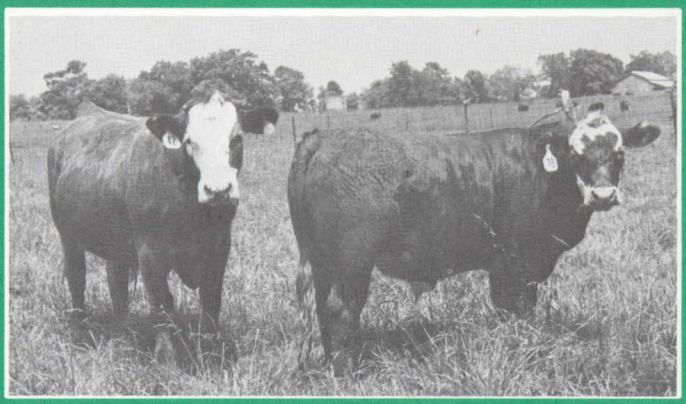
STEER RESPONSE TO AU TRIUMPH AND KENTUCKY 31 FESCUE AT THREE ENDOPHYTE LEVELS



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ON THE COVER. Steers on infested Kentucky 31 fescue (top) show contrast with others on AU Triumph (bottom).

Steer Response to AU Triumph and Kentucky 31 Fescue at Three Endophyte Levels

J. F. Pedersen, J. A. McGuire, S. P. Schmidt, C. C. King, Jr., C. S. Hoveland, E. M. Clark, L. A. Smith, H. W. Grimes, and J. L. Holliman[1]

POOR ANIMAL PERFORMANCE has been associated with tall fescue (*Festuca arundinacea* Schreb.) for many years. One theory attributed this poor performance to alkaloids, naturally occurring toxic compounds in tall fescue *(3)*, but more recently a fungal endophyte (a fungus growing inside the grass), *Acremonium coenophialum,* has been blamed *(1,7,8)*.

Gains of cattle grazing endophyte-free tall fescue have been nearly double those on infected pastures *(7,8)*. In those studies, the pastures were either nearly 100 percent infected or nearly free of the endophyte. It is known, however, that the infection levels of pastures can vary from 0 to 100 percent, with intermediate levels being possible *(1)*. Preliminary reports have indicated that intermediate levels of animal performance are associated with intermediate levels of endophyte infection *(5,10)*. To date, definitive studies on the effects of intermediate levels of endophyte infection on animal performance have not been reported.

Some new cultivars of tall fescue, including the Alabama Agricultural Experiment Station variety AU Triumph, are being marketed as endophyte-free *(2,9)*. In the case of AU Triumph, animal gains per acre and average daily gains (ADG) per steer have been double that of Kentucky 31 tall fescue *(6)*. However, these results were confounded by AU Triumph being endophyte-free and Kentucky 31 being heavily infected in these tests.

[1]Assistant Professor of Agronomy and Soils; Professor of Research Data Analysis; Associate Professor of Animal and Dairy Sciences; Professor of Agronomy and Soils (Retired); Professor of Agronomy and Soils (now at Agronomy Department, University of Georgia, Athens, Georgia); Associate Professor of Botany, Plant Pathology, and Microbiology; and Superintendent (Retired), Superintendent, and Associate Superintendent, Black Belt Substation, respectively.

The major objective of this study was to determine if an intermediate level of endophyte infection would be reflected in an intermediate level of animal performance. A secondary objective was to compare AU Triumph with Kentucky 31 in terms of animal performance when both cultivars were endophyte-free.

MATERIALS AND METHODS

Pasture Management

Kentucky 31 tall fescue was seeded during October 1974 on six 3-acre paddocks at the Black Belt Substation in west central Alabama. Three paddocks were virtually free of the endophyte (1 percent infected), while the others were more than 90 percent infected. At least 117 samples were collected from each treatment during the course of this study and were examined microscopically to determine the endophyte infection level *(4)*. The reason for the different infection levels is not known for certain, but it is likely that commercial seed lots of differing age, and therefore different endophyte viability, were planted *(10)*. Three additional 3-acre paddocks each of Kentucky 31 and AU Triumph tall fescue were planted at the same location in September 1979. No endophyte infection was found in the AU Triumph paddocks, while 34 percent of the plants in the Kentucky 31 paddocks were infected. The 90 percent infected paddocks were located on a Eutaw clay (very fine, montomorillonitic, thermic Typic Chromuderts) soil. The other paddocks were located on a mixture of Sumter (fine-silty, carbonatic, thermic Rendollic Eutrochrepts) and Houston (very-fine montmorillonitic, thermic Typic Chromuderts) clay soils.

Grass residue was mowed and removed from the paddocks each September to a stubble height of 3 inches. Nitrogen at 100 pounds per acre was applied in September and again in February. Mineral fertilizer was applied to each paddock according to soil test recommendations. Visual estimates of botanical composition and tall fescue maturity were made at random by two persons at 10 locations in each paddock at monthly intervals during the grazing season.

Animal Management

Crossbred steers, weighing approximately 500 pounds each, were purchased each September and grazed on dallisgrass (*Paspalum dilatatum* Poir.) before being placed on the experimental paddocks. An estimate of minimum stocking rate (3 steers per paddock) was used to determine the number of animals that could be supported continuously by the expected forage in the paddocks.

These animals were termed "stocker" animals. Relative forage availability was visually estimated on at least a monthly basis. When excess forage was present on some or all paddocks, extra steers maintained on adjacent tall fescue pastures (90 percent infected) were used to graze the excess forage and thereby equate the available forage on all paddocks. Pasture height was measured at 10 random locations in each paddock on monthly intervals to provide documentation of relative forage availability.

Steer weights were recorded at 28-day intervals for all stocker animals, and at times of placement in and removal from the paddocks for the extra animals. Water, salt, and shade were provided in all paddocks. During January and February when sufficient forage was not available, the steers were removed from the paddocks and fed Johnsongrass or dallisgrass hay plus a corn-cottonseed meal supplement (20 percent protein) to maintain an ADG of approximately 1 pound. The trial lasted three grazing seasons, beginning in autumn 1980 and ending in spring 1983.

RESULTS AND DISCUSSION

Botanical Composition

Botanical composition of forage in the paddocks changed only slightly over the 3-year period and averaged at least 90 percent tall fescue for all treatments. Relative fescue maturity was not shown to differ among treatments at any time throughout the experiment. Steers were grazed on the experimental paddocks from October 20, 1980, to January 5, 1981; March 2, 1981, to May 20, 1981; September 28, 1981, to December 21, 1981; February 18, 1982, to May 30, 1982; September 29, 1982, to December 20, 1982; and March 7, 1983, to June 1, 1983. Grazing was terminated each year when tall fescue ceased making any appreciable growth.

Forage Availability

Average pasture height, an indicator of relative forage availability, is shown for each treatment on a monthly basis in table 1. At the .05 level of probability, treatment differences were shown slightly over one-half of the time. Where differences existed among the three infection levels in Kentucky 31, the 90 percent infected Kentucky 31 was usually the tallest. When AU Triumph was shown to be different from the 1 percent infected Kentucky 31, AU Triumph was the tallest. At no date was the extreme range of treatment height averages greater than 1.9 inches, indicating a fair degree of success in maintaining equal grazing pressures on all treatments.

TABLE 1. PASTURE HEIGHTS OF AU TRIUMPH AND KENTUCKY 31 TALL FESCUE AT THREE LEVELS OF ENDOPHYTE INFECTION

Date	Height, by variety and infection level			
	AU Triumph (0)[1]	Kentucky 31 (1)	Kentucky 31 (34)	Kentucky 31 (90)
	Inches	*Inches*	*Inches*	*Inches*
10-29-80	5.8*	4.7**	5.3	6.2
11-24-80	5.0	4.2**	4.8	5.8
12-22-80	2.7	2.4**	2.2	3.3
1-5-81	1.1	1.0**	1.2	1.5
3-2-81	5.0*	3.2**	3.7	3.7
3-24-81	5.3*	4.2**	4.5	4.7
4-23-81	5.5	4.8	5.3	5.3
5-21-81	3.7*	4.4**	3.8	4.5
6-17-81	3.0	3.7	3.7	3.7
9-28-81	6.0	6.2	5.8	5.5
10-26-81	4.7	5.0	4.8	5.3
11-23-81	3.4	3.6**	3.9	4.3
12-21-81	2.2	2.4	2.4	2.9
2-17-82	4.4*	3.7**	3.5	4.5
3-17-82	5.8	4.3	4.9	5.2
4-14-82	5.8*	5.3**	6.3	5.3
5-13-82	4.4*	5.8**	5.5	4.9
9-28-82	7.5	8.4	8.0	8.5
10-26-82	6.7	6.7	6.4	7.2
11-23-82	6.0	5.5	5.8	5.5
3-2-83	4.3*	3.0**	3.5	2.4
4-3-83	5.3*	3.8**	4.5	3.9
5-3-83	4.9	4.7	5.4	5.0
6-1-83	4.3*	5.7	6.0	5.9

[1]Numbers in parenthesis indicate percent infection with *A. coenophialum.*

*Significant difference at .05 level of probability between AU Triumph and non-infected Kentucky 31.

**Significant difference at .05 level of probability among the three infection levels of Kentucky 31.

Average Daily Gains

The ranking of total season ADG corresponds quite well to the percent infection of the Kentucky 31 paddocks, with lower infection percentages being associated with higher gains, table 2. Although differences were not statistically significant among all three levels of infection in each year, they were different when averaged over the 3 years of this study, and ranked similarly in all years of this study.

TABLE 2. TOTAL SEASON AVERAGE DAILY GAIN OF TESTER STEERS GRAZING KENTUCKY 31 AND AU TRIUMPH TALL FESCUE AT DIFFERENT LEVELS OF ENDOPHYTE INFECTION

Cultivar and percent infection	Average daily gain			
	1980-81	1981-82	1982-83	Mean
	Lb.	*Lb.*	*Lb.*	*Lb.*
AU Triumph—0	2.20 a*	2.03 a	2.03 a	2.09 a
Kentucky 31—1	2.36 a	2.07 a	2.09 a	2.16 a
Kentucky 31—34	2.16 a	1.50 b	1.63 b	1.76 b
Kentucky 31—90	1.89 a	1.21 b	1.08 c	1.41 c

*Means within a column with the same letter are not significantly different at the .05 level.

TABLE 3. FALL AVERAGE DAILY GAIN OF TESTER STEERS GRAZING KENTUCKY 31 AND AU TRIUMPH TALL FESCUE AT DIFFERENT LEVELS OF ENDOPHYTE INFECTION

Cultivar and percent infection	Average daily gain			
	1980-81	1981-82	1982-83	Mean
	Lb.	*Lb.*	*Lb.*	*Lb.*
AU Triumph—0	2.44 a*	2.29 a	1.67 a	2.14 a
Kentucky 31—1	1.85 a	2.03 ab	1.34 b	1.74 b
Kentucky 31—34	2.09 a	1.59 b	1.30 b	1.65 b
Kentucky 31—90	1.76 a	1.59 b	.66 c	1.34 c

*Means within a column with the same letter are not significantly different at the .05 level.

TABLE 4. SPRING AVERAGE DAILY GAIN OF TESTER STEERS GRAZING KENTUCKY 31 AND AU TRIUMPH TALL FESCUE AT DIFFERENT LEVELS OF ENDOPHYTE INFECTION

Cultivar and percent infection	Average daily gain			
	1980-81	1981-82	1982-83	Mean
	Lb.	*Lb.*	*Lb.*	*Lb.*
AU Triumph—0	1.98 a*	1.78 ab	2.38 b	2.05 b
Kentucky 31—1	2.75 a	2.11 a	2.80 a	2.56 a
Kentucky 31—34	2.20 b	1.43 bc	1.96 c	1.87 b
Kentucky 31—90	1.98 b	.86 c	1.48 d	1.43 c

*Means within a column with the same letter are not significantly different at the .05 level.

When the ADG was divided into fall and spring periods, fall differences were small in most cases where they existed, table 3. The only large difference, 0.66 pound vs. 1.30 pounds, occurred between the 90 percent infected paddocks and the other Kentucky 31 paddocks in the fall of 1982. The spring ADG showed large differences among the 1, 34, and 90 percent infected Kentucky 31 paddocks, with the non-infected treatment having the highest, the 34 percent level an intermediate, and the 90 percent level the lowest ADG, table 4.

Stocking Rates

Highly infected Kentucky 31 paddocks had higher carrying capacities than did non-infected Kentucky 31, tables 5, 6, and 7. This effect tended to carry through the breakdown of stocking rates into fall, spring, or total season grazing periods. No differences were de-

TABLE 5. TOTAL SEASON STOCKING RATE ON KENTUCKY 31 AND AU TRIUMPH TALL FESCUE AT DIFFERENT LEVELS OF ENDOPHYTE INFECTION

Cultivar and percent infection	Stocking rate, steers/acre			
	1980-81	1981-82	1982-83	Mean
	No.	*No.*	*No.*	*No.*
AU Triumph—0	2.00 a*	1.44 b	1.60 b	1.54 b
Kentucky 31—1	1.28 b	1.24 b	1.45 c	1.32 c
Kentucky 31—34	1.39 b	1.31 b	1.49 bc	1.40 c
Kentucky 31—90	1.67 a	1.79 a	1.84 a	1.77 a

*Means within a column with the same letter are not significantly different at the .05 level.

TABLE 6. FALL STOCKING RATE ON KENTUCKY 31 AND AU TRIUMPH TALL FESCUE AT DIFFERENT LEVELS OF ENDOPHYTE INFECTION

Cultivar and percent infection	Stocking rate, steers/acre			
	1980-81	1981-82	1982-83	Mean
	No.	*No.*	*No.*	*No.*
AU Triumph—0	1.13 b*	1.11 b	1.39 b	1.21 b
Kentucky 31—1	1.02 b	1.14 b	1.50 b	1.22 b
Kentucky 31—34	1.13 b	1.11 b	1.41 b	1.22 b
Kentucky 31—90	1.67 a	1.33 a	2.00 a	1.67 a

*Means within a column with the same letter are not significantly different at the .05 level.

TABLE 7. SPRING STOCKING RATE ON KENTUCKY 31 AND AU TRIUMPH TALL FESCUE AT DIFFERENT LEVELS OF ENDOPHYTE INFECTION

Cultivar and percent infection	Stocking rate, steers/acre			
	1980-81	1981-82	1982-83	Mean
	No.	*No.*	*No.*	*No.*
AU Triumph—0	1.98 a*	1.76 b	1.79 a	1.84 a
Kentucky 31—1	1.49 b	1.30 b	1.35 c	1.38 b
Kentucky 31—34	1.60 b	1.51 b	1.58 b	1.56 b
Kentucky 31—90	1.67 b	2.23 a	1.69 ab	1.86 a

*Means within a column with the same letter are not significantly different at the .05 level.

tected between Kentucky 31 paddocks in the spring of 1980-81. In all cases except the spring of 1982-83, stocking rates were similar on 34 percent infected and non-infected Kentucky 31 paddocks.

Beef Production Per Acre

Total seasonal steer gain per acre was similar for the 90 percent and 34 percent infection rates when averaged over 3 years, table 8. A difference in steer gain per acre for those two levels of infection in Kentucky 31 paddocks was detectable only during the third year. However, the non-infected Kentucky 31 paddocks gave higher gains in both 1981-82 and 1982-83 and in the 3-year average. When the gain was split into spring and fall seasons, few differences were found during the fall grazing period, table 9. The differences shown for total season gain are ranked identically to those shown for spring gain for the three levels of infection in Kentucky 31, table 10.

TABLE 8. TOTAL SEASON GAIN PER ACRE OF STEERS GRAZING KENTUCKY 31 AND AU TRIUMPH TALL FESCUE AT DIFFERENT LEVELS OF ENDOPHYTE INFECTION

Cultivar and percent infection	Steer gain/ acre			
	1980-81	1981-82	1982-83	Mean
	Lb.	*Lb.*	*Lb.*	*Lb.*
AU Triumph—0	489 a*	421 a	555 a	519 a
Kentucky 31—1	438 a	450 a	497 b	462 b
Kentucky 31—34	431 a	369 b	408 c	397 c
Kentucky 31—90	431 a	352 b	308 d	370 c

*Means within a column with the same letter are not significantly different at the .05 level.

TABLE 9. FALL GAIN PER ACRE OF STEERS GRAZING KENTUCKY 31 AND AU TRIUMPH TALL FESCUE AT DIFFERENT LEVELS OF ENDOPHYTE INFECTION

Cultivar and percent infection	Steer gain/ acre			
	1980-81	1981-82	1982-83	Mean
	Lb.	*Lb.*	*Lb.*	*Lb.*
AU Triumph—0	187 a*	221 a	193 a	199 a
Kentucky 31—1	129 a	202 a	182 a	171 a
Kentucky 31—34	164 a	149 a	154 b	156 a
Kentucky 31—90	200 a	171 a	114 c	162 a

*Means within a column with the same letter are not significantly different at the .05 level.

TABLE 10. SPRING GAIN PER ACRE OF STEERS GRAZING KENTUCKY 31 AND AU TRIUMPH TALL FESCUE AT DIFFERENT LEVELS OF ENDOPHYTE INFECTION

Cultivar and percent infection	Steer gain/ acre			
	1980-81	1981-82	1982-83	Mean
	Lb.	*Lb.*	*Lb.*	*Lb.*
AU Triumph—0	304 ab*	290 a	363 a	319 a
Kentucky 31—1	308 a	247 ab	320 a	292 a
Kentucky 31—34	267 bc	203 b	254 b	241 b
Kentucky 31—90	231 c	198 b	202 c	210 b

*Means within a column with the same letter are not significantly different at the .05 level.

These results indicate that total season steer production per acre is indeed higher on endophyte-free Kentucky 31 than on Kentucky 31 that is moderately or highly infected. Even though intermediate ADG's are shown for intermediate infection levels, the beef production per acre of the intermediately infected paddocks did not differ from the highly infected paddocks. Apparently, the lower stocking rate of the intermediate infection level paddocks, when compared to the highly infected paddocks, decreased gain per acre.

For both total seasonal steer production per acre and ADG, the effect of endophyte infection in Kentucky 31 appears to be much more pronounced in the spring. The reason for this is unknown.

AU Triumph vs. Kentucky 31

When comparing AU Triumph to the non-infected Kentucky 31, total season ADG's are both high and similar (2.09 and 2.16 pounds per day, respectively), table 2. Fall ADG's tended to be higher for AU Triumph, table 3, while spring ADG's tended to be higher on non-infected Kentucky 31, table 4.

Total season stocking rates were higher for AU Triumph than for non-infected Kentucky 31, table 5. Differences were shown for the 3-year average and years 1980-81 and 1982-83. Of the four treatments, total season stocking rate on AU Triumph was second only to the 90 percent infected Kentucky 31. Fall stocking rates were

similar on AU Triumph and non-infected Kentucky 31, table 6. Spring stocking rates on AU Triumph and non-infected Kentucky 31 were similar to that for the total season stocking rate, table 7.

The differences in stocking rates of AU Triumph and non-infected Kentucky 31 are reflected in steer gain per acre for these cultivars. Steer gain per acre of AU Triumph and non-infected Kentucky 31 showed no differences for either the spring or fall periods when considered alone, tables 9 and 10. However, when total season gain per acre was considered, AU Triumph produced more gain per acre than non-infected Kentucky 31 over the 3-year period, table 8.

SUMMARY

The results of this study show that steers grazing Kentucky 31 tall fescue having intermediate levels of *A. coenophialum* infection had ADG intermediate to those grazing either highly infected or essentially non-infected pastures of Kentucky 31. However, since the stocking rate was increased on pastures with high infection levels due to reduced consumption by "stocker" animals, beef production per acre was about the same on pastures having intermediate levels of infection. (Under farm conditions where stocking is not adjusted during the grazing season, per acre beef production would be higher where infection level was lower.) Steer performance on non-infected tall fescue was superior to performance on highly infected tall fescue. Average daily gains on endophyte-free Kentucky 31 and AU Triumph were similar. Most of the endophyte effect occurred during the spring. Greater winter production on AU Triumph resulted in the potential for a higher stocking rate during early spring as compared to Kentucky 31. The higher stocking rates possible on AU Triumph resulted in a 3-year average of 12 percent more beef production per acre than on non-infected Kentucky 31.

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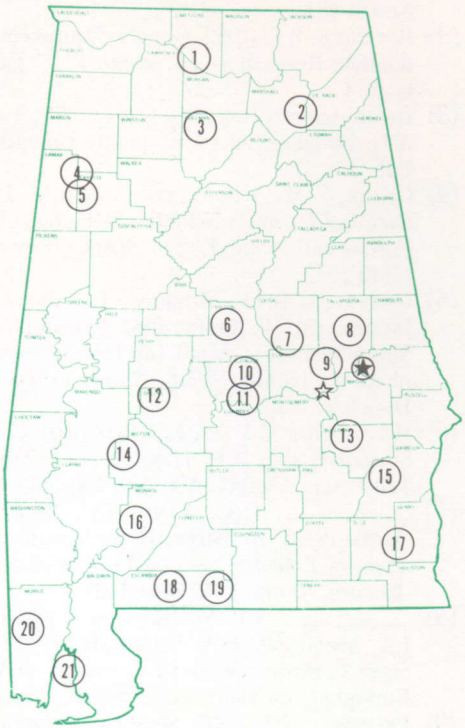

Research Unit Identification

✪ Main Agricultural Experiment Station, Auburn.
☆ E. V. Smith Research Center, Shorter.

1. Tennessee Valley Substation, Belle Mina.
2. Sand Mountain Substation, Crossville.
3. North Alabama Horticulture Substation, Cullman.
4. Upper Coastal Plain Substation, Winfield.
5. Forestry Unit, Fayette County.
6. Chilton Area Horticulture Substation, Clanton.
7. Forestry Unit, Coosa County.
8. Piedmont Substation, Camp Hill.
9. Plant Breeding Unit, Tallassee.
10. Forestry Unit, Autauga County.
11. Prattville Experiment Field, Prattville.
12. Black Belt Substation, Marion Junction.
13. The Turnipseed-Ikenberry Place, Union Springs.
14. Lower Coastal Plain Substation, Camden.
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21. Gulf Coast Substation, Fairhope.