Agricultural Research Service
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U.S. Dairy Forage Research Center

Endophyte Status Does Not Affect Persistence of Tall Fescue under Wisconsin Winter Conditions

Introduction

Tall fescue is a perennial cool-season grass that is well-adapted to various climates and soil types. It also is resilient to heat and drought stress, winter frosts, wide ranges of soil pH, and intense grazing by livestock. These characteristics make it one of the primary forages used in beef-cattle enterprises throughout the Ozark and Appalachian Mountains of the upper South. Part of tall fescue's capacity to grow in various environments is derived from its symbiotic association with fungal endophytes.

More specifically, benefits of the endophyte to host plants include:

- enhanced seedling performance
- greater heat and drought tolerance
- decreased damage from insects and nematodes
- overall improved persistence, especially when subjected to overgrazing by livestock

While endophytic infection imparts great benefits to the host plant, it also produces ergot alkaloids that cause fescue toxicosis in livestock, which can be described as a form of sub-acute poisoning. Ergot alkaloids have vasoconstrictive properties that limit blood flow to body extremities, thereby causing sloughing of hooves, tails, and ear tips. Compromised reproductive performance also has been reported. An important consequence of vasoconstriction during summer months is a compromised ability to dissipate heat, leading cattle to remain in shaded areas, or to stand in ponds, streams, and mud. These behaviors often lead to depressed pasture intake and subsequent poor animal performance, sometimes referred to as 'summer slump.'

Sometimes, tall fescue that does not possess fungal endophytes (known as endophyte-free) has been used in an effort to reduce animal disorders associated with ergot alkaloids. Studies performed in warmer regions, such as the upper South, suggest endophyte-free tall fescue is less persistent, resilient, and productive compared with endophyte-infected tall fescue. Unfortunately, comparatively little is known about the effects of freezing temperatures and inconsistent snow cover during winter on the fungal endophytes associated symbiotically with tall fescue.

Newly established tall fescue. Will endophyte-free tall fescue survive and thrive in the Upper Midwest?

Research Trial

To address this research question (Casler and van Santen, 2008), 5,120 plants from four tall fescue populations (AU Vigor, GA 5, Jesup, and KY-31) were established (transplanted) in May 2005 at four University of Wisconsin research locations (Arlington, Lancaster, Marshfield, and Prairie du Sac). Both endophyte-infected and endophyte-free plants were included in the study, and subsequently managed under either turfgrass- or forage-harvest management systems. The endophyte status of each plant was confirmed prior to establishment. Plants were scored for survival at the end of two subsequent

Table 1. Survival (%) of endophyte-infected (+) or endophyte-free (-) tall fescue populations two years after transplanting at four locations in Wisconsin [adapted from Casler and van Santen (2008)].

		---------------------------- Location ----------------------------				
Population	**Endophyte**	**Arlington**	**Lancaster**	**Marshfield**	**Prairie du Sac**	**Average**
AU Vigor	-	0	0	0	0	0
	+	0	0	0	0	0
GA 5	-	90.6	94.4	93.1	90.0	92.0
	+	90.6	95.0	95.0	92.5	93.3
Jesup	-	87.5	98.8	91.9	83.1	90.3
	+	85.0	98.1	91.3	79.4	88.4
KY 31	-	97.5	98.1	95.6	97.5	97.2
	+	98.8	98.1	96.9	95.6	97.3

summers (September 2005 and 2006), and after spring growth began following two winters (May 2006 and 2007).

During the first summer of the trial (2005), 82 of 5,120 (1.6%) plants died, while 1,276 (24.9%) plants were lost during the subsequent winter. The majority of winter-killed plants were from AU Vigor, which demonstrated poor adaptation to Wisconsin winters. More than 90% of all AU Vigor plants died during the first winter, and the remainder were lost by the end of the trial. During the second summer of the trial (2006), 11 of 5,120 plants were lost, followed by an additional 176 during the final winter. In total, this represented an overall mortality rate of 30%. Of these losses, about 94% succumbed during winter. Survival rates determined at the end of the two-year evaluation are summarized by location in Table 1.

Summary and Conclusions

When the primary factors stressing plants were freezing temperatures coupled with cold desiccating winds and sporadic or intermittent snow cover, there was no discernable benefit to endophytic infection. Results showed that survivability was almost entirely related to cultivar. The AU Vigor cultivar was not adapted to Wisconsin winters, and this was explained by the largely Mediterranean influence within its genetic background. The other fescues appeared to be quite well adapted to Wisconsin winters. While endophytic infection within tall fescue plants is critical to their survival under heat, drought, overgrazing, and other stresses common throughout the upper South, these symbiotic associations appeared to offer little benefit when the main source of plant stress was cold winter conditions, such as those observed throughout Wisconsin. In short, tall fescue populations that were not adapted to Wisconsin winters (AU Vigor) died, irrespective of endophyte status. In contrast, adapted populations demonstrated similar survival rates (generally, > 90%), regardless of testing location or endophyte status.

References

Casler, M.D., and E. van Santen. 2008. Fungal endophyte does not enhance cold tolerance of tall fescue. Crop Sci. 48:2033-2039. doi: 10:2135/cropsci2007.11.0615.

U.S. Dairy Forage Research Center, USDA-Agricultural Research Service

1925 Linden Drive, Madison, WI 53706 | Phone: 608-890-0050

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