COMPARATIVE LAMB AND HEIFER GROWTH RATES ON NON-TOXIC AND ENDOPHYTE-FREE TALL FESCUE

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Abstract

Although one option for avoiding toxicity from endophyte-infected (Toxic-E) tall fescue is use of endophyte-free (E-) varieties of tall fescue, these E- stands frequently become re-infested with Toxic-E fescue. A new option is the use of non-toxic endophyte tall fescue (Non-toxic E), however there is relatively little data showing livestock performance on these stands. Triplicate plots (0.1 ha each) of E- and Non-toxic E Jesup tall fescue were established at 2 sites in Ohio in spring 2001. During fall 2001-04, plots at Caldwell were individually stocked with 4-8 lambs and their growth measured over 3 months. During summer & fall 2002, at Jackson the 2 pasture treatments were sequentially grazed by 2 groups of six rising 2 year-old heifers. There were negligible differences in the growth rates of lambs and heifers between the 2 pasture treatments. Plot endophyte status was measured using the antibody method in fall of each year and found appreciable toxic-E infestation of E-, and negligible infestation of non-toxic-E.

Introduction: Tall fescue (*Lolium arundinaceum*, formerly *Festuca arundinacea*) infected with the endophyte *Neotyphodium coenophialum* is known to have detrimental effects on livestock (Hoveland et al. 1983). Although one option for avoiding toxicity from endophyte-infected (Toxic-E) tall fescue is use of endophyte-free (E-) varieties of tall fescue, these E- stands frequently become re-infested with Toxic-E fescue (Penrose et al. 2001, Barker et al. 2005). A new option for avoiding toxicity is the use of non-toxic endophyte tall fescue, however there is relatively little data showing livestock performance on these stands. Non-toxic endophytes are those naturally occurring races of endophyte that have negligible production of the toxic alkaloids such as ergovaline that are reported to cause negative effects on animals (West et al., 2001; Bouton et al., 2002). Currently the fescue variety Jessup with a non-toxic endophyte is being traded as MaxQ tall fescue. The objectives of this study were to establish E- and MaxQ pastures to quantify re-infestation by toxic endophyte and measure the performance of livestock grazing these treatments. It was our hypothesis that E- pastures might show re-infestation by toxic endophyte over time, to the extent that might impair livestock production. We also hypothesized that in the absence of significant re-infestation by toxic endophyte, MaxQ and E- pastures would have similar livestock production.

Materials and Methods: Large plots (approx 0.2 ac) of endophyte-free (E-) or novel endophyte infected (MaxQ) Jessup tall fescue were sown at two sites in Ohio (Caldwell

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W 80° 32', N 39° 46' N and Jackson W 82° 36', N 39° 2'). At Caldwell, treatments were seeded into a tilled seedbed on 3 May 2001. The Caldwell site had been cropped with corn for 2 years, and prior to that was tall fescue pasture. At Jackson, treatments were no-till drilled on 25 April 2001 into the remains of a turnip crop that had been planted the previous fall. The Jackson site was previously in tall fescue pasture. Weeds at both sites that emerged during winter were killed with Roundup. Trial sites were fertilized annually according to standard recommendations. Experimental designs were randomized complete blocks, with 3 replicates. The same seed lots were planted at both sites, at the rate of 20 lb/ac. The E- seed had 0% endophyte and the MaxQ seed had 95% non-toxic endophyte. All plots were tested for presence of endophyte using an immunoblot antibody endophyte kit (ENDO797-3, Agrinostics Ltd, GA) on 20 tillers/plot during Sep. 2001-2003. It was assumed that positive tests on E- plots were from re-infestation by toxic-endophyte tall fescue. In MaxQ plots toxic-E and nontoxic-E infected tall fescue plants were distinguished using a commercial ELISA kit (ENDO899-2-96, Agrinostics Ltd, GA).

At Caldwell, pastures were stocked with 6-month lambs at a rate of 4-6 per plot, for an average 84 days during fall each year (28 Sep. to 29 Nov. 2001, 4 Oct. to 5 Dec. 2002, 2 Oct 2003 to 14 Jan 2004, and 30 Sep. 2004 to 15 Jan 2005). A winter stockpile (approx 5000 lb/ac) was allowed to accumulate during the summer, and lambs grazed until insufficient pasture remained. Lambs were provided an *ad libitum* ration of corn-based supplement or soybean hulls. All lambs in 2001 and 2002, and half the lambs in 2004-05 were dewormed. At Jackson, plots were sequentially grazed with four 18-month heifers during the growing 2002 season (15 Jul. – 10 Nov. 2002). Heifers were allowed 2-4 days grazing per plot based on a visual assessment of the available forage, and then were weighed prior to moving to the next plot in the rotation. Between rotations heifers grazed orchardgrass pasture to prevent any chance of transfer of fescue seeds onto the plots. All plots were grazed 4 times for a total of 9-12 days during the growing season. Pasture mass was measured with a calibrated rising plate meter before and after each grazing, and pasture disappearance (by grazing) was calculated.

Results and Discussion: Both endophyte-free and MaxQ Jessup tall fescue established satisfactorily at two Ohio sites. Pastures remained persistent through a severely dry summer (2002) and very wet springs (2003 and 2004). The wet springs prevented cattle grazing at Jackson for fear of causing excessive plot damage. There was a high background level of toxic endophyte at both locations, with levels of toxic endophyte in adjacent pastures (>15 years old) of 75% and 65% at Caldwell and Jackson respectively. Areas that were not planted within the plots at Jackson had tall fescue appearing, presumably from buried seed, that averaged 55.5% endophyte.

An average of 7.3% of plants in E- plots at both locations had endophyte. It was assumed this was toxic endophyte since there was a high 'background' level of endophyte at both sites. It has been reported (Hume and Barker 2005) that E- tall fescue can become re-infested with toxic-endophyte tall fescue, however there was no evidence that endophyte levels were changing appreciably over time in this study. There are various mechanisms that E- re-infestation can occur (Hume and Barker 2005), however it

is likely that these were all negligible for these locations. It was likely that the 7.3% of toxic-endophyte plants at both locations resulted from buried seed. The levels of non-toxic endophyte in MaxQ plots remained high and stable over 3 years. The ELIZA tests found no evidence of re-infestation of MaxQ by toxic endophyte in 2001 and 2002 (not tested in 2003), and presumably the presence of the non-toxic endophyte prevented appearance of toxic-endophyte plants. There was no evidence of statistically significant differences in lamb or heifer production between the E- and MaxQ treatments. The number of animals and replicates were low and did not afford high experimental power, however the differences between means were also small and inconsistent. Measurements of pasture mass at Jackson showed similar forage performance for both treatments. It was concluded that non-toxic endophyte tall fescue is a valid option for livestock production in regions in Ohio that are dominated by toxic endophyte tall fescue. There was some evidence that MaxQ pastures are less likely to show re-infestation by toxic endophyte tall fescue than E- pastures.

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Literature Cited:

Barker, D.J., R.M. Sulc, T.L. Bultemeier, J. McCormick, R. Little, C.D. Penrose, D. Samples. 2005. Contrasting toxic-endophyte contamination between endophyte-free and nontoxic-endophyte tall fescue pastures. Crop Sci. 45:616-625.

Bouton, J.H., G.C.M. Latch, N.S. Hill, C.S. Hoveland, M.A. McCann, R.H. Watson, J.A. Parish, L.L Hawkins, F.N. Thompson. 2002. Reinfection of tall fescue cultivars with non-ergot alkaloid-producing endophytes. Agron. J. 94:567-574.

Hoveland, C.S., S.P. Schmidt, C.C. King, Jr., J.W. Odom, E.M. Clark, J.A. McGuire, L.A. Smith, H.W. Grimes, and J.L. Holliman. 1983. Steer performance and association of *Acremonium coenophialum* fungal endophyte on tall fescue pasture. Agron. J. 75:821-824.

Hume D.E. and D.J. Barker. 2005. Growth and Management of Endophytic Grasses in Pastoral Agriculture. p. 199-225. *In* C.A. Roberts, C.P. West, and D.E. Spiers (eds.) *Neotyphodium* in cool-season grasses. Blackwell Publishing, Ames, IA. *Proceedings of the Fifth International Symposium on* Neotyphodium*/Grass Interactions, Fayetteville, Arkansas, USA. 23-26 May 2004.*

Penrose, C.D., R.M. Sulc, and J.S. McCutcheon. 2001. Impact of management on endophyte free and endophyte infected tall fescue cultivars in Ohio. p. 610-612 *In* Proc. XIX Int. Grassl. Congr., Sao Pedro, SP, Brazil. 10-21 February 2001. ID#16-03.

West, C.P., E.L. Piper, M.E. Hihsen, S.A. Gunter, K.A. Cassida, D.A. Spiers, C.A. Roberts, and R.C. Crawford. 2001. Performance of cattle on 'HiMag' tall fescue infected with novel endophytes. p. 17 *In* K. Cassida (ed.) Proc. Am. For. and

Grassl. Council Apr 22-25 2001, Springdale AR. American Forage and Grassland Council, Georgetown, TX.

Table 1. Percentage of toxic endophyte in endophyte-free (E-) and of non-toxic endophyte in novel-endophyte infected (MaxQ) tall fescue plots over 3 years at 2 Ohio locations. No toxic endophyte was measured in MaxQ plots in 2001 or 2002. Data are the mean of 3 replicates.

Year	E-	MaxQ
Jackson		
2001	8.3%	83.3%
2002	11.3%	65.0%
2003	6.7%	72.5%
Caldwell		
2001	6.3%	76.7%
2002	8.3%	78.3%
2003	2.5%	79.5%

Table 2. Lamb growth rates (lb/day) on endophyte-free (E-) and novel-endophyte infected (MaxQ) tall fescue over 4 years at Caldwell OH. Data are the mean of 4-6 lambs and 3 replicates.

Year	E-	MaxQ	Statistical significance
2001	0.56	0.52	NS
2002	0.49	0.45	NS
2003	0.69	0.72	NS
2004	0.46	0.47	NS

Table 3. Mean pre- and post grazing pasture mass (lbDM/ac), pasture disappearance (lb DM/cow/day) and heifer growth rate for endophyte-free (E-) and novel-endophyte infected (MaxQ) tall fescue during 2002 at Jackson OH. Pasture data are the means for 4 rotations and 3 replicates. Heifer growth rates are the average for 4 heifers per plot, 4 rotations and 3 replicates.

Year	E-	MaxQ	Statistical significance
Pre-grazing pasture mass	1640	1660	NS
Post-grazing pasture mass	1125	1130	NS
Pasture disappearance	52	46	NS
Heifer growth rate	1.48	3.78	NS

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Charles Darwin proposed greater production from species-rich grasslands in 1872, but there is still uncertainty as to whether this is actually true. Our research aimed to add more data to this debate, and to attempt to make recommendations to the forage industry for seed mixtures for pasture sowings. We planted a range of simple and complex forage mixtures in Ohio and Pennsylvania during 2001, and measured forage production during 2002. We found strong positive relationships between the number of species sown and forage production. The highest yielding treatment in all seasons and at all sites had only 1-2 species sown, however, in most cases this was not significantly different from the 9-species treatment. It was concluded that although maximum forage yield might occur for 1-2 species mixtures of the best adapted species, the difficulty in predicting which species to use, and variation in the best species between spring and summer, suggests forage production might be most easily maximized from planting more complex mixtures of up to 12 species.

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