Novel Endophyte Tall Fescue

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"Novel" endophyte is a term used to describe a "good" or "friendly" fungus (endophyte) in tall fescue as opposed to the endophyte that's present if over eighty-five percent of the tall fescue in the Fescue Belt of the USA. This endophyte is costing beef producers an estimated $1 Billion dollars in losses from animal gains, reproduction and overall performance.

In order to better understand the importance of "Novel" endophytes, let's go back and look at the history of tall fescue and events leading to the development and release of Novel endophyte varieties.

Tall fescue is a native of Europe. The exact date of its' introduction into the United States is not known, but likely came as a contaminant in meadow fescue seed from England prior to 1880 (Figure 1). Tall Fescue was an entry in the National Herbarium Collection in 1879 and was grown in plots in Utah, Kentucky and Maryland (USDA) in 1880. In 1916, tall fescue plants were identified in Pullman, Washington with some of these plants taken to Corvallis, Oregon in 1918. Selections out of this initial planting was released in 1945 as the variety Alta.

FARM VISIT – The most important farm visit in the history of Kentucky agriculture occurred in 1931 when Dr. E.N. Fergus, an agronomist with the University of Kentucky, was invited to Menifee County to judge a sorghum syrup show. Following the field day, Dr. Fergus visited a hillside farm owned by Mr. W.M. Suiter. Dr. Fergus observed an excellent stand of grass growing on a steep hillside. The grass had been growing in the field for over forty years. Dr. Fergus identified the grass as tall fescue and took a few pounds of seed back to the University for testing. After lengthy testing, it was released in 1943 as the variety "Kentucky 31". It now occupies over 35 million acres in the Southeastern USA.

FARM VISIT 2 – A second historic development involved cattle herds grazing separate tall fescue pastures on the A.E. Hays farm near Mansfield, Georgia. Only one of the herds exhibited fescue toxicity symptoms. Dr. Joe Robbins and Dr. C.W. Bacon, USDA, Athens, Georgia, began searching for an explanation for this situation in 1973. Finally, in 1976, the toxic pasture was found to be 100% infected with an endophytic fungus, while the non-toxic pasture was less than 10% infected. This implied an association between the endophyte and fescue toxicity.

Endophyte Impact Documented – A third development involved a grazing experiment initiated in the mid-1970's at Auburn University. Dr. Carl S. Hoveland and co-workers noted marked differences in the appearance and gains of steers grazing newly-established paddocks of tall fescue on the Black Belt Substation near Marion Junction,

Alabama. Ultimately, it was found that there was no fungus infection in paddocks where performance was good, but a heavy infection in paddocks producing poor gains. Thus, the association of the endophyte with poor performance of cattle was documented in a replicated, controlled grazing experiment (Table 1). It is believed that some paddocks were endophyte-free because they had been established with old seed in which the fungus had died prior to planting.

Table 1. Grazing days, beef gain/acre, average daily gain, and gain/animal of steers grazing *A. Coenophialum*-infected and non-infected tall fescue pastures, Marion Junction, Alabama 1978-82.*

Tall Fescue Pasture	Animal Days/acre	*Beef Gain (lbs/ac)	Avg. Daily gain (lbs)	Gain/ steer (lbs)
Non-infected	240	426	1.82	318
Fungus-infected	311	301	1.00	185

*Adapted from: C.S. Hoveland and co-workers. Steer Performance and Association of *Acremonium coenophialum* Fungal Endophyte on Tall Fescue Pasture. Agron. J. 75:821-824, 1983.

Endophyte Free Varieties

Once the endophyte had been documented as the "problem", the obvious solution was to develop a variety without the endophyte (endophyte-free). That process was not difficult or terribly time consuming and by the early 1980's, Triumph was released from Auburn University, Johnstone from the University of Kentucky, followed by several varieties from both university and private breeding groups.

Endophyte-free varieties were planted on many acres and in several experiments/demonstrations. Experimental results, along with farmer experience, showed excellent animal performance once the endophyte was eliminated; however, it was also learned that the endophyte had provided the tall fescue plant considerable "protection" enabling the old Kentucky 31 endophyte infected to be very persistent and resistant to many environmental, pest, and management stresses including overgrazing. As a result, most endophyte-free varieties did not persist well and were not popular among farmers as a "solution."

Need for a GOOD Endophyte

With full knowledge that the endophyte was the major causative factor in poor animal performance of tall fescue and the fact endophyte-free varieties were not as tough and as persistent as needed, thoughts then turned to a "new solution." The need for a "good" endophyte – an endophyte that would permit positive animal performance along with stress tolerance of the plant seemed to be an academic "pipe dream" until Dr. Gary Latch in New Zealand identified, isolated, and tested several endophytes and indeed found some that would give that win-win situation. Dr. Latch selected the best endophyte from his program in New Zealand and entered a cooperative research venture with Dr. Joe Bouton, Tall Fescue Breeder at the University of Georgia. The

research team inserted the best endophyte into the best tall fescue variety in Dr. Bouton's program and indeed produced a novel endophyte variety that gave animal performance equal to the same variety without an endophyte and permitted the plant to be more stress tolerant, similar to the same variety with the "toxic" endophyte. Marketing rights to this variety was obtained by Pennington Seed Company and released in 2000 as the variety Max Q Tall Fescue.

Since the release of Max Q Novel Endophyte Tall Fescue in 2000, over 500,000 acres have been seeded in 35 states in the USA and at least six different countries.

Other varieties are being developed and tested and are or will be available in the future including a release from the University of Kentucky. To date, the U.K. Variety has not been named or commercialized but I am hopeful we can move forward soon. Varieties that are named and available in some quantity and areas of the country include Texoma Max Q II from Pennington, DuraMax from DLF, Estancia from Mountain View Seeds and BarOptima from Barenbrug (Table 2). Several of these varieties have been in our variety test but not all have animal performance data. If you are planning to seed a novel endophyte variety, make sure you get as much information on it as possible. In particular, adaptability to Kentucky, persistence and animal performance.

Table 2. Novel endophyte tall fescue commercial products, 2000-2011.

Year of 1st Sales	Cultivar	Tall Fescue Owner	Endophyte Brand	Strain I.D.	U.S. Patent #	Endophyte Owner	USA Marketer
2000	Jesup	Univ Georgia	MaxQ	AR542	6,111,170	Grasslanz	Pennington Seed
2007	BarOptima	Barenbrug	Plus E34	E34	7,642,424	Barenbrug	Barenbrug USA
2011	Texoma	Noble Foundation	MaxQ II	AR584	6,111,170	Grasslanz	Pennington Seed
2011	Estancia	Univ Missouri	ArkShield	#4	7,465,855 7,553,654 7,977,550	Univ Arkansas	Mountain View Seeds
2011	DuraMax	Auburn Univ	Armor	#9 or #12	7,465,855 7,553,654 7,977,550	Univ Arkansas	DLF International Seeds

SOURCE: Dr. Tim Phillips. 2012 Proceedings Forages at KCA. KFGC 2012-1.

Summary

The endophyte of tall fescue is a very serious problem for the livestock industry. This organism is costing the beef cattle industry in the USA over $1 billion dollars annually. Our challenge is to utilize the best research information, management practices and proven products to reduce the economic impact of this "fungus" to our livestock industry.

Figure 1. Tall Fescue At A Glance	
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Pre 1800	Tall fescue to USA likely as a contaminant in Meadow Fescue Seed.
1879	Tall fescue seed in National Herbarium Collection.
1880	Plots of tall fescue grown in Utah, Kentucky, and at the USDA in Maryland.
1916	Tall fescue plants found in Pullman, WA.
1918	Plants from Pullman site taken to Oregon State University in Corvallis, OR
1931	Dr. E.N. Fergus identifies tall fescue growing on a hillside farm owned by Mr. W.M. Suiter in Menifee County, KY. Plants were there when Mr. Suiter bought the farm in 1893.
1943	KY-31 Tall Fescue released.
1945	Alta Tall Fescue released.
1940's-50's	Tall fescue seeded on over 35 million acres in Southeast USA.
1950's & 60's	Three animal syndromes (fescue foot, fat necrosis and fescue toxicity) associated with tall fescue – cause unknown.
1950's-70's	University of Kentucky discovers association of certain alkaloids with tall fescue toxicity.
1973	Dr. J.D. Robbins discovers association of "endophyte fungus" with tall fescue toxicity on a farm in Georgia.
1980	Dr. Carl Hoveland demonstrates association of fungal endophyte with tall fescue toxicity in grazing studies at Auburn University.
1982	The first endophyte free tall fescue variety (AU Triumph, Auburn University) released. Other varieties including Johnstone from Kentucky followed.
1980's	Endophyte free varieties resulted in good animal performance but poor persistence.
1993	Dr. Carl Hoveland estimates endophyte costing beef industry in Southeast USA $600 million annually.
1997	Dr. Gary Latch, New Zealand, finds first non-toxic (friendly/Novel) endophyte strain.
2000	First Novel endophyte variety (Max Q) made commercially available by Pennington Seed Company.
2005	G.D. Lacefield estimates the endophyte to cost the beef industry in the Southeastern USA over 1 billion dollars annually.
2007-2011	Four new Novel endophyte varieties released (BarOptima, Estancia, Texoma MaxQ II, and DuraMax)
20__	University of Kentucky Variety Released (KY 9301)