## WISCONSIN– Fermentation Trends in Round-Bale Silages

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Over the last eight years, ~10 different trials with baled silages have been conducted at the UW-Marshfield Agriculture Research Station on a wide variety of management issues (e.g., different plastic formulations, number of layers of plastic wrap, storage time, wrapping delays, use of bale-cutting mechanisms, forage species, aerobic stability). A collective look at the relationship between fermentation acids and bale moisture can be instructive. Fermentation products in 243 bales were regressed against bale moisture. Figure 1 shows the cumulative concentration of fermentation acids (sum of lactic, acetic, propionic, butyric, and succinic acids in the silage). The most commonly cited recommendation for proper bale moisture ranges from 45-55% (within vertical red lines on graphs). There are several worthy points of emphasis: despite differing experimental goals and conditions in these studies: bale moisture explained ~70% of data variability; concentrations of total fermentation acids are highly variable, particularly across studies; fermentation acids increase with bale moisture; and relatively little fermentation occurs when bale moisture is <45%. Lactic acid is most desirable because it is the strongest fermentation acid produced, and, therefore, drives silage pH lower (more acidic). Homofermentative lactic acid production is more efficient than production pathways for other acids. The lactic acid and bale moisture relationship is shown in Figure 2; it closely resembles the pattern observed for total fermentation acids, and it often exists in very low concentrations at bale moistures <45%. Concentrations even can be undetected in some cases (see data point concentration along the x-axis within this moisture range).

**Figure 1.** Cumulative total of fermentation acids in 243 baled silages, Marshfield, WI. Red lines outline recommended moisture range for silage type; red dots indicate bales with butyric acid concentrations >0.25% DM.

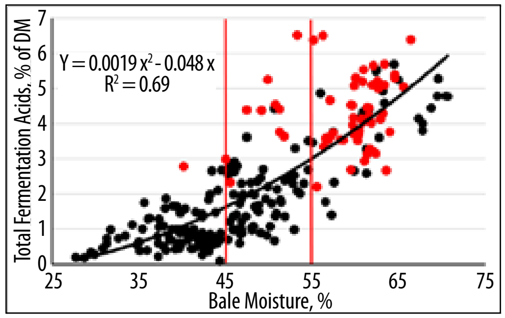
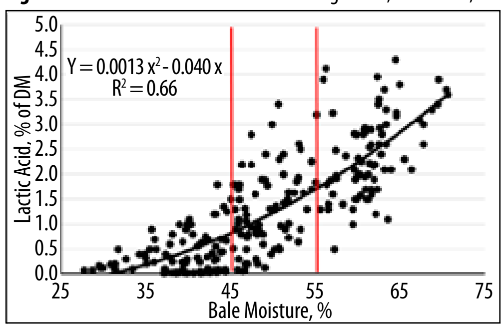



**Figure 2.** Lactic acid concentrations in 243 silage bales, Marshfield, WI.




Why would a farmer want low lactic acid concentrations? Bales made at >55% moisture may be problematic due to bale weight and associated safety issues, but also baler design, where balers still generally handle drier bales better than wetter ones. Moisture recommendations for baled silages are lower than chopped silages due to the potential for clostridial fermentations. Typical products produced in this secondary fermentation type are ammonia and butyric acid; however, significant DM losses and reduced voluntary intakes also result. In Figure 1, bales with butyric acid concentrations >0.25% are pictured as red data points. For bales >55% moisture, 52 of 78 bales (66.7%) exceeded this concentration threshold, and 12 bales were >1%, with a maximum concentration of 1.79%. In the recommended 45-55% range, only 10 of 75 bales (13.3%) exceeded the 0.25% threshold. Below 45% moisture, only 1 of 90 bales (1.1%) had elevated concentrations. Recommended targets for butyric acid concentrations vary by literature source and conditions, but butyric acid should be low, or undetectable in the lower (drier) half of the moisture range (Figure 1). Field wilting is a recommended approach for controlling clostridial activity in silages; it is particularly important for baled silages, which are more susceptible. It also is important to note bales at <45% moisture were well preserved and suitable for feeding, but the primary mode of preservation and stability in those bales was air elimination, which requires good plastic integrity throughout storage.