent and 1 percent level. "-" means the factor did not significantly impact days on hay.

[b] Example interpretation: If a producer increased their stocking rate by 1 animal unit per acre, then it increased hay feeding days by 3.5 days in the spring and 3.0 days in the fall.

Most producers indicated zero days on hay in the summer. Those utilizing a mixture of cool-season perennial and annual grasses (*DIVC*) fed hay 12.3 fewer days (43.9 percent) than producers relying solely on cool-season perennials. Grazing a cool- and warm-season forage mixture (*DIVW*) had no impact on the number of days hay was fed relative to producers who only grazed cool-season perennial grass.

For the fall months, increasing the per acre stocking rate (*Stock*) by a single animal unit increased feeding hay in the fall by 3.0 days (6.4 percent), which was similar to spring. Stocking density naturally increases in the fall and spring as most cattle are calving during these months. The natural increase in stocking rate during spring and fall may provide an incentive to identify ways of reducing the stocking rate during these time periods. One method may be to test cows for pregnancy after the breeding season and cull open cows, which in turn would reduce total stocking rate and potentially reduce the number of days hay is fed. Rotating cattle between pastures during the summer, applying herbicide, and soil testing decreased the number of days on hay 5.4 days (11.4 percent), 3.5 days (7.4 percent), and 2.8 days (6.0 percent), respectively.

Interestingly, none of the practices examined in this study were found to reduce the number of days feeding hay in the winter months. There could be several logical explanations for this finding, but it suggests more focused research on practices to reduce days on hay in the winter is needed.

From a profitability standpoint, the optimal forage mix and pasture management practice is reliant on the costs of the mixes and practices, their ability to reduce supplemental hay feeding, hay prices, and impacts on production. Thus, a producer would have to compare the cost of each alternative to the cost of feeding hay as well as determine the operation's ability to manage the alternative production method.

Cost Analysis Example

The average number of days survey respondents fed hay to cattle in 2017 was 143 days, resulting in 222 days of grazing. Assuming that hay can be produced or purchased for $100 per ton (conservative price) on a dry matter basis and a cow will consume 30 pounds of dry matter each day, then it costs $1.50 per day to feed hay. When accounting for higher hay prices, hay storage loss, and hay feeding loss, per day cost can balloon to $2.50 per cow. Thus, annual per cow hay cost may range from $214.50 to $360. In most instances, pasture cost of feeding a cow is less than $1.00 per day. Assuming a cost of $1.00 per day, per cow savings from grazing compared to feeding hay would range from $0.50 to $1.50. Thus, the savings from grazing a 30-head cattle herd compared to feeding hay would range from $15 to $45 per day.

Conclusions

This study determined how the inclusion of various forage species and pasture management practices in a forage system influenced the number of days hay was fed to cattle by season. Respondents largely indicated they graze cattle on a diverse pasture mixture of cool- and warm-season perennial grasses as well as cool-season annual grasses. Most producers responding to the survey also manage soil fertility and pasture weeds.

A mixture of cool- and warm-season forages decreased the number of days hay was fed in the winter, while a mixture of cool-season perennial and annual grasses reduced the number of days hay was fed in the spring and summer. These findings suggest that producers are stockpiling

forage to some degree since they are able to reduce hay feeding in months in which they do not have actively growing forage species. For example, a mixture of cool-season perennial and annual grasses reduces hay fed in summer, although cool-season grasses do not perform well during the summer.

This research is not without limitations. The survey asked about a single production year, which could skew the responses. Thus, year-to-year variation may be likely based on variability in climate and environmental factors.

References

Byrnes, R.C., D.J. Eastburn, K.W. Tate, and L.M. Roche. "A Global Meta-Analysis of Grazing Impacts on Soil Health Indicators." *Journal of Environmental Quality* 47(2018):758-765.

Gillespie, J., S.A. Kim, and K. Paudel. "Why Don't Producers Adopt Best Management Practices? An Analysis of the Beef Cattle Industry." *Agricultural Economics* 36(2007):89-102.

Gillespie, J.M., W. Wyatt, B. Venuto, D. Blouin, and R. Bucher. "The Role of Labor and Profitability in Choosing a Grazing Strategy for Beef Production in the U.S. Gulf Coast Region." *Journal of Agricultural and Applied Economics* 40(2008):301-313.

Johnson, R.J., D. Doye, D.L. Lalman, D.S. Peel, K.C. Raper, and C. Chung. "Factors Affecting Adoption of Recommended Management Practices in Stocker Cattle Production." *Journal of Agricultural and Applied Economics* 42(2010):15-30.

Looper, M.L, S.T. Reiter, B.C. Williamson, M.A. Sales, D.M. Hallford, and C.F. Rosenkrans. "Effects of Body Condition on Measures of Intramuscular and Rump Fat, Endocrine Factors, and Calving Rate of Beef Cows Grazing Common Bermudagrass or Endophyte-Infected Tall Fescue." *Journal of Animal Science* 88(2010):4133-4141.

Muir, J.P., W.D. Pitman, and J.L. Foster. 2011. "Sustainable, Low-Input, Warm-Season, Grass-Legume Grassland Mixtures: Mission (nearly) Impossible?" *Grass and Forage Science* 66(2011): 301-315.

Pruitt, J.R., J.M. Gillespie, R.F. Nehring, and B. Qushim. "Adoption of Technology, Management Practices, and Production Systems by U.S. Beef Cow-Calf Producers." *Journal of Agricultural and Applied Economics* 4(2012):203-222.

Stanley, P.L., J.E. Rowntree, D.K. Beed, M.S. DeLonge, and M.W. Hamm. "Impacts of Soil Carbon Sequestration on Life Cycle Greenhouse Gas Emissions in Midwestern USA Beef Finishing Systems." *Agricultural Systems* 162(2018):249-258.

United States Department of Agriculture Agricultural Marketing Services. Market Portal. 2018. Internet site: https://marketnews.usda.gov/mnp/ls-report-config (Accessed January 11, 2019).

Ward, C.E., M.K. Vestal, D.G. Doye, and D.L. Lalman. "Factors Affecting Adoption of Cow-Calf Production Practices in Oklahoma." *Journal of Agricultural and Applied Economics* 40(2008): 851-863.

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