Soil Microbial Activity and Diversity under *Festuca arundinacea* Infected with *Neotyphodium coenophialum*

Poster presented at the
16th World Congress of Soil Science
Scientific registration number 2466
Symposium number 11
(Biodiversity and Soil Functioning)
24 August 1998
Montpellier, FRANCE

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Rationale

Tall fescue (*Festuca arundinacea*) is an important cool-season forage for many cattle producers in the humid regions of the USA and throughout the world.

The majority of tall fescue pastures in the USA are infected with a fungus, *Neotyphodium coenophialum*.

Mutualistic relationship:
Tall fescue provides *Neotyphodium* with energy, nutrients, shelter, and a means of propagation through the seed.
Neotyphodium provides mechanisms for improving tall fescue persistence by offering several biochemical deterrents to overgrazing and insect pressures.

Reported negative effects of endophyte infection of tall fescue on cattle:
65 to 92% less forage intake
57 to 83% less milk production
21 to 78% less weight gain per day
65 to 89% less weight gain per hectare

Reported positive effects of endophyte infection on pasture persistence:
reduction in insect herbivory
greater drought tolerance
greater resistance to pathogenic fungi
deterrence to viral vectors and root-feeding nematodes

A healthy steer on left and a steer affected by toxic fescue on right.

Steers suffering from fescue toxicosis due to grazing on endophyte-infected tall fescue are wallowing in mud to get relief from stress.

Objective

Determine the effect of endophyte infection of tall fescue on:

1) size and distribution of soil organic C and N

2) potential microbial activity

3) microbial diversity

Methodology

Location: Watkinsville Georgia USA (34 N, 83 W)

Climate: Mean temperature 16.5 C,
Mean precipitation 1250 mm
Mean evaporation 1560 mm

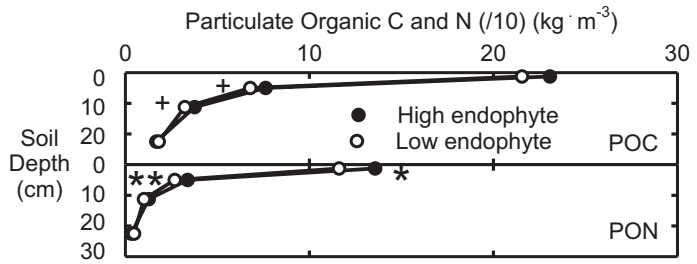
Soil: Cecil sandy loam (clayey, kaolinitic, thermic Typic Kanhapludult)

Experimental units:
0.7-0.8 ha paddocks with fixed shade/water
Six low endophyte paddocks (0-20%)
Six high endophyte paddocks (60-100%)
Established in 1982 (8 units) and in 1988 (4 units)
Grazed each year with Black Angus steers

Soil sampling:
Cores (4.1 cm diam) taken in Jan-Feb 1997
Distances of 1, 10, 30, 50, and 80 m from shade

Results

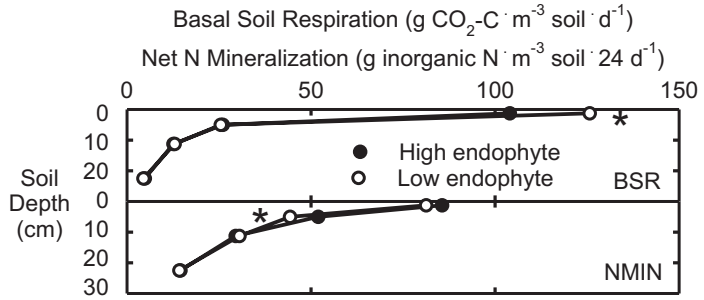
1 Total and particulate organic C and N were higher with than without endophyte infection.



	Mean (0 to 15 cm) Low endophyte		High endophyte
(kg/m2)	1.11	*	1.24
(g/m2)	49.4	**	59.8

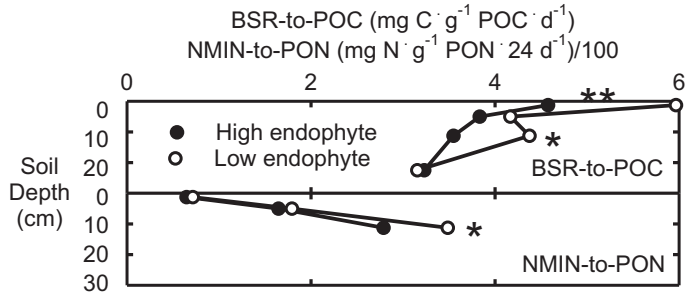
ns = not significant
+ = P<0.1
* = P<0.05
** = P<0.01
*** = P<0.001

2 Basal soil respiration was lower with than without endophyte infection.



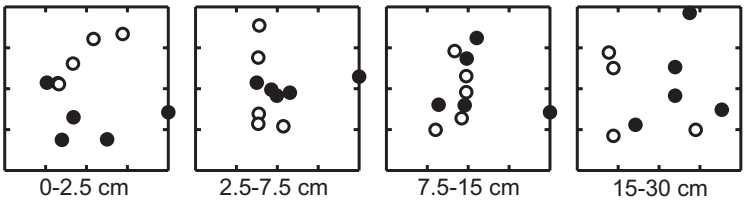
(g/m2/d)	5.39	+	4.85
(g/m2/24 d)	6.43	ns	6.86

3 Endophyte infection reduced potential microbial activity when expressed as a portion of particulate organic C and N.



(mg/g/d)	4.89	***	3.91
(mg/g/24 d)	135	+	119

4 Soil microbial diversity (using FAME analysis) was altered at a depth of 0-2.5 cm by endophyte infection.



Principal component analysis of fatty-acid methyl esters

Conclusions

Endophyte-infected tall fescue led to increased soil organic C (3.12 vs 2.91 kg/m2 to a depth of 15 cm), perhaps due to reduced potential microbial activity near the soil surface.

Although endophyte infection has negative effects on animal productivity, it appears to enhance environmental stability by reducing the susceptibility of soil organic matter to decomposition.