ENVIRONMENTAL QUALITY AND PRODUCTION EFFICIENCY OF BEEF CATTLE IN TALL FESCUE PASTURE SYSTEMS

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ABSTRACT

The establishment, longevity, and utilization of mixed *Acremonium coenophialum* endophyte-infested (E+) and endophyte-free (E-) tall fescue (*Festuca arundinacea* Schreb.) pastures were evaluated in three beef production experiments. In Experiment-1, E-, 80% E+ , and a sward of alternate sets of four drill rows of E+ and E- were compared under put-and-take grazing. Stand density of E- was inadequate after 3 yr, but stands and animal performance of the other treatments were similar for 4 yr. Wide strips (6-7 m) of E- fescue were established (Experiment-2) subsequently with no-till methods in E+ fescue sods after destruction of the original vegetation on level soils, and have been maintained under two stocking densities of grazing. Experiment-2 treatments were repeated on steep, rocky and shallow soils (Experiment-3) at another location. The overall results are promising for improving productivity of E+ pastures on level or highly erodible land with minimal adverse environmental effects.

KEYWORDS

Acremonium coenophialum, endophyte, *Festuca arundinacea*, no-till seeding, hill pastures.

INTRODUCTION

Tall fescue is the predominant cool-season grass in the transition zone of the eastern USA because of its persistence and productivity. Infestation of fescue pastures with *A. coenophialum* is associated with substantial economic reduction in grazing livestock production. Endophyte-free cultivars have been advocated for improved cattle performance, increased weight gains, and improved conception rates (Paterson *et al.*, 1995). However, E- cultivars do not benefit from the symbiotic relationship with *A. coenophialum*, and consequently may have less persistence, pest resistance and drought tolerance than E+ genotypes (Fribourg *et al.*, 1991). The lack of long-term survival of E- stands led to our investigating whether mixtures of E- and E+ fescues in the same pasture could be established (Fribourg *et al.*, 1988) on level and then on steep pastures, and whether they might result in long-lived stands under grazing, improved productivity of hill pasture systems, and minimal adverse environmental consequences.

MATERIALS AND METHODS

Experiment 1. Tall fescue 1.2-ha pastures were established near Knoxville (35×49'N, 83×59'W) in autumn 1989 using 20-cm drill rows and 15.7 kg/ha seed in a prepared seedbed on upland soils of <5% slopes. Prior to seeding, mechanical and glyphosate (Roundup, [N-(phosphonomethyl)glycine], 1.12 kg a.i./ha) fallows eliminated fescue and weeds from the area. Fertilizer (P and K) was applied to provide medium fertility levels. Pasture treatments were 'Kentucky 31' tall fescue differing only in E+ infestation, 80% E+, and E-, and a mixed sward of alternating sets of four 20-cm drill rows of E+ and E- seed (E+/E-). Each September and March, pastures were fertilized with 45 kg N/ha. Put-and-take stocking was used with three 280-kg test Angus steers (*Bos taurus* L.) on each pasture, with extra steers used to maintain a grazing height of 2.5-7.5 cm and forage availability of 1000-2000 kg dry matter/ha. Levels of endophyte infestation were monitored yearly using PAS-ELISA and remained constant throughout the study. Stand density and ground cover were estimated visually at 21-d intervals, and measured each spring at 96 random sites in each pasture with inclined point quadrats (10 pins 5-cm apart/quadrat) both parallel and perpendicular to the drill rows.

Experiment 2. In 1994, sods of E+ from Experiment 1 were grazed to 2.5-cm stubble, and alternate lengthwise 6.5-m strips were sprayed with glyphosate, and soybeans (*Glycine max* (L.) Merr.) were no-till drilled at 80 kg/ha. In late August, soybeans were cut and removed. In early October, fescue was no-till seeded as described earlier. In pastures with 6.5-m strips of E+, E- was seeded in the areas where soybeans had been grown. In other pastures, solid stands of E+ or of E-, or alternating 6.5-m strips of E+ and E- were established. Finally, the two E+/E- pastures from Experiment 1 were continued unchanged. Management practices were similar to those used in Experiment 1, but two levels of set stocking densities were used.

Experiment 3. In 1996, treatments were initiated on E+ fescue pastures near Greeneville (36×6'N, 82×48'W) to determine whether E- fescue strips can be established within E+ hilly pastures and maintained on sites with severe environments caused by shallow soils and a southern exposure. Four 1.17-ha pastures with 10-25% slopes were left unchanged, and strips of 6-8-m widths were sprayed with glyphosate in June and August in four other pastures. The strips were laid out on the contour and covered one-half of each pasture. Strip widths were variable in order to avoid rock outcroppings and not compromise existing terraces. Immediately after the second spraying, pasture areas with living grass were stocked with 5.13 animal units/ha and grazed to 3-5-cm stubbles. In early October, E- fescue was seeded as described earlier in the previously-sprayed areas. Management practices will be similar to those used in the other experiments after initiation of experimental grazing at a set stocking density in 1997.

RESULTS AND DISCUSSION

Experiment 1. Excellent uniform stands existed in all pastures in the spring after seeding. Pastures were grazed about 10 months/yr for 4 yr. *A. coenophialum* infestation levels remained at the initial levels in each treatment. The stands in all treatments were maintained for 3 yr. Following a 1993 summer drought, E- fescue stands declined rapidly in the succeeding fall-winter. By spring 1994, E- stands were insufficient to continue grazing, but stands of E+ and E+/E- were still excellent (Table 1). Although the inclined point quadrat data indicate a decrease from 1993 to 1994 in E+ and E+/E- stands, sod density was acceptable in these pastures and equal for E+ and E- in the E+/E- treatment. Sod density was inadequate for E-. Steers grazing E+/E- pastures had an average daily gain (ADG) almost as low as that of steers grazing E+ pastures (about 400 g/d), although the mixed pastures could support more steers during the summer than E- fescue pastures, where steers gained about 900 g/d. Liveweight production/ha was similar in the E- and E+/E- treatment, and more than from E+ fescue.

Experiment 2. Strips sprayed with glyphosate and planted to soybeans were free of vegetation by fall. No-till seeding of E- in mid-fall was successful and grazing could be initiated the following April. There was no differential grazing the first year between the older E+ sods and the younger E- strips with stocking densities of 2.5-5 300-kg-steer/ha. After two years of grazing, no apparent differences in stand or sod density were noted between E+ and E-

sections in a pasture. Data are being collected regarding agronomic and animal performances.

Experiment 3. The kinds of E- strips established successfully in E+ were repeated on steep, shallow and rocky soils typical of many areas in the region. The initial glyphosate spray eliminated all cool-season plants, but some warm-season grasses and a few broad-leaved weeds survived. Grazing unsprayed areas removed the remaining vegetation, and E- tall fescue was no-till seeded in October. No major soil erosion or other adverse environmental problems occurred. It is anticipated that successful stands will be available for grazing study in spring 1997.

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Table 1
Tall fescue stand counts and ground cover

Year	E+	E+/E-	E-
Percent hits at ground level:			
1991-93	83	86	87
1994	49	48	20
Percent ground cover:			
1991-93	98	98	97
1994	98	96	25