7-1-1989

Fescue, fescue-clover, and ryegrass for stocker production and profitability

W. J. Woods

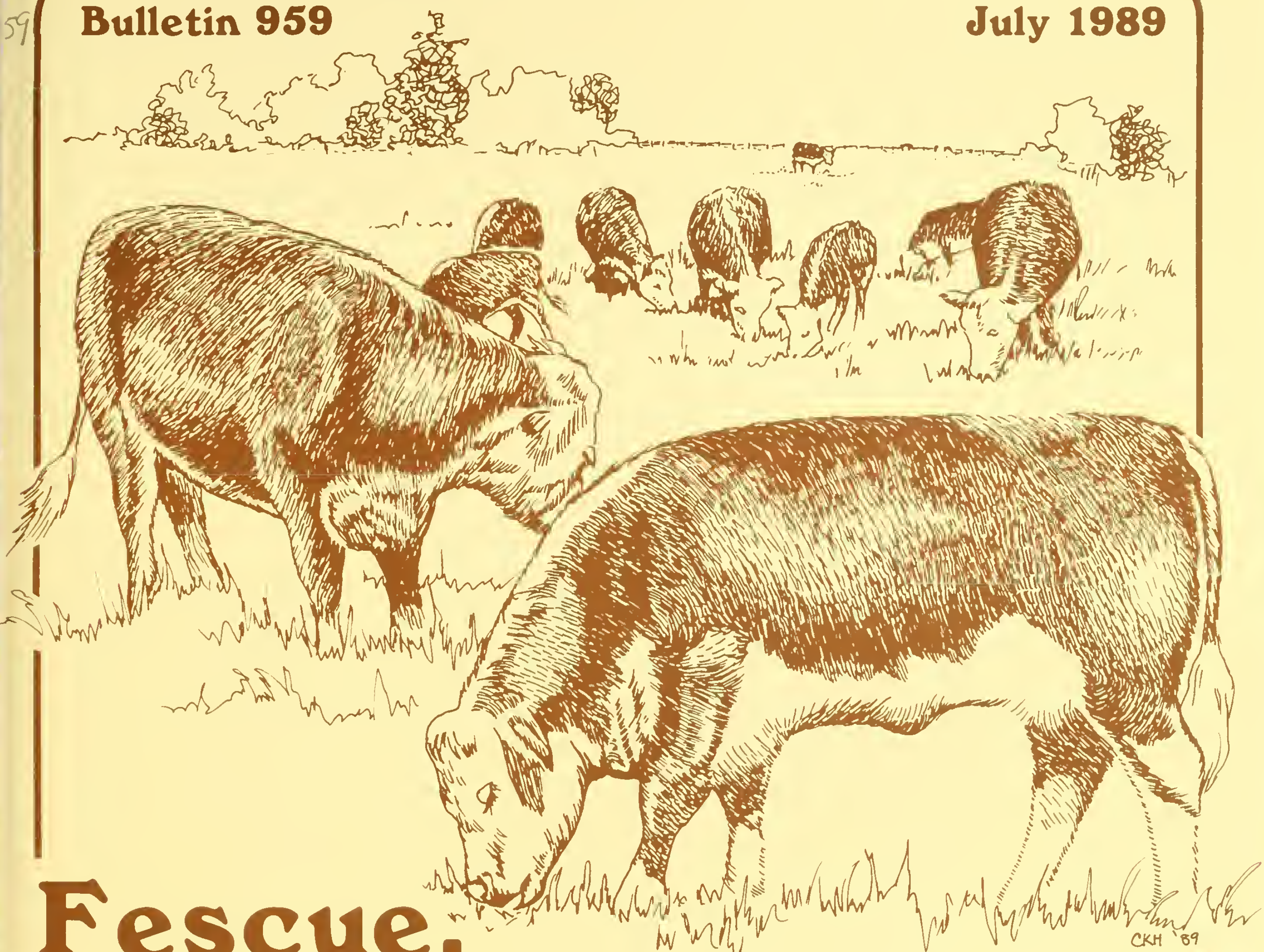
H. W. Essig

F. T. Withers Jr.

Vance H. Watson

C. E. Centrell

Bulletin 959 July 1989



Fescue, Fescue-Clover, and Ryegrass for Stocker Production and Profitability

MAFES
MISSISSIPPI AGRICULTURAL & FORESTRY EXPERIMENT STATION Verner G. Hurt, Director Mississippi State, MS 39762
Donald W. Zacharias, President Mississippi State University R. Rodney Foil, Vice President

Fescue, Fescue–Clover, and Ryegrass for Stocker Production and Profitability

W. J. Woods
Graduate Assistant
Department of Animal Science

H. W. Essig
Professor and Animal Scientist
Department of Animal Science
Leveck Animal Research Center

F. T. Withers, Jr.
Superintendent
Leveck Animal Research Center

V. H. Watson
Professor, Department of Agronomy
Head, MAFES Auxiliary Units

C. E. Cantrell
Instructor and Facilities Coordinator
Leveck Animal Research Center

Fescue, Fescue–Clover, and Ryegrass for Stocker Production and Profitability

Introduction

Cool season pastures of either annual ryegrass or tall fescue have been the basic forage for beef stocker operations in the southeastern United States for many years. Since the discovery that infestation of tall fescue (*Festuca arundinacea* Schreb.) by the endophyte fungus, *Acremonium coenophialum*, reduced performance and economic return of stocker cattle, efforts have been made to determine the best management procedures to improve performance of stocker cattle grazing tall fescue. Endophyte-free fescue (EFF) pastures require higher levels of management in the lower South because of the decreased hardiness of the grass and poor stand persistence.

Decisions on whether to destroy the endophyte-infested fescue (EIF) pastures or continue to use the more expensive annual ryegrass (RG) in Mississippi and other southeastern states must be based on sound economics if beef cattle producers expect to maintain profitable operations. Thirty years ago, researchers were showing the benefits of cool season forages for the production of gain even in finishing beef cattle (Williams and Edgar, 1959). Yet Hoveland (1986) stated that beef production in the southeastern United States, as elsewhere, is basically an inefficient enterprise. He further stated that this inefficiency is illustrated by the very low beef production obtained per acre by average cattle producers in the region.

Many desirable characteristics of tall fescue as a cool season forage allow its extensive use as a pasture for beef cow-calf and stocker operations in the southeastern United States (Standaert, 1986; Ball et al., 1987; Smith et al., 1987). Those characteristics include a long growing season, stand persistence, limited management requirements, high dry matter (DM) yield, and drought tolerance.

Initially, it appeared that most, if not all, the tall fescue pastures in the southern United States were infected with *A. coenophialum* (Ball et al., 1987; Evans, 1985). The problem was compounded when it was determined that seeds and hay from infested stands were also infected with the fungus and would cause the same symptoms when fed to cattle (Boling, 1985; Schmidt et al., 1982). Early results indicated much improved performance for cattle grazing the fescue with low or no endophyte fungus present (Burton, 1986; Standaert, 1986; Essig et al., 1987; Stuedeman et al., 1988; McMurphy et al., 1988). However, EFF pastures did not produce as much total forage yield as the EIF pastures nor were they as stress tolerant (Siegel et al., 1987a; Siegel et al., 1987b; West, 1987; Wilkinson, 1987).

Experimental Procedures

In the fall of 1984, five paddocks in each of two 25-acre pastures located on the Animal Research Center at Mississippi State were to one of five forages or forage mixtures: Marshall ryegrass; Ky-31 EFF; Ky-31 EFF, plus red (*Trifolium pratense*) and subterranean (*Trifolium subterraneum* L.) clover (EFFC); Ky-31 EIF; or Ky-31 EIF, plus red and subterranean clover (EIFC). Infection levels were checked on all fescue paddocks during each year of the trial. Results are shown in Table 1.

The ryegrass pastures were planted between September 1 and September 10 each year of the experiment. Appropriate tall fescue or tall fescue-clover combinations were planted using a no-till drill. Due to a poor EFF stand, extra EIF seed was applied, in error, to one paddock (No. 19-5) in fall 1985. Because of the mixed seeding, the results of the performance on this paddock were not included in statistical analysis.

All pastures were fertilized in the fall and spring with ammonium nitrate at the rate of 200 lb/acre for ryegrass, EFF, and EIF pastures, and 100 lb/acre for the pastures containing clover. The intent throughout the trials was minimum intervention with minimum supplemental feeding to provide the most economical gain for a typical stocker producer in the southeastern United States.

The first year was extremely dry

Table 1. Endophyte Infestation Levels.

	Paddock and forage									
Year	19-1 EIF	19-2 EIF	19-3 RG	19-4 EFF	19-5 EFF	20-1 RG	20-2 EFF	20-3 EIF	20-4 RG	20-5 EIF
1	27	32	0	0	0	0	0	26	0	33
2	47	67	0	0	24**	0	0	43	0	46
3	88	82	0	0	36**	0	0	68	0	73

* Percent of tillers infested.

**Supplemental EIF seed erroneously applied fall 1985 due to loss of stand in this paddock only.

and calves were not placed on pasture until March. For years 2 and 3, a November start date was selected when forage tiller height had reached approximately 10 inches. Comparisons of forage yield for each treatment were made during each trial. Duplicate cages, 4 feet square by 2 feet deep were placed in each paddock in areas of typical forage coverage and growth. Clippings from each cage were collected on each weigh day throughout the experiment.

Experimental Animal Selection

Criteria for selection of experimental weanling heifers were age, weight, and breed. Breeds were Hereford, Angus, Charolais, Santa Gertrudis, F1 (Angus x Brahman), and three-breed crosses (Angus x Brahman x Hereford). In all cases, the number in each breed classification allowed equal placement in each complete block so that all paddocks had equal numbers of each breed. Stocking rate for all years was seven animals on each 5-acre paddock or 1.4 animals per acre.

Economics

In calculating the returns per unit area, the following assumptions were made: (1) Cost of animals for all treatments were equal since the heifers were randomly assigned to all treatments in equal numbers; (2) Cost of management practice were equally applied to all treatments; (3) The value of gain per unit of weight was equal for animals on all treatments since the animals were balanced by breed and randomly assigned.

An economic evaluation for each trial was calculated using the following procedures: (1) total gain for each treatment was calculated; (2) cost to establish or maintain the forage in each treatment was calculated using appropriate cost from budgets developed by the Mississippi Agricultural and Forestry Experiment Station and Mississippi Cooperative Extension Service for the year in question (MAFES/MCES, 1985; 1986; 1987); (3) supplemental feeding required to maintain animals when forage was unavailable was determined using the following: year 1 – none used; year 2 – shelled corn at $1.75/bu, soybean meal at $210/T, mineral premix at $14.56/cwt, salt at $5.00/cwt, and 1,200-lb large round bales of hay at $20.00 each; year 3 – hay fed to animals on pasture as needed. The diet for year 2 (excluding hay) cost $110.40/T. Because all animals were pooled in a common non-treatment pasture during periods of supplemental feeding in year 2, the cost of that feeding was equally divided among treatment groups.

The following formula was used to compute profit (loss) for each treatment: Profit(loss)/acre = (ADG x number animals x grazing days x $.60) – (cost of maintenance + cost of supplemental feed).

In Vitro Dry Matter Disappearance

Samples of the forages for the spring and summer growing periods for 1987 were retained. An *in vitro* dry matter disappearance (IVDMD) procedure (Goering and Van Soest, 1970) was used to simulate the digestibility of these forages.

Statistical Analysis

Weigh data collected each 28 days were analyzed using the general linear model (GLM) of the Statistical Analysis System (SAS, 1985). The model was a split-plot design using forage as whole plot effect with weigh period as sub-plot effect. Whole plot effect was tested using forage by block mean square as error. The LSD procedure was used to separate means that were significantly different.

Results and Discussion

Year 1

Dry matter (DM) yields for year 1 (Table 2) were measured on the day the calves were placed in the pastures and each 28 days thereafter. Yields were calculated to make comparisons with animal gain for that 28-day period. Even though the ryegrass pastures had begun to deteriorate by the last weight period, there was no great divergence in yield for all treatment forages. Loss of clover from two of the treatments was expected after reviewing research by Standaert (1986). The clover loss occurred after the first year of grazing.

During year 1, there was no difference in DM yields among treatments; however, the gains of the test animals across treatments were different (Table 3). Test animals were removed from the paddocks containing ryegrass after period 3 (May 6) because the volume of forage was insufficent to maintain economical gain. The ryegrass forage under protection of the cages was harvested on June 3 and July 2 even though there were no animals on the paddocks. The DM:gain ratio shows a relationship between total forage yield and gain per acre. The smaller ratios

Table 2. Dry matter yield for the forage systems, Year 1.

	Treatments, lb DM/acre				
Date	RG	EFF	EFFC	EIF	EIFC
Mar 12	1,582	1,415	995	1,240	1,260
Apr 9	892	1,189	988	1,192	976
May 6	672	638	1,090	910	857
June 3	418	306	674	388	431
July 2	148	527	487	742	403
Mean*	742	815	847	895	785

*Means not significantly different.

for ryegrass and EFIC indicate more efficient use of forage produced. Profit per acre was higher for all fescue treatments than for the ryegrass even though gain per acre was higher for ryegrass. This fact was amplified by the longer growing season for the fescue treatments and the additional gain per acre as a result. The higher cost of establishing the ryegrass pastures and the short 84-day grazing period were principal causes.

Year 2

Early growth of forage in 1985 allowed placement of heifers in paddocks in late fall as the original plan dictated. After evaluation of the forage growth in November 1985, the decision was made to place the heifers on pasture November 25.

Evaluation of growth of the forage in the experiment began with a harvest of the forage under cages on each weigh day except for those when growth was insufficient for measurement. Total DM yields were calculated for each 28-day period (Table 4). The DM yields among forages show very little difference through the growing season.

Gain per acre among treatments shows the first major measureable effect of the endophyte fungus with gains for the ryegrass and EFF being significantly larger than gains of infested pastures. Even though there was no difference in forage yield, the ratio of DM yield to gain reflected the low per acre gain of animals on EIF. The lower gain per acre was reflected in lower profit per acre for heifers grazing the EIF, even though it (EIF) was less expensive to maintain than to establish and maintain ryegrass. Performance during year 2 was the first suggestion of the detrimental effect of endophyte on cattle. An evaluation of returns per acre using the formula stated earlier showed the returns for animals grazing ryegrass and EFF to be superior to those grazing EIF (Table 5).

Year 3

Measurements of the DM yields of forage harvested from cages indicated excellent forage growth for the entire season. The EIF pro duced the most total DM yield per acre (Table 6). Lack of consistent production was very evident when the average DM yield per period was computed for the different forages. The EIF produced an average of 54% more forage per acre than did EFF and 60% more

Table 3. Total animal gain, forage yield, grain yield ratio, and economic calculations, Year 1 in all forage systems (84 days and 140 days).

	Treatments				
Item	RG	EFF	EFFC	EIF	EIFC
No. animals	14	14	14	14	14
Init wt., lb.	609	613	619	623	618
Cost, $/ac	145.77	81.10	100.85	81.10	100.85
84-day					
Gain, lb/ac	272.9a	203.4b	236.0ab	204.2b	254.9ab
ADG, lb	2.32	1.73	2.01	1.74	2.17
DMyld, lb/ac	3,146	3,242	3,073	3,342	3,093
DM/gain	11.53	15.94	13.02	16.36	12.13
Profit, $/ac	17.97	40.29	40.75	41.42	52.09
140-day					
Gain, lb/ac		245.0ab	279.4a	230.8b	287.4a
ADG, lb		1.75	2.00	1.65	2.05
DM yld, lb/ac		4,075	4,234	4,472	3,927
DM/gain		16.63	15.15	19.38	13.66
Profit, $/ac		65.90	66.79	57.38	71.59

*Means within a row with a different letter differ significantly (P<.05).

Table 4. Dry matter yields, Year 2.

	Treatments, lb DM/acre		
Date	RG	EFF	EIF
Nov 25	1,955	2,075	2,033
Dec 17	400	606	592
Mar 17	474	382	446
Apr 14	1,077	841	917
May 12	512	427	437
Mean*	885	866	885

* DM yields not significantly different.

Table 5. Total animal gain, forage yield, gain yield ratio and economic calculations, Year 2 (196 days)

	Treatments		
Item	RG	EFF	EIF
No. animals	14	28	28
Init wt. lb.	516	516	533
Gain, lb/ac	395a	362a	209b
ADG, lb	1.44	1.32	0.76
DM Yield, lb/ac	4,418	4,331	4,425
DM/Gain, lb	11.18	11.96	21.17
Cost, $/ac	137.81	86.39	86.39
Profit, $/ac	99.19	130.81	39.01

a,b Means within a row followed by a different letter differ significantly (p<.05).

total DM yield suggests that the fungus adds hardiness to the EIF cultivar. Dry matter yield was considerably higher for EIF during May, June, and July than for EFF.

Gain per acre values were more different during year 3 than year 2. Animals on ryegrass produced significantly more gain than those on either of the other treatments (Table 7). Likewise, the heifers that grazed EFF gained more than those allowed to graze EIF. Differences in forage yield increased the DM:gain ratio with ryegrass and EFF showing much more efficiency. Higher gain per acre for ryegrass generated more gross income, but the additional cost of establishment and maintenance resulted in a higher net income attributed to EFF. Likewise the lower gain per acre for EIF animals resulted in the lowest net return for all treatments. Even though the EIF forage was lush and had the highest DM yield the test animals performed poorly.

Whatever is causing poor animal performance might be causing lower digestibility of the forage or decreased intake and thus providing animals with less energy. Samples from all treatment forages for the spring and summer growing season in year 3 (1987) were evaluated using the *in vitro* dry matter digestibility (IVDMD) procedures (which simulates rumen dry matter digestibility using microbial fermentation in a laboratory apparatus), to determine if the endophyte fungus reduced dry matter digestibility (Goering and Van Soest 1975).

There were no significant differences in the IVDMD values of the forages indicating little or no effect of the endophyte on DM digestibility (Table 8). These data are in agreement with data of Fribourg (1987) who showed only a small decrease for in vitro digestibility of EIF versus EFF forage, Schmidt et al. (1982), Bush and Burris (1988), and Burton (1986) who showed no change in IVDMD as a result of endophyte infestation.

Summary

The addition of clover to EIF pastures appeared to increase the gain and economic return of stocker cattle on such pastures. Normally, one could expect 2 to 3 years or more of clover production under good management; however, virtually all the clover in these trials disappeared after the first year. Drought was blamed for the clover loss and has occurred with some regularity. Atypical environmental conditions, such as drought, reduced the economic return on all treatments but were especially harmful to the ryegrass pasture because of the high expense of initial establishment. There was a large increase in the ratio of DM yield to gain over 3 years for heifers grazing the EIF treatment. This led us to conclude that intensity of endophyte infestation also increased with the age of stand.

Results of both animal performance and profitability in these trials build a strong case for con

Table 6. Dry matter yields, Year 3.

	Treatments, lb DM/acre		
Date	RG	EFF	EIF
Nov 10	733	1,604	1,997
Dec 5	377	295	341
Jan 5	134	139	184
Mar 27	1,658	792	1,128
Apr 24	709	555	587
May 21	2,082	2,460	4,212
June 19	1,408	1,932	3,326
July 17	147	144	564
Mean*	915a	990a	1,515b

* Means within a column followed by a different letter differ (p<.05).

Table 7. Total animal gain, forage yield, gain yield ratio, and economic calculations, Year 3 (252 days).

	Treatments		
Item	RG	EFF	EIF
No. animals	14	28	28
Initial wt.	461	467	466
Gain, lb/ac	427a	366b	306c
ADG, lb	1.21	1.04	0.87
DM yield, lb/ac	7,248	7,931	12,139
DM/gain, lb	16.97	21.35	39.67
Cost, $/ac	125.62	78.98	78.98
Profit, $/ac	134.78	143.02	102.82

*Means within a row foll owed by a different letter differ (P<.05).

Table 8. In vitro dry matter disappearance values of forage systems, Year 3*.

Forage	Minimum	Maximum	Mean	SD
	%			
RG	47.34	88.35	68.99	12.57
EFF	40.67	83.10	64.67	8.34
EIF	46.66	82.24	65.02	9.08

* Values are % DM disappearance

tinued use of annual ryegrass and (or) EFF as a primary source of the total diet for stocker cattle in the southeastern United States. The amount of rainfall at planting or shortly after, along with winter temperatures are major factors in determining the economics of stocker production.

Literature Cited

Ball, D. M., G. Lacefield, and C. S. Hoveland. 1987. The fescue endophyte story. Pamphlet. Oregon tall fescue commission.

Boling, J. A. 1985. Endophytic fungus and tall fescue utilization by ruminants. Professional Anim. Sci.

Bush. L. P. and P. B. Burrus Jr. 1988. Tall fescue forage quality and agronomic performance as affected by the endophyte. J. Prod. Agric. 1:55.

Burton, Glen W. 1986. Forage of future. Proceedings of the 42nd Southern Pasture and Forage Crop Improvement Conference. pp 1-3.

Essig, H. W., V. H. Watson, and F. T. Withers. 1987. Mississippi research report. Proceedings tall fescue endophyte meeting. Southern Region Information Exchange Group 37.

Evans, J. Kenneth. 1985. Tall fescue–history and future. Proceedings of 41st Southern Pasture and Forage Crop Improvement Conference. pp 14.

Fribourg, H. A. 1987. Tennessee research report. Proceedings tall fescue endophyte meeting. Southern Region Information Exchange Group 37.

Goering, H. K. and, P. J. Van Soest. 1975. Forage fiber analyses (apparatus, reagents procedures, and some applications). Agric. Handbook 379. ARS, USDA, Washington, DC.

Hoveland, Carl. S. 1986. Beef-forage systems for the southeastern United States. J. Anim. Sci. 63.978.

MAFES/MCES. 1985. Cost of establishing and maintaining forage crops in Mississippi. pp 83-86, 91-94, 111-114.

MAFES/MCES. 1986. Cost of establishing and maintaining forage crops in Mississippi. pp 83-86, 115-118.

MAFES/MCES . 1987. Agric. Econ. Rep. 22. 1987 Forage cost. pp 94-, 110-113.

McMurphy, W. E., K. S. Lusby, S. Muntz, J. Cantrell, and S. C. Smith, 1988. Effects of level of endophyte and clover on performance of steers grazing fescue in Eastern Oklahoma. Amer. Soc. Of Anim. Sci. Southern Section. p 57 (Abstr).

Schmidt, S. P. , C. S. Hoveland, E. M. Clark, N. Davis, L.A. Smith, H. W. Grimes and, J. L. Holliman. 1982. Association of an endophytic fungus with fescue toxicity in steers fed Kentucky 31 tall fescue seed or hay. J. Anim. Sci. 55:1259.

Siegel, M. R., N. Fannin, L. P. Bush, D. L. Dahlman, P. M. Savos, J. Jackson, R. Hemken, and D. R. Varney. 1987a. Kentucky research report. Proceedings tall fescue endophyte meeting Southern Region Information Exchange Group 37.

Siegel, M. R., L. P. Bush, and D. D. Dahlman. 1987b. What am I losing by removing endophyte from tall fescue. Proceedings of the 43rd Southern Pasture and Forage Crop Improvement Conference.

Smith, W. L. N. Gay, J. A. Boling, and R. B. Muntifering. 1987. Growth and metabolism of growing beef calves fed tall fescue haylage supplemented with protein and (or) energy. J. Anim. Sci. 65:1094.

Standaert, James E. 1986. The benefits of fescue pasture renewal. Proceedings of the 42nd Southern Pasture and Forage Crop Improvement Conference. pp 41-46.

Stuedemann, J. A., D. L. Breedlove, K. R. Pond, D. P. Belesky, L. P. Tate, Jr., F. N. Thompson, and S. R. Wilkinson. 1988. Effect of level of endophyte infection of tall fescue and paddock exchange on intake of grazing steers. Amer. Soc. of Anim. Sci. Southern Section. p 56 (Abstr).

Wilkinson, S. R. 1987. Georgia research report. Proceedings tall fescue endophyte meeting. Southern Region Information Exchange Group 37.

Williams, L. W., and R. A. Edgar. 1959. A comparison of winter grazing crops at state university. Information Sheet 640. Mississippi State University Agricultural Experiment Station.