



Agricultural Research Service



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JPC Research Note 14

Tall Fescue Persists and Cattle Perform Well on a Novel-Endophyte Association

Why does it matter?

- Tall fescue is a widely disseminated grass grown around the world and is considered the most important perennial, cool-season grass in the southeastern USA.
- Tall fescue withstands grazing pressure by cattle and persists better than other cool-season perennial forages, especially when exposed to the stressful conditions (hot, dry summers; acidic and eroded soils) prevalent in the southeastern USA.
- Superior persistence of tall fescue is likely related to a mutualistic association with a fungal endophyte (fungus that lives within plants), *Neotyphodium coenophialum*.
- The fungus produces various alkaloids (physiologically active, nitrogen-containing organic bases), of which ergot alkaloids (causing blood vessel constrictions) are associated with different toxic symptoms in cattle, sheep, and horses.
- A novel strain of fungal endophyte that does not produce ergot alkaloids was selected and inserted into 'Jesup' tall fescue by researchers at the University of Georgia (Joe Bouton and colleagues, Agronomy Journal 2002, Vol. 94, Pages 567-574).
- Grass-based cattle producers depending on tall fescue are faced with a choice of tall fescue-endophyte options:
 - N poor animal performance and excellent stand persistence with wild-type endophyte,
 - N excellent animal performance and poor stand persistence with endophyte-free,
 - N relatively unknown animal performance and stand persistence and substantial cost of pasture establishment with novel-endophyte infection.

What was done?

- Our objective was to evaluate three tall fescue-endophyte association options under near continuous stocking with weanling heifers during 6 years on a Piedmont soil fertilized with either inorganic N-P-K or with broiler litter.
- A 50-acre tract of land at the USDA–Agricultural Research Service facility in Watkinsville GA was developed for simultaneously studying animal production, soil quality, soil carbon sequestration, and water runoff and quality beginning in 2002.
- Inorganic fertilizer was 80-40-80 lb N-P₂O₅-K₂O/acre in spring (Feb-Mar) and 80-0-0 lb N-P₂O₅-K₂O /acre in autumn (Sep-Oct).
- Broiler litter was targeted for 1.5 ton/acre in both spring and autumn, supplying the equivalent of 190-147-168 lb N-P₂O₅-K₂O/acre/year (with the assumption that 80% of N would be available each year).
- A pool of 39 to 66 newly weaned Angus heifers (born in Feb-Mar) were made available for initiation of grazing in Sep-Oct each year (initial body weight of 433 ± 37 lb).

Paddock	Endophyte	Fertilizer	Harvest
2, 8	Wild	Inorganic	Grazed
6, 11	Novel	Inorganic	Grazed
3, 7	Free	Inorganic	Grazed
4, 10	Wild	Broiler litter	Grazed
1, 9	Novel	Broiler litter	Grazed
5, 12	Free	Broiler litter	Grazed
A, B	Novel	Inorganic	Hayed



What was found?

- Our results from year-round grazing are in agreement with those found at the end of 3 to 5 years of stockpiled winter grazing in North Carolina. Therefore, persistence of novel-endophyte-infected tall fescue can be considered superior to endophyte-free tall fescue pastures.
- Stocking weight was 23% greater on pastures with wild than with novel endophyte.
- Essentially no difference in stocking weight was found between pastures with novel endophyte and endophyte-free, indicating that they can be stocked to the same level.
- Average daily gain (lb/day) and weight gain (lb/acre) across the 6 years were as good on novel as on endophyte-free pasture.

Pasture and cattle responses to (a) fertilizer source and (b) endophyte association during the course of 6 years of continuous grazing at Watkinsville GA.

Response / Period	Fertilizer Source		Endophyte Association		
	Inorganic	Broiler Litter	Free	Novel	Wild
<i>Tall Fescue Basal Area (% ground cover)</i>					
2002-2008	74	† 70	67	* 73	76
<i>Calf Stocking Weight (lb/acre)</i>					
2002-2007	930	899	853	847	* 1045
<i>Calf Average Daily Gain (lb/day)</i>					
2002-2007	1.5	1.5	1.6	1.7	*** 1.2
<i>Calf Weight Gain (lb/acre)</i>					
2002-2007	499	475	494	514	454
Spring	246	232	247	254	† 215
Summer	75	*** 91	79	† 75	*** 95
Autumn	136	123	132	146	** 109
Winter	43	*** 29	35	38	34

†, *, **, and *** indicate significance between means at $P \leq 0.1$, $P \leq 0.05$, $P \leq 0.01$, and $P \leq 0.001$, respectively.

- Average daily gain (lb/day) on novel-endophyte-infected pasture was an average of 44% greater than on wild-endophyte-infected pasture, but calf weight gain with novel endophyte was only 13% greater (not statistically different) due to 19% lower cattle stocking weight with novel than with wild endophyte.
- Improved cattle weight gain (lb/acre) with novel compared with wild endophyte occurred in spring (39 lb/acre) and in autumn (37 lb/acre).
- Calf weight gain (lb/acre) was lowest in winter, more a result of limited forage growth that restricted grazing days, than due to average daily gain. Calf weight gain was also lower under novel than under wild endophyte in summer due to lower stocking that resulted from limited forage availability, not because of a difference in average daily gain.
- Compensatory weight gain appears to have occurred on wild compared with novel (or free) endophyte association. Based on a calf backgrounding period from weaning ($\frac{1}{2}$ year) until $1\frac{1}{2}$ years of age, weight gain was 469 ± 157 lb/acre (mean \pm standard deviation among 6 years) on endophyte-free tall fescue pasture, 487 ± 144 lb/acre on novel-endophyte-infected pasture, and 441 ± 171 lb/acre on wild-endophyte-infected pasture. Only in 3 years (i.e., 2002/03, 2005/06, and 2006/07) was there significantly lower cumulative calf weight gain per acre on wild than on novel-endophyte-infected tall fescue; two of those years occurred during short grazing years due to drought, and therefore, ending weights occurred soon after the toxic period in spring.

What is the impact?

- Yearly average daily gain (1.5 lb/day) and calf weight gain (487 lb/acre) were as good with broiler litter fertilization as with inorganic fertilization, while cost of broiler litter was at least \$50/acre/year lower than inorganic fertilizer (more than covering the higher seed cost of novel compared with wild endophyte). Therefore, broiler litter with novel endophyte should be considered a more profitable and sustainable production system, especially considering the broader spectrum of nutrients applied, better animal production, and enhanced stand persistence.
- These results have important implications for the more than half million farmers in the southeastern USA, as well as the agronomic support system of farm advisors, university extension, and research scientists in the region.

For more information

Full-length article can be accessed at: <http://www.plantmanagementnetwork.org/>

Franzluebbers AJ, Seman DH, Stuedemann JA. 2009. Tall fescue persists and cattle perform well on a novel-endophyte association in the Southern Piedmont USA. *Forage and Grazinglands* doi:10.1094/FG-2009-0227-01-RS.