FINAL PROJECT REPORT

Impact of poultry litter application on yield and quality of alfalfa grown in Mississippi

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Abstract

Alfalfa production in the Deep South has increased in over the past 10 years due to varietal development and improved management systems. This increase in production had generated the need for more economical and sustainable nutrient management plans in alfalfa production, particularly in areas where poultry litter (PL) is readily available. A field trial was conducted in Starkville and Newton, MS during the 2018 growing season to compare poultry litter and synthetic fertilizer applications to southern adapted alfalfa varieties. The trial consisted of a randomized split-plot arrangement with 4 fertilizer treatments [(1) 1 and (2) 2 tons PL/acre; (3) N-P-K based on PL analysis; (4) P-K based on PL analysis] and three varieties ([(1) 'Bulldog 505'; (2) 'Bulldog 805'; (3) 'AlfaGraze 600RR'] and was replicated 4 times at each location. Dry matter (DM) yield, stand persistence, and forage quality was assessed at each harvest. Plots were established in the fall of 2017. The Starkville site was abandoned due to poor drainage and weed pressure. Five harvests were conducted at Newton. Bulldog 505 and AlfaGraze 600RR had the greatest cumulative yield with 10,512 and 9,464 lb/acre, respectively. No differences were observed between fertility treatments at the Newton site. Crude protein (CP) ranged from 20.8 to 26.5% across all five harvests. Relative forage value (RFV) was affected by variety and fertilizer treatment. Bulldog 505 had the lowest seed cost per pound of mean DM ($0.0099). Poultry litter application was more economical than synthetic fertilizer at the nutrient levels applied. Based on a single site year of data collection, Bulldog 505 with a 1 ton PL/acre fertilizer application generated the greatest amount of DM with the least cost.

Introduction

Demand for high quality forages has increased in the southeastern U.S. due to the desire to increase livestock productivity and grazing efficiency. Alfalfa (*Medicago sativa* L.) is an ideal species that can be inserted into traditional haying and grazing systems to enhance forage quality. Furthermore, in an era of high-priced protein and energy supplements, the higher quality of alfalfa and alfalfa-grass mixtures is of significant value to the beef and dairy industry, along with other forage-based livestock producers.

In Mississippi, a coordinated research and demonstration/extension effort has substantially increased alfalfa acreage 700% since 2014. As some of the targeted producers in the region have a negative view of alfalfa and its management challenges, many of these efforts have been under a pretext of demonstrating cutting and fertility management techniques. Within the program, discussion about the benefits of alfalfa production and use are integrated. This results in participants realizing that alfalfa has a potential as a forage crop because of the combination of new varieties, better nutrient management techniques, and marketing opportunities for the region.

Alfalfa requires high phosphorus (P) and potassium (K) soil fertility and has a high demand for these nutrients. Alfalfa removes large amounts of nitrogen (N) and K from the field when harvested as hay, and also has the ability to draw down nitrate levels within its root zone, thus decreasing nutrient runoff and leaching potential. Manure, particularly poultry litter, is high in P and K and micronutrients such as boron. Proper applications of poultry litter to alfalfa can provide sufficient quantities of required nutrients without overloading the soil profile. Poorly timed applications, however, can physically damage plants, increase weed competition, and can result in excess soil N, potentially increasing N losses to water and the atmosphere (Lory 2015).

Poultry production was the top agricultural commodity in Mississippi for 2016, grossing nearly $2.3 billion in sales and ranking 5th in the nation (DAFVM, 2016). Poultry has been the leading commodity in Mississippi for 20 straight years, in which 28,000 employees were paid another $2.1 billion in wages and salaries (Mississippi Poultry Association, 2014). Poultry litter, a mixture of manure, feathers, and bedding material, is a valuable source of plant nutrients and organic matter that is of great interest to many livestock and row crop farm managers across Mississippi and remains the most sustainable option for disposal (Tabler et al., 2015). The use of poultry litter has shown to increase dry matter yields in bermudagrass production (Evers 2008), lint in cotton, and grain in corn (Mitchell and Tu 2003). For forages, linking dry matter production with litter utilization can be a difficult, yet effective approach for addressing both the problems associated with manure disposal, and impact reductions on the environment (Pant et al., 2004). In 2014, 210 broiler farms (10% of Mississippi total) were sampled to determine average nutrient contents of litter. Concentrations averaged 61.37, 47.44, and 69.39 lb/ton for K_2O, N, and P_2O_5, respectively (Tabler et al., 2015). Often times, poultry litter is the most economical, and most available source of fertilizer in Mississippi.

As alfalfa acreage across Mississippi and the Deep South increases, information regarding fertility management in this crop will be crucial in helping new farmers produce an economically sustainable forage. This projects seeks to bridge this knowledge gap by evaluating the impacts of poultry litter on alfalfa production in Mississippi. To address these needs, the following objectives were established: 1) Determine the impact of poultry litter fertilization on forage yield, plant persistence, forage quality, and economic analysis of alfalfa in Mississippi, and 2) Implement an

Extension and Outreach program to educate beef cattle producers and small and medium-sized dairies about the use of alfalfa in their production systems with a sustainable poultry litter nutrient management program.

Materials and Methods

<u>Objective 1</u>: Determine the impact of poultry litter fertilization on forage yield, plant persistence, forage quality, yield components, and economic analysis of alfalfa in Mississippi.

The experiment was conducted at two locations in Mississippi during the 2017/2018 growing season (Coastal Plain Branch Experiment Station in Newton and H.H. Leveck Animal Research Farm in Starkville). The experiment, a randomized complete block design with four replications, was planted in the fall of 2017. Plots measured 5 ft x 12 ft. Three varieties were evaluated: 'Bulldog 505,' 'Bulldog 805,' and 'AlfaGraze 600RR'. Varieties were planted at a rate of 20 lb pure live seed (PLS) per acre in a prepared seed bed. A split-plot arrangement of the experimental treatments was used. The main plots were variety and the subplots were poultry litter application rates. Alfalfa was harvested at 30% bloom. Five harvests were conducted prior to the critical fall rest period.

Poultry litter was applied at a rate of 1/2X, and 1X in split applications (in the winter after seedlings are greater than 4 inches, and after second cut) to achieve 100 lb K_2O applied per year (1/2X rate is approximately 1 ton/acre). Litter was analyzed by the Mississippi State Chemical Laboratory to determine nutrient content of litter used. Due to the N content of poultry litter, a positive control treatment in which synthetic N, P_2O_5, and K_2O was applied in the same amounts as poultry litter plots. A negative control treatment received P_2O_5 and K_2O, but no N. This resulted in a 3 x 4 factorial arrangement of treatments (3 varieties x 4 fertility treatments). Plots were limed prior to planting according to soil test recommendations. Chemical control of pests (weeds and insects) were applied when necessary.

Alfalfa yield was determined by harvesting the whole plot. A wet sample was collected from each plot for moisture determination and subsequent mineral and forage quality analysis. Samples were dried at 130^{o} F for at least 72 hours to determine dry matter concentration. Dried samples were ground to pass a 1 mm screen and analyzed using near-infrared spectroscopy (NIRS). Samples were analyzed using the alfalfa hay equation developed by the NIRS Forage and Feed Testing Consortium (Hillsboro, WI) to determine crude protein (CP), acid detergent fiber (ADF), neutral detergent fiber (NDF), fat, lignin, and mineral concentrations. Total digestible nutrients (TDN) and relative forage value (RFV) were calculated based on analyses. Stand density was rated at each harvest by counting the number of plants within a 3 ft^2 quadrat placed at a random location within each plot. All data was analyzed using the PROC GLIMMIX of SAS (SAS Inst., 2016). Replication within location was considered a random effect while variety, fertilizer treatment, and interaction between the effects were considered as fixed. Statistical significance was declared at $\alpha = 0.05$ unless otherwise stated. Data collected during the duration of Objective 1 was used to develop budget and economic models to determine the economic efficacy of poultry litter application in alfalfa production. Cost of production was determined based on yield and quality data collected from field trials.

<u>Objective 2</u>: Implement an Extension and Outreach program to educate beef cattle producers and small and medium-sized dairies about the use of alfalfa in their production systems.

A field day was hosted at the Coastal Plain Branch Experiment Station in Newton, MS, and at the H.H. Leveck Animal Research Unit on the campus of Mississippi State University in the spring and summer of 2018. At each event, seminars and a field tour were presented on the use of alfalfa in forage production systems in Mississippi. Topics that were covered included variety selection, fertility management, disease and pest management, harvest/grazing management, and economics/marketing. The field tour encompassed stops at several plot trials, including the poultry litter trial described above. Other stops included an alfalfa inter-seeded hay demonstration, an alfalfa grazing trial, and a potassium fertility trial already in progress. These events were open to the general public, and were highly advertised to livestock and hay producers within Mississippi, Louisiana, and Alabama. Natural resource professionals, private industry, and county Extension personnel were also in attendance. As part of the training at each event, Agriculture and Natural Resource County Agents from the Mississippi State Cooperative Extension Service will qualify for 5 hours of in-service training. At the end of each event, participants filled out surveys based on their knowledge gained, along with their likelihood of adoption of the practices discussed and displayed during the event.

Results and Discussion

<u>Objective 1 Results</u>

Field trials were established on October 4 and 6, 2017 at Newton and Starkville, MS, respectively (**Figures 1 and 2**). Initial fertilizer treatments were applied on November 27, 2017 at both sites. Due to heavy rains and poor drainage, combined with heavy weed infestations, the Starkville site was abandoned in the spring of 2018 with no harvests conducted. For Newton, excellent establishment and weed control was accomplished. Five harvests were conducted on April 25, May 30, July 2, July 30, and Sep 4.

Cumulative DM yield was analyzed using PROC GLM in SAS to determine the effects of variety and treatment on cumulative yield (**Table 1**). The main effect of variety was found to be significant ($P < 0.0001$). Bulldog 505 (10512 lb/a/yr) and AlfaGraze 600RR (9464 lb/a/yr) were both greater in mean DM yield than Bulldog 805 (8972 lb/a/yr). No differences in fertilizer treatment were observed for cumulative yield ($P = 0.1824$). Repeated measures was used to analyze DM yield by harvest date. Harvest date was found to be significant ($P < 0.0001$), and was therefore removed from analysis of variance. Variety was found to be significant ($P = 0.0001$), therefore DM yield by harvest date across all fertilizer treatments can be found in **Table 2**. The greatest DM yield observed was for Bulldog 505 for harvest 1 (3281 lb/a). Differences were observed for harvests 1, 3, and 4. As with cumulative yield, no differences were observed for DM yield when analyzed as a repeated measure ($P = 0.1667$).

Forage quality was measured for each plot at each harvest. Samples dried, ground, and analyzed using NIRS to determine CP, ADF, NDF, fat, lignin, and mineral concentration. Total digestible nutrients and RFV were calculated based on these results. Only CP, ADF, NDF, TDN, and RFV will be discussed. Similar to DM yield, quality parameters were run in SAS as a repeated measure

due to repeated harvests. For CP, no differences were observed for variety ($P = 0.1377$) or fertilizer treatment ($P = 0.1123$). Mean CP values ranged from 26.5% at harvest 1 to 20.8% for harvest 5 (**Table 3**). For ADF, significant differences were observed by fertilizer treatment ($P = 0.0032$; **Table 4**). For harvest 3, treatment 3 (synthetic N, P, K) recorded a greater ADF value (29.2%) than all other treatments. The same treatment for harvest 5 again recorded a greater ADF value (30.8%) than all other treatments. For NDF, significant differences were observed for variety ($P = 0.063$; **Table 5**) and fertilizer treatment ($P = 0.0083$; **Table 6**). Bulldog 505 had lower NDF values for harvest 2 (31.3%) and harvest 3 (34.2%). For harvest 3, Bulldog 805 was similar at 34.4%. By fertilizer treatment, only harvests 3 and 5 recorded differences. For harvest 3, treatment 3 (synthetic N, P, K) had a greater value (36.5%) than all other treatments. At harvest 5, the same treatment (3) again had a greater value (38.7%). Total digestible nutrient values were calculated from protein, fat, NDFn, dNDF48 and NFC analyses. Variety was the only main effect that was significant ($P < 0.0001$; **Table 7**). For harvest 2, Bulldog 505 had a greater TDN percentage than the other two varieties (60.7%). At harvest 3, AlfaGraze 600RR (57.7%) was significantly lower than the other two entries. For both harvest 4 and 5, Bulldog 505 was greater than its counterpart 805, but not AlfaGraze 600RR. Finally, for RFV, both variety ($P = 0.0004$; **Table 8**) and fertilizer treatment ($P = 0.0016$; **Table 9**) were found to be significant. Ranges for RFV values were between 140.0 and 167.7, and decreased as the season progressed. Differences between varieties were only observed at harvest 2, 3, and 5. As for fertilizer treatments, differences were only observed at harvest 3 and 5. For each of these harvests, treatment 3 (synthetic N, P, K) had significantly lower RFV values than all other treatments (138.3 and 135.1, respectively).

The primary economic analysis focuses on the costs and benefits of establishment and production. The limitation of only one location in year one forces more narrow findings that can be broadened with the addition of more site-years. For the current results, we will focus on the seed cost of establishment as the primary cost associated with each treatment.

AlfaGraze 600RR was the most expensive seed at $11.10 per pound while Bulldog 505 and Bulldog 805 were $5.18 and $4.78 respectively. At a rate of 20 pounds per acre, the seed costs for AlfaGraze 600RR, Bulldog 505, and Bulldog 805 were $222, $103.60, and $95.60, respectively. The relatively similar yield and quality results from this study show clear cost benefits for the Bulldog varieties over AlfaGraze 600RR – however, interpretation of these results should consider that weed control was not a primary issue or objective of this study. AlfaGraze 600RR provides advantages in weed control that might offset the higher seed cost in a different setting.

Seed cost per pound of mean dry matter yield by variety across all fertilizer treatments for 2018 can be found in **Table 10**. In terms of total dry matter yield, Bulldog 505 had the lowest seed cost per pound of total dry matter yield at $0.0099 per pound. The Bulldog 805 variety was also very close at $0.01 of seed cost per pound of dry matter yield. AlfaGraze 600RR seed cost per pound of dry matter yield was $0.026.

Fertilizer costs are the other primary cost to consider given the goal of this project to measure the impact of poultry litter application. Poultry litter is less expensive than synthetic fertilizer. The results from the one project site in 2018 suggest that the relative forage quality is very similar or better when using poultry litter compared to the same nutrients from synthetic fertilizer. Given the

lower application costs and similar forage quality, the poultry litter applications are more economical than the synthetic fertilizer at these nutrient levels.

This economic analysis suggests that Bulldog 505 seed and poultry litter fertilizer have cost advantages for Alfalfa producers. A more comprehensive analysis with the benefit of multiple site-years will also consider fertilizer costs and performance across site-years and the valuation of forage output. A complete economic analysis would consider the impact on the revenue-generating output such as pounds added to livestock or hay sold. Though these impacts are beyond the scope of the current project, these metrics can be considered for comparison in future work.

Objective 2 Results

Two field days were hosted during the 2018 growing season. These included the Coastal Plain Forage Field Day on April 5 in Newton (**Figure 3**) and the MSU Forage Field Day on July 17 in Starkville, MS. These meetings were attended by producers, industry representatives, and public sectors (Extension, NRCS, and Soil and Water Conservation Districts). A total of 39 were in attendance in Newton, followed by 23 in Starkville. Survey analysis for each field day can be found in **Tables 11** and **12**. In Newton, 62% or attendees reported agriculture as their primary occupation, with a majority of producers citing hay as their main agricultural business. Attendees were very positive of the information presented at the field day, with 100% of the responses saying that the content was relevant to their needs. In Starkville, agriculture was again the primary occupation of the attendees (41%), with 45% of their business described as other (i.e. timber, row crop, etc.). Similar to the Newton field day, 100% of the attendees described the event as relevant to their needs. The transfer of information was apparent in the responses to content, as few producers were familiar with the management practices discussed (25%). For both events, 51% of attendants said they would tell others about what they learned. This is extremely important, as most producers rely on information gained from neighbors regarding the implementation of specific practices into their operations. The positive response observed from each field day indicates that there is a strong interest in the use of alfalfa as a perennial hay crop in Mississippi, and that more research and training events are necessary to increase the skills required for largescale production.

Results from the field trials were presented at the field days, along with regional and national meetings. Below are citations from all events and presentations in which NAFA supported.

Rushing, J.B. 2018. Alfalfa production and research. Starkville Forage Field Day. South Farm. Mississippi State, MS. 17, Jul.

Rushing, J.B. 2018. Grazing Management and Forage Production. Kemper County Cattlemen's Association. DeKalb, MS. 19, Jun.

Maples, J.G., J.B. Rushing, R.W. Lemus, and J.C. Lyles. 2018. Economic analysis of the application of poultry litter on alfalfa production in Mississippi. Southern Extension Economics Committee Annual Meeting. Myrtle Beach, SC. 11-13, Jun. Selected Poster.

Lemus, R., J.B. Rushing, and J.A. White. 2018. Influence of harvest management and potassium fertilization in alfalfa production. North American Alfalfa Improvement Conference. Logan, UT. 4-6, Jun. (abstract).

Rushing, J.B., R. Lemus, and J.C. Lyles. 2018. Impact of poultry litter application on yield and quality of alfalfa grown in Mississippi. 72nd Southern Pasture and Forage Crop Improvement Conference. Fayetteville, AR. 14-16, May. (abstract/poster).

Rushing, J.B. 2018. Current Research at CPBES. Coastal Plain Forage Production Field Day. Newton, MS. 5, Apr. (presentation).

Rushing, J.B. 2018. How to establish legumes in southern pastures and forage systems. Alabama Farmer's Federation Commodity Organization Meeting – Hay and Forage. Montgomery, AL. 8, Feb. (invited presentation).

Conclusion

In conclusion, this project is part of an on-going effort to generate quality data while simultaneously educating producers, government agencies, and the private industry on the potential of alfalfa production in Mississippi. Based on results from the 2018 growing season, Bulldog 505 has the potential to generate high DM yields regardless of fertilizer source. No differences in fertilizer treatment were observed, therefore cost and soil test analysis should be the primary factors in determining a nutrient management plant for alfalfa production. In terms of forage quality, regardless of variety, alfalfa can produce much higher quality feedstuffs than traditional hay species in the Deep South. Crude protein values above 20%, and TDN values of well over 50% are much better than high quality bermudagrass or bahiagrass hays. Based on producer response, more information regarding management and variety selection (especially long term data) is needed to increase producer acceptance and market adoption. A second year of data collection would be beneficial in refining fertility recommendations for alfalfa production in this part of the state. Also, soils data could more thoroughly determine the effects of poultry litter application on nutrient build-up and removal.

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Tabler, T., A. Brown, G. Hagood, M. Farnell, C. McDaniel, and J. Kilgore. 2015. Nutrient content in Mississippi Broiler Litter. Mississippi State Cooperative Extension Service. Publication 2878.

USDA-NASS. 2018. United States Department of Agriculture National Agricultural Statistics Service. Alfalfa and hay production reports. Accessed Sep 14, 2018.

Table 1. Mean cumulative dry matter yield (lb/acre) by variety across all fertilizer treatments for 2018 growing season.

Variety	Yield (lb/acre)
Bulldog 505	10512 a*
Bulldog 805	8972 b
AlfaGraze 600RR	9464 a

*****Lowercase letter denotes significant differences at the $\alpha = 0.05$ probability level.

Table 2. Mean dry matter yield (lb/acre) by variety across all fertilizer treatments for 2018 growing season.

Variety	Dry matter yield (lb/acre)				
	Harvest 1	*Harvest 2*	*Harvest 3*	*Harvest 4*	*Harvest 5*
Bulldog 505	3281 a*	2144 a	1397 a	1946 a	1742 a
Bulldog 805	2169 b	2027 a	1222 b	1756 b	1794 a
AlfaGraze 600RR	2978 a	2060 a	1278 ab	1752 b	1793 a

*****Lowercase letter denotes significant differences at the $\alpha = 0.05$ probability level.

Table 3. Mean crude protein values (%) by harvest across all varieties and fertilizer treatments for 2018 growing season.

Harvest	CP (%)
1	26.5
2	24.4
3	23.0
4	21.6
5	20.8

Table 4. Mean ADF (%) by fertilizer treatment across all varieties for 2018 growing season.

Treatment	ADF (%)				
	Harvest 1	*Harvest 2*	*Harvest 3*	*Harvest 4*	*Harvest 5*
(1) 1 ton PL/acre*	20.6 a**	25.4 a	26.7 b	24.2 a	28.8 b
(2) 2 ton PL/acre*	20.6 a	25.9 a	27.3 b	23.1 a	28.2 b
(3) Synthetic N, P, K*†	21.2 a	27.2 a	29.2 a	23.0 a	30.8 a
(4) Synthetic P, K*	20.6 a	26.2 a	27.0 b	22.6 a	28.3 b

*Applied in split applications; ½ in winter 2017 and ½ approximately 30 d prior to first harvest.
******Lowercase letter denotes significant differences at the $\alpha = 0.05$ probability level.
†Synthetic fertilizers were applied as 33-0-0 for N, 0-46-0 for P, and 0-0-60 for K; amounts used were based on PL analysis and were applied at the same rate as treatment 2.

Table 5. Mean NDF (%) by variety across all fertilizer treatments for 2018 growing season.

Variety	NDF (%)				
	Harvest 1	*Harvest 2*	*Harvest 3*	*Harvest 4*	*Harvest 5*
Bulldog 505	26.5 a*	31.3 b	34.2 b	30.2 a	36.2 a
Bulldog 805	26.0 a	32.3 ab	34.4 b	30.7 a	37.7 a
AlfaGraze 600RR	26.0 a	33.3 a	36.5 a	30.9 a	37.1 a

*****Lowercase letter denotes significant differences at the $\alpha = 0.05$ probability level.

Table 6. Mean NDF (%) by fertilizer treatment across all varieties for 2018 growing season.

Treatment	NDF (%)				
	Harvest 1	*Harvest 2*	*Harvest 3*	*Harvest 4*	*Harvest 5*
(1) 1 ton PL/acre*	25.8 a**	31.6 a	34.2 b	31.0 a	37.1 ab
(2) 2 ton PL/acre*	26.1 a	32.0 a	34.8 b	30.8 a	36.3 b
(3) Synthetic N, P, K*†	26.7 a	33.5 a	36.5 a	30.5 a	38.7 a
(4) Synthetic P, K*	26.2 a	32.1 a	34.6 b	30.1 a	36.0 b

*Applied in split applications; ½ in winter 2017 and ½ approximately 30 d prior to first harvest.
******Lowercase letter denotes significant differences at the $\alpha = 0.05$ probability level.
†Synthetic fertilizers were applied as 33-0-0 for N, 0-46-0 for P, and 0-0-60 for K; amounts used were based on PL analysis and were applied at the same rate as treatment 2.

Table 7. Mean TDN (%) by variety across all fertilizer treatments for the 2018 growing season.

Variety	TDN (%)				
	Harvest 1	*Harvest 2*	*Harvest 3*	*Harvest 4*	*Harvest 5*
Bulldog 505	63.2 a*	60.7 a	58.9 a	61.2 a	59.2 a
Bulldog 805	62.9 a	59.8 b	58.5 a	60.0 b	58.2 b
AlfaGraze 600RR	63.1 a	59.3 b	57.7 b	60.6 ab	58.9 ab

*****Lowercase letter denotes significant differences at the $\alpha = 0.05$ probability level.

Table 8. Mean RFV by variety across all fertilizer treatments for the 2018 growing season.

Variety	RFV				
	Harvest 1	*Harvest 2*	*Harvest 3*	*Harvest 4*	*Harvest 5*
Bulldog 505	167.1 a*	154.5 a	145.9 a	158.9 a	144.3 a
Bulldog 805	167.3 a	148.5 b	143.4 ab	155.8 a	137.6 b
AlfaGraze 600RR	167.7 a	147.5 b	141.2 b	157.1 a	140.0 ab

*****Lowercase letter denotes significant differences at the $\alpha = 0.05$ probability level.

Table 9. Mean RFV by fertilizer treatment across all varieties for 2018 growing season.

Treatment	RFV				
	Harvest 1	*Harvest 2*	*Harvest 3*	*Harvest 4*	*Harvest 5*
(1) 1 ton PL/acre*	168.3 a**	152.8 a	146.3 a	156.2 a	141.4 a
(2) 2 ton PL/acre*	167.9 a	150.5 a	144.6 a	156.6 a	143.2 a
(3) Synthetic N, P, K*†	166.6 a	147.3 a	138.3 b	157.4 a	135.1 b
(4) Synthetic P, K*	166.6 a	150.0 a	144.8 a	158.8 a	142.7 a

*Applied in split applications; ½ in winter 2017 and ½ approximately 30 d prior to first harvest.
**Lowercase letter denotes significant differences at the $\alpha = 0.05$ probability level.
†Synthetic fertilizers were applied as 33-0-0 for N, 0-46-0 for P, and 0-0-60 for K; amounts used were based on PL analysis and were applied at the same rate as treatment 2.

Table 10. Seed cost per lb of mean cumulative dry matter yield (lb/acre) by variety across all fertilizer treatments for 2018 growing season.

Variety	Seed cost per pound of mean dry matter yield					
	Harvest 1	*Harvest 2*	*Harvest 3*	*Harvest 4*	*Harvest 5*	*Avg. Total*
Bulldog 505	$0.0316	$0.0483	$0.0742	$0.0532	$0.0595	$0.0099
Bulldog 805	$0.0441	$0.0472	$0.0782	$0.0544	$0.0533	$0.0107
AlfaGraze 600RR	$0.0745	$0.1078	$0.1737	$0.1267	$0.1238	$0.0235

Table 11. Survey data from the Coastal Plain Forage Field Day held on April 5, 2018, in Newton, MS (39 attendees).

Question	**Response**			
Counties/states represented	9 counties in MS; 4 states (MS, LA, AR, AL)			
Is agriculture primary occupation?	*Yes*		*No*	
	62%		37%	
How many years have you been in business?	*0-10*	*11-20*	*21-30*	*>31*
	20%	16%	6%	43%
What is your primary ag business?	*Stocker*	*Cow/calf*	*Hay*	*Other*
	10%	34%	36%	16%
	Agree		*Strongly Agree*	
Instructors were knowledgeable of subject matter.	25%		75%	
The content was relevant to my needs.	0%		100%	
The content was at an understandable level.	51%		48%	
The content was well-organized.	34%		62%	
The content was based on credible information.	27%		72%	
Attending program was worth my time.	20%		79%	
I would recommend this program to others.	31%		68%	
I increased my knowledge of the topics covered.	34%		62%	
I learned new skills related to topics covered.	20%		51%	
I will use information I learned in this program.	44%		55%	
I will tell others about what I learned.	48%		51%	
	None	*Little*	*Some*	*A lot*
How much of content did you already know?	0%	6%	58%	24%
How many of the resource materials will you use?	0%	6%	51%	27%
How well did information meet your expectations?	0%	0%	41%	48%

Table 12. Survey data from the MSU Forage Field Day held on July 17, 2018, in Starkville, MS (23 attendees).

Question	**Response**			
Counties/states represented	11 counties in MS			
Is agriculture primary occupation?	*Yes*		*No*	
	41%		58%	
How many years have you been in business?	*0-10*	*11-20*	*21-30*	*>31*
	26%	0%	0%	26%
What is your primary ag business?	*Stocker*	*Cow/calf*	*Hay*	*Other*
	5%	30%	20%	45%
	Agree		*Strongly Agree*	
Instructors were knowledgeable of subject matter.	9%		91%	
The content was relevant to my needs.	0%		100%	
The content was at an understandable level.	50%		50%	
The content was well-organized.	20%		80%	
The content was based on credible information.	28%		72%	
Attending program was worth my time.	20%		80%	
I would recommend this program to others.	20%		80%	
I increased my knowledge of the topics covered.	33%		66%	
I learned new skills related to topics covered.	33%		66%	
I will use information I learned in this program.	25%		75%	
I will tell others about what I learned.	48%		51%	
	None	*Little*	*Some*	*A lot*
How much of content did you already know?	0%	25%	50%	25%
How many of the resource materials will you use?	0%	0%	50%	50%
How well did information meet your expectations?	0%	0%	22%	77%

Figure 1. Alfalfa poultry litter field trial taken on November 10, 2017 at the Newton location.

Figure 2. Alfalfa poultry litter field trial taken on April 4, 2018 at Newton location.

Figure 3. Coastal Plain Forage Field Day hosted on April 5, 2018.