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## The Effect of Spike-Tooth Aeration on Tall Fescue Yield

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### Abstract

Over the last several years, spike-tooth aerators have been promoted as a tool to increase yield of grass pastures and hayfields across the Southeast. A two-year research project was conducted at two locations in Tennessee to evaluate the effect of spike-tooth aeration on the yield of tall fescue (*Festuca arundinacea* Schreb.). At the East Tennessee Research and Education Center and the Middle Tennessee Research and Education Center tall fescue plots were aerated once, either in spring or fall. Plots were fertilized with N at 60 lb/acre at spring green-up and harvested when forage height reached 8 to 10 inch. Results from both locations showed that aeration had no effect on tall fescue yield.

### Introduction

Cattle producers in much of the USA depend on cool-season perennial grasses to provide the majority of forage for their cattle operations. Grasses such as tall fescue can be utilized for many years without any type of tillage tool being used on the field. There are concerns that traffic from cattle and machinery in pastures and hayfields may result in soil compaction, which could limit water infiltration and result in reduced yield. Over the last several years, spike-tooth aerators have been promoted as a tool to decrease soil compaction caused by this traffic. These aerators penetrate into the soil, which supposedly loosens any soil compaction in the upper soil surface. Holes in the soil allow water to infiltrate the soil, rather than run off without being absorbed. Research has indicated that aeration did not increase the yields of bermudagrass (2), bahiagrass (2,5) or alfalfa (4). Limited work has shown that the spike-tooth aerators may actually increase compaction around the penetration area (2).

Studies conducted on cool-season grasses and grass-legume mixtures indicated that aeration had no effect on forage yield (3). Research has shown the impact of aeration will vary based on soil properties (1). Anecdotal evidence from producers using these tools has provided a minimal amount of support for these tools. Investigation of these instances has failed to provide definite information, either positive or negative. A research project was begun to determine if spike-tooth aeration would improve yield of tall fescue.

### Evaluating Aeration's Effect on Forage Yield

**Aeration treatments.** The study was begun in 1998 on the East Tennessee Research and Education Center, Knoxville, TN (35°57'N, 83°55'W), and the Middle Tennessee Research and Education Center, Spring Hill, TN (35°36'N, 87°2'W). At both locations, treatments were imposed on an established tall fescue sod. In Knoxville, a 10-ft aerator with two 5-ft axles arranged end to end was used. The axles could be adjusted from a straight, horizontal position to achieve an angle on the blades of up to 10% (relative to travel direction). Knives were located approximately 1 ft apart on the axles, and were arranged to produce approximately one penetration per square foot. Weight was added to the aerator to produce the recommended penetration depth of 6 inches. During a preliminary run, it was determined that the greatest angle caused too much sod destruction, so a 7.5% angle was used instead of the maximum 10%. Three

treatments (no aeration, aeration-no angle, aeration-angle) were applied in March each year to a Sequoia silty clay loam (clayey, mixed, mesic Typic Hapludults) with 12% slope.

In Spring Hill, the aerator consisted of a large drum (approximately 4-ft diameter) with 8-inch spikes every 10 inches. The design of this aerator prevented any manipulation of the machinery other than depth of penetration. The drum was filled with water in order to produce the maximum soil penetration. Three treatments (no aeration, aeration in spring, aeration in fall) were applied each year to a Maury silt loam (fine, mixed, semiactive, mesic Typic Paleudalfs) with 2 to 5% slope.

**Fertilization and harvest.** Plots were fertilized with N at 60 lb/acre in spring at green-up. Phosphate and potash were applied according to soil test recommendations for cool-season grass hay production. Plots were harvested with a flail-type mower when forage height reached 8 to 10 inches (2 to 3 times each year). A sub-sample was taken from each plot and dried at 140°F in a forced-air oven for dry matter determination.

**Statistical analysis.** Each study was analyzed separately, since aeration equipment and timings were slightly different. For each study, aeration treatments were arranged in a randomized complete block design with four replications. Data were analyzed using analysis of variance procedures and means were separated using Fisher's LSD at a  $P \leq 0.05$  percent level of significance.

### Forage Yield

Results from the two studies indicated that aeration had no effect on forage yield. In Knoxville, approximately 4 ton/acre of dry matter was produced each year, with no differences between aeration treatments (Table 1). In Spring Hill, drought conditions both years of the study resulted in poor yields (Table 2). No differences were found between treatments.

Table 1. Effect of aeration on tall fescue yield, Knoxville, TN.

Treatment	1998	1999	Avg.
	Yield (lb DM/acre)		
No aeration	8105	8746	8426
Aerated, no angle	7758	8260	8006
Aerated, angle	7516	8744	8130
LSD (.05)	NS	NS	NS

Table 2. Effect of aeration on tall fescue yield, Spring Hill, TN.

Treatment	1998	1999	Avg.
	Yield (lb DM/acre)		
No aeration	2416	3376	2896
Aerated in spring	2400	3375	2888
Aerated in fall	2319	3291	2805
LSD (.05)	NS	NS	NS

Rainfall pattern in Knoxville during the 1999 growing season provided an interesting and unusual opportunity to evaluate the effectiveness of spike-tooth aerators. During May, rainfall was approximately 170% of the 30-year average (Fig.1). During June, drought conditions developed as less than 5% of the 30-year average rainfall occurred. During July, rainfall increased to over 250% of the average rainfall for the period. Claims concerning the benefits of spike-tooth aeration are decreased water runoff and increased infiltration, a thus resulting in increased yields. Rainfall runoff and water infiltration were not measured in this study. However, if spike-tooth aeration increases water infiltration and

decreases runoff, the aeration treatments should have produced higher yields. Abundant rainfall during July should have been more efficiently captured and utilized in the aerated plots, particularly considering the soil conditions following the drought during June. Yields from this year indicate that this was not the case (Table 3). The forage harvested on August 5 was growth that occurred during the period of abundant rainfall. There were no significant differences in yield due to aeration treatment. These were measurements taken during a single year, but provided a unique opportunity to view aeration effects.

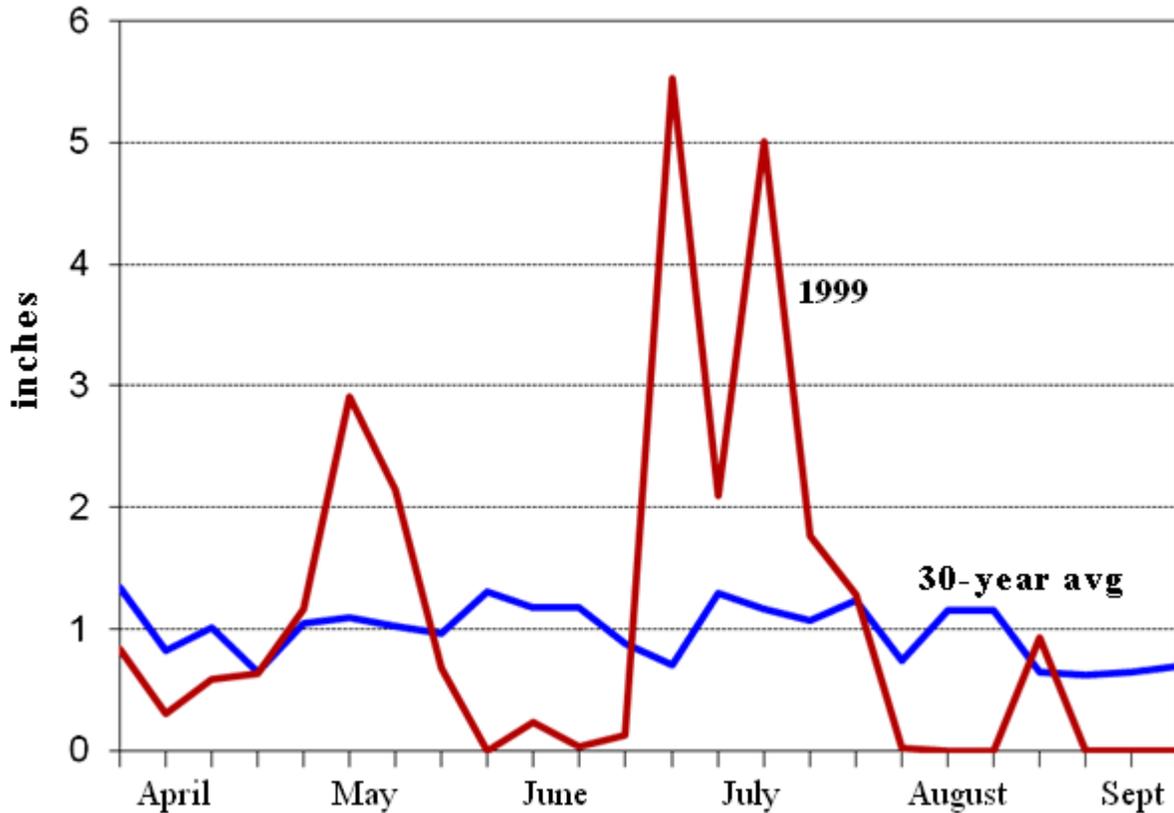


Fig. 1. Weekly rainfall (inches) in 1999 and 30-year average for Knoxville, TN.

Table 3. Effect of aeration on tall fescue yield in 1999, Knoxville, TN.

Treatment	May 4	June 23	Aug 5
	Yield (lb DM/acre)		
No aeration	2841	2447	3458
Aerated, no angle	2637	2282	3341
Aerated, angle	2717	2541	3486
LSD (.05)	NS	NS	NS

### Conclusions

Results of this study indicate that spike-tooth aeration does not seem to improve forage yield of tall fescue. Compaction problems that may occur in tall fescue stands in Tennessee are probably reduced through freezing/thawing cycles during winter and by root channels, thereby reducing the potential for spike-tooth aeration to be beneficial in these conditions. There may be soil types and situations in other regions that can benefit from aeration. However, thorough investigation of those types needs to be done before producers invest in the substantial cost of purchasing/utilizing these implements.

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