Birdsfoot Trefoil-Grass Pasture for Steers in the Tennessee Valley

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INTRODUCTION

BIRDSFOOT trefoil (*Lotus corniculatus*) is a perennial legume used for pastures in some areas of the Northern United States because it is tolerant to soil acidity, has good natural reseeding, and does not cause bloat. Northern trefoil varieties tested in Alabama have been unsuccessful because of poor seedling vigor and disease susceptibility (*2*). However, an experimental semi-prostrate variety, AT-P, developed from Mediterranean germplasm, has had good seedling vigor, excellent stand persistence, high forage yield, and good reseeding ability. Forage yields of AT-P trefoil have exceeded 6,000 pounds dry forage per acre in the Tennessee Valley area (*2*).

Since the perennial nature of trefoil is shortened by diseases, natural reseeding has been shown to be essential for maintaining stands and productivity in Kentucky (*9*). Poor stand persistence under heavy grazing is related to depletion of carbohydrate root reserves (*8*), which is even more critical under warm than cool temperature (*7*). Prostrate type trefoils such as AT-P should tolerate more grazing pressure than upright types since more leaf tissue remains on the plants and the seed pods are closer to the ground.

Previous grazing trials with a northern trefoil variety provided high average daily gain (ADG) with lambs in Minnesota (*6*). Fergus, a Kentucky variety, furnished good steer ADG at the Sand Mountain Substation, Crossville, Alabama (*4*). Limited results in Alabama indicate that trefoil probably responds

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best when included in a grass-legume mixture (*2*). In northern Alabama, the two most commonly used cool-season perennial grasses are tall fescue (*Festuca arundinacea*) and orchardgrass (*Dactylis glomerata*). Therefore, the logical swards to be included in a feasibility study should be fescue-trefoil and orchardgrass-trefoil.

Previous research has shown that the fungal endophyte, *Acremonium coenophialum*, is associated with tall fescue toxicosis and the consequent severely depressed gains of steers grazing that forage (*5*). When the fungal endophyte was absent, steer gains averaged 1.82 pounds daily for the grazing season contrasted with 1.00 pound per day for steers grazing fungus-infected tall fescue (*5*).

AU-Triumph, a newly released variety of tall fescue, is more winter productive than Kentucky 31, thus resulting in a higher carrying capacity during late winter and early spring (*1*). Additionally, AU-Triumph is compatible with interplanted legumes because it grows in a bunch or clump and is less prone than Kentucky 31 to crowd the interplanted species.

EXPERIMENTAL PROCEDURE

This report summarizes the results of steer performance over a 3-year period at the Tennessee Valley Substation, Belle Mina, Alabama, on four pasture combinations: (1) Hallmark orchardgrass-AT-P trefoil, (2) AU-Triumph tall fescue-trefoil, (3) Kentucky 31 tall fescue-trefoil, and (4) Kentucky 31 tall fescue + 150 pounds N per acre.

Pasture Management

Pastures were established on Decatur clay. Hallmark orchardgrass and the two tall fescue varieties were seeded in September 1979 with the grass-nitrogen paddocks planted in 7-inch rows and the grass-legume paddocks in 14-inch rows. AT-P trefoil was seeded at 5 pounds per acre with a culti-packer-seeder. Three paddocks, each 2½ acres in area, were planted to each pasture combination. Grazing was begun in the spring of 1980.

Nitrogen-fertilized Kentucky 31 tall fescue paddocks received 50 pounds N per acre in September, in late February, and again in April each year. No N fertilizer was applied to the grass-trefoil paddocks. Phosphorus and potassium were

applied to all paddocks according to soil test recommendations. Botanical estimates of percentage orchardgrass or fescue, trefoil, and weeds in the forage available to be grazed were made at monthly intervals during the grazing season. Pastures were sampled in May each year for the fungal endophyte, *A. coenophialum.*

Management of Grazing Animals

Crossbred steers, weighing approximately 500 pounds, were purchased each August and pre-conditioned for several weeks on tall fescue-bermudagrass (*Cynodon dactylon*)-white clover (*Trifolium repens*) pasture before being put on the experimental paddocks. During the winter period when grazing was inadequate, steers were removed from the paddocks and fed Coastal bermudagrass hay supplemented with grain to maintain gains of approximately 1 pound per day. Pastures were stocked initially at a rate of 1.2 animals per acre; however, additional animals were placed on paddocks during peak periods of pasture growth to utilize the forage. All cattle were weighed at 28-day intervals during the grazing season. Water, salt, and shade were provided in all paddocks.

RESULTS AND DISCUSSION

Pastures

The AT-P trefoil established rapidly and stands in several paddocks were superior to those of orchardgrass and AU-Triumph tall fescue. Trefoil seed were produced each summer and natural seeding resulted in thick stands during succeeding years. Trefoil ground cover averaged 50 to 70 percent in most paddocks during the last 2 years of grazing.

Trefoil percentage of the available forage was higher in orchardgrass-trefoil than tall fescue-trefoil paddocks, table 1. Trefoil composition was lowest in early spring, and increased with warmer weather. During late May and June, trefoil composed 35 to 50 percent of the available forage. The higher trefoil and weed content of forage in the orchardgrass-trefoil as compared to tall fescue-trefoil paddocks indicates the less competitive nature of orchardgrass. Trefoil composition of the pastures during autumn was similar to that during spring.

TABLE 1. ESTIMATED AVERAGE BOTANICAL COMPOSITION OF TREFOIL-GRASS AND TALL FESCUE-NITROGEN PASTURES DURING THE GRAZING SEASON OVER 3 YEARS

Pasture species	Trefoil	Orchardgrass or tall fescue	Weeds
	Pct.	*Pct.*	*Pct.*
Orchardgrass-trefoil	37	49	14
AU-Triumph tall fescue-trefoil	21	70	9
KY 31 tall fescue-trefoil	23	72	5
KY 31 tall fescue + 150 lb. N/acre	0	96	4

Drought during summer each year resulted in grazing being terminated earlier than might be expected. During one summer, trefoil remained green while the grasses turned brown, showing the drought tolerance of this legume. In years with more adequate rainfall, trefoil forage was produced in small plot experiments at this location during July and August (*2*).

Cattle Performance

The average grazing dates each spring were from March 22 to June 14 when drought terminated grazing. Autumn grazing dates averaged September 20 to November 17 for 2 years.

Animal days per acre during spring of the establishment year were higher on Kentucky 31 tall fescue-nitrogen than on trefoil-grass pastures, table 2. This was to be expected because at that time trefoil furnished little nitrogen for the associated grasses. During the third season, animal days per acre in early spring were higher on AU-Triumph tall fescue-trefoil than on Kentucky 31 tall fescue-trefoil or orchardgrass-trefoil.

Beef gain per acre during spring of the 2 years following establishment was highest on Kentucky 31 tall fescue-nitrogen, followed by AU-Triumph tall fescue-trefoil, Kentucky 31 tall fescue-trefoil, and orchardgrass-trefoil, table 3. The superior late winter growth of AU-Triumph as compared to Kentucky 31 tall fescue resulted in a 39-pound-per-acre advantage for the AU-Triumph (589 vs. 550 pounds per acre). Orchardgrass-trefoil had poorer autumn production than the other combinations. It is apparent that trefoil did not supply as much N for early spring growth as did the application of N fertilizer. However, the 589-pound gain per acre on AU-Triumph tall fescue-trefoil without N fertilizer is impressive and indicates the potential of this grass-legume pasture mixture.

TABLE 2. STEER GRAZING DAYS ON TREFOIL-GRASS AND TALL FESCUE-NITROGEN PASTURES

Pasture species	Steer grazing days/acre			
	Establishment year, spring	2-year mean		
		Autumn	Spring	Total autumn + spring
	No.	*No.*	*No.*	*No.*
KY 31 tall fescue + 150 lb. N/acre	162 a*	122 a	200 a	322 a
AU-Triumph tall fescue + AT-P trefoil	133 b	100 b	147 b	247 b
KY 31 tall fescue + AT-P trefoil	136 b	98 b	130 b	228 b
Hallmark orchardgrass + AT-P trefoil	139 b	68 c	96 c	164 c

*Means within a column with the same letter are not significantly different at the 0.05 level.

TABLE 3. TOTAL BEEF GAIN PER ACRE ON TREFOIL-GRASS AND TALL FESCUE-NITROGEN PASTURES

Pasture species	Beef gain/acre			
	Establishment year, spring	2-year mean		
		Autumn	Spring	Total autumn + spring
	Lb.	*Lb.*	*Lb.*	*Lb.*
KY 31 tall fescue + 150 lb. N/acre	364 a*	219 a	462 a	681 a
AU-Triumph tall fescue + AT-P trefoil	336 a	177 b	412 b	589 b
KY 31 tall fescue + AT-P trefoil	310 b	200 ab	350 c	550 b
Hallmark orchardgrass + AT-P trefoil	385 a	116 c	334 c	450 c

*Means within a column with the same letter are not significantly different at the 0.05 level.

The average daily gain (ADG) of steers was high on all pasture combinations in this study, table 4. Orchardgrass-trefoil pasture furnished the highest ADG ever obtained in any Alabama grazing trial, averaging 3.48 pounds during spring over the 3-year period. During spring of the second and third years, tall fescue-trefoil furnished ADG superior to that of Kentucky 31 tall fescue-nitrogen. ADG of steers during autumn averaged 1.84 pounds for all pasture combinations. Gains were similar on all combinations during autumn, but lower than in spring.

TABLE 4. AVERAGE DAILY GAIN OF TESTER STEERS ON TREFOIL-GRASS AND TALL FESCUE-NITROGEN PASTURES

Pasture species	Average daily gain		
	Establishment year, spring	2-year mean	
		Autumn	Spring
	Lb.	*Lb.*	*Lb.*
KY 31 tall fescue + 150 lb. N/acre	2.25 b*	1.81 a	2.32 c
AU-Triumph tall fescue + AT-P trefoil	2.54 ab	1.76 a	2.80 b
KY 31 tall fescue + AT-P trefoil	2.29 b	2.05 a	2.69 b
Hallmark orchardgrass + AT-P trefoil ..	2.78 a	1.72 a	3.48 a

*Means within a column with the same letter are not significantly different at the 0.05 level.

The ADG of steers grazing Kentucky 31 tall fescue-nitrogen in this experiment is about double that normally obtained on tall fescue (*5*). Previous studies had shown that infestation of tall fescue with the fungal endophyte *A. coenophialum* was to be associated with poor animal performance (*3*). In the present experiment, grasses in the orchardgrass-trefoil, AU-Triumph tall fescue-trefoil, and Kentucky 31 tall fescue-trefoil combinations were free of the fungus, while Kentucky 31 tall fescue-nitrogen had a fungal infestation level of 29 percent. Previous research in Alabama had shown that a legume such as white clover or trefoil substantially increased the ADG of steers grazing heavily fungus-infected tall fescue (*4*). Had the tall fescue in the present experiment been heavily infested with the fungus, it is likely that trefoil in the pasture combinations would have increased the ADG even more. In the present experiment, steers on tall fescue-nitrogen pastures had rough hair coats. They also spent more time in the shade during high daytime temperatures than those on trefoil-grass pastures. Thus, there is an indication that even this low level of fungal infestation may be harmful.

TABLE 5. GAIN PER TESTER STEER ON TREFOIL-GRASS AND TALL FESCUE-NITROGEN PASTURES

Pasture species	Gain per tester steer			
		2-year mean		
	Establishment year, spring	Autumn	Spring	Total autumn + spring
	Lb.	*Lb.*	*Lb.*	*Lb.*
KY 31 tall fescue + 150 lb. N/acre	187 b*	132 a	218 b	350 c
AU-Triumph tall fescue + AT-P trefoil..	212 ab	123 a	262 ab	385 b
KY 31 tall fescue + AT-P trefoil	194 ab	139 a	245 b	384 b
Hallmark orchardgrass + AT-P trefoil....	234 a	106 a	320 a	426 a

*Means within a column with the same letter are not significantly different at the 0.05 level.

Individual steers grazed continuously for the season on the same pasture made the highest weight gains during spring on orchardgrass-trefoil pastures, table 5. Autumn gains were similar on all pasture combinations. Total autumn-spring weight gains on tall fescue-trefoil mixtures were also superior to those on Kentucky 31 tall fescue-nitrogen.

SUMMARY AND CONCLUSIONS

A grazing study with yearling steers was conducted for 3 years at the Tennessee Valley Substation on: (1) Hallmark orchardgrass-AT-P birdsfoot trefoil, (2) AU-Triumph tall fescue-trefoil, (3) Kentucky 31 tall fescue-trefoil, and (4) Kentucky 31 tall fescue + 150 pounds N per acre.

AT-P trefoil persisted well in association with orchardgrass or tall fescue under continuous grazing. Good natural reseeding was obtained each year and stands improved so that trefoil ground cover averaged 50 to 70 percent during the second and third years of grazing.

The average grazing season was from September 20 to November 17 and March 22 to June 14. Summer droughts terminated grazing earlier than expected.

Animal grazing days were higher on Kentucky 31 tall fescue + 150 pounds N per acre than on trefoil-grass combinations.

AT-P trefoil-grass pasture provided higher ADG in spring than Kentucky 31 tall fescue having a low level of fungal endophyte and fertilized with 150 pounds N per acre. Average daily gains of steers during spring on orchardgrass-trefoil, AU-Triumph tall fescue-trefoil, Kentucky 31 tall fescue-trefoil, and Kentucky 31 tall fescue-nitrogen were 3.48, 2.80, 2.69, and 2.32 pounds, respectively, over a 2-year period.

Over a 142-day grazing season, beef gains per acre on Kentucky 31 tall fescue-trefoil without N fertilizer were 85 percent that of Kentucky 31 tall fescue fertilized with 150 pounds N per acre. AU-Triumph tall fescue-trefoil furnished 589 pounds of beef per acre as compared to 681 pounds for Kentucky 31 tall fescue-nitrogen.

These results indicate that an adapted birdsfoot trefoil may be a useful perennial legume in northern Alabama because of its potential for high animal performance. AT-P trefoil is not yet released and no seed are available until seed production potential is determined.

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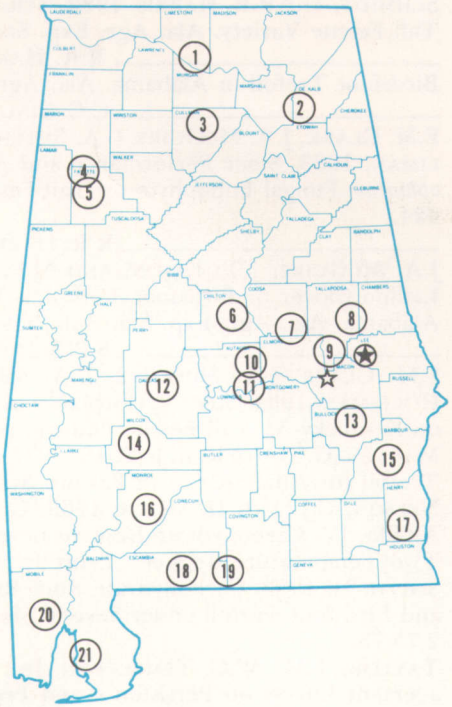

Research Unit Identification

★ 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.
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