Preservation of High Moisture Male Sterile BMR Forage Sorghum Silage

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ISC 2025 XX INTERNATIONAL SILAGE CONFERENCE

Introduction

Male sterile brown midrib (BMR) forage sorghum is a crop that has been shown to improve forage digestion (Hao et al., 2021). The BMR trait, coupled with male sterility, is unique in that it can enhance the nutritional value of the forage sorghum. Although there are benefits to enhanced nutritional value, there are challenges associated with nutrient preservation during ensiling, particularly when the crop is harvested at a high moisture content. This high moisture is beneficial to achieve proper fermentation but can be detrimental due to clostridia and butyric acid formation. Inoculants can be utilized to prevent these outcomes. The two main types of inoculants available are homofermentative and heterofermentative (Muck, 2010). This study was conducted to discern differences between inoculant types when ensiling high moisture male sterile BMR forage sorghum.

Homofermentative inoculants improve fermentation via lactic acid production which may decrease storage losses and curtail undesirable fermentation, whereas heterofermentative inoculants should decrease losses at feedout (Oude Elferink et al., 2001). The preferred inoculant, homofermentative or heterofermentative, has not been researched with high moisture male sterile BMR forage sorghum.

Objectives

To determine whether a homofermentative or heterofermentative inoculant would be more advantageous to use on High Moisture Male Sterile BMR Forage Sorghum (DM <23%).

Materials and methods

The study was conducted at the University of Tennessee research farm on June 6th 2020 and evaluated the effects of different inoculants on male sterile BMR forage sorghum silage. The target seeding rate was 8.97 kg/ha. Unfortunately, the older drill that was used planted half at the correct rate and half at a much higher rate, which had significant lodging. The part that grew normal, not lodged, was harvested, starting when most of the field had headed, and continued each Tuesday for 10 weeks. At week 1 (just headed), week 5 (halfway to optimum), and week 9 after heading to optimize nutrient concentration in forage cells and to duplicate corn silage, which is chopped 56 days after tassel. The treatments were water mist for control (CON), homofermentative inoculant (MC, (*Lactiplantibacillus plantarum* (DSM16568), *Enterococcus lactis* (DSM22502) and *Lactococcus lactis* (NCIMB30117)) SiloSolve® MC, Novonesis, Lyngby, Denmark) or heterofermentative inoculant (FC, (*Lactococcus lactis* (DSM11037) and *Lentilactobacillus buchneri* (DSM22501), SiloSolve® FC, Novonesis, Lyngby, Denmark). Inoculants were applied at 150,000 CFU/g of fresh matter. Upon harvest, 6 individual typical plants were cut, chopped in a portable chopper, and treated with either SiloSolve® MC or FC. The 6 control samples were treated with misted water only. Each sample was vacuum-sealed and fermented for 3 weeks before analysis. The samples were then sent to Cumberland Valley Analytical Services for NIR+, wet chemistry starch and sugar, and fermentation analysis. Statistical analysis was performed by comparing treatment groups by sampling weeks, treating each sample as its own experimental unit without repeated measures. A multiple range test was used to test for significance ($P < 0.05$).

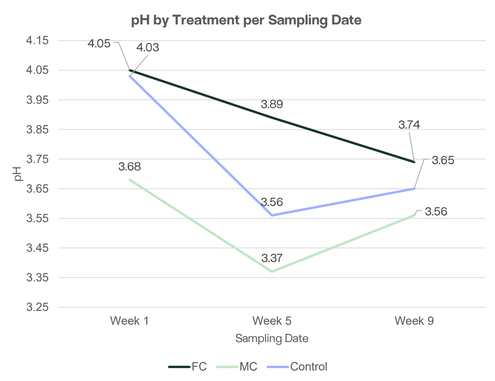
Results

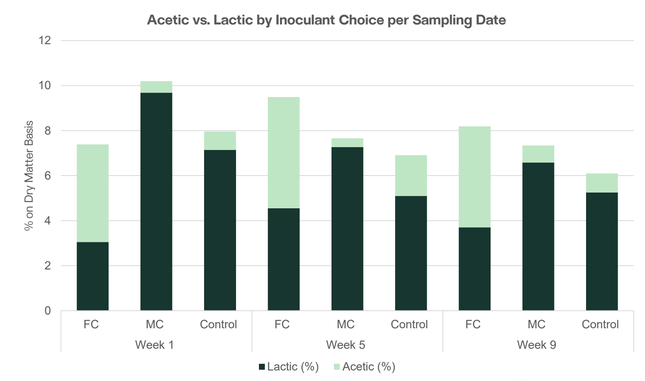
An unexpected factor arose 5 weeks after heading when the sorghum variety sent out lateral shoots with male sterile heads. This factor began influencing most nutritional components during the last two harvest dates. For the weeks after this, it drastically altered the nutrient enhancement as the plant utilized photosynthetic products to produce the lateral shoots instead of increasing the digestible components of the plant. An example is the WSC sugar, which recorded a 33% drop from weeks 5 to 9.

Table 1. Mean Water Soluble CHO Sugar across treatments based on sampling time.

	Week 1			Week 5			Week 9		
	FC	MC	Control	FC	MC	Control	FC	MC	Control
Water Soluble CHO Sugar	2.21[a]	4.58[b]	5.97[b]	5.83[a]	22.81[b]	15.38[c]	4.54[a]	12.06[b]	12.14[b]

Figure 1 (left): The pH of BMR forage sorghum by time and inoculant.
Figure 2 (right): Lactic and acetic acid content (% DM basis) by inoculant.





Discussion

BMR Male Sterile Sorghum is a worthy fermented feed due to its enhanced nutritional digestibility. However, as shown here, having the right genetic diversity for a given region is crucial to improve the opportunity for success. Although this study had challenges, the inoculated forage still showed beneficial fermentation characteristics. The Novonesis inoculants could handle this wetter forage and properly ferment the crop given the pH that was exhibited here. For this forage, it is critical to identify the right genetic strain for a given area to prevent the production of the shoots exhibited in this study.

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