Silage Inoculants – Are They Worth the Money?

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Ensiled forages form the foundation of many rations fed to dairy cows, providing many nutrients necessary to support milk production. When forages are correctly ensiled, water-soluble carbohydrates are converted into organic acids by bacteria naturally found on the leaves of plants. These organic acids, mostly lactic acid, lower the pH of the ensiled crop; thus preserving the forage crop and inhibiting the growth of spoilage and pathogenic bacteria. Once these silages are exposed to oxygen during feeding and at the exposed open face of a silo, yeasts and molds can grow, allowing for heating and deterioration of silage quality. Two different types of silage inoculants have been developed and studied as they relate to controlling each of these two processes. The question then becomes, on what crops and under what field and storage conditions are these inoculants the most beneficial.

Lactic Acid Bacterial Inoculants

Inoculants containing lactic acid bacteria (LAB), such as *Lactobacillus plantarum*, include some of the older types of bacterial silage inoculants. These bacteria ferment carbohydrates in ensiled plants to primarily lactic acid and, as such, were known as homofermentative lactic acid bacteria. Today, they are classified as facultative heterofermentative lactic acid bacteria, but still produce predominately lactic acid, an acid that decreases the pH of the ensiled crop. These inoculants were developed to cause a quicker drop in the pH of silage crops shortly after ensiling, as well as decrease the pH of the crop during the entire fermentation process. This drop in pH inhibits the growth of undesirable microbes, such as molds or Clostridia (cause of botulism in cattle), and prevents the loss of nutrients in the ensiled crop.

Responses to an inoculant vary by ensiled forage type (i.e. corn versus alfalfa), bacterial species and strains used in the silage inoculant, application rate of LAB, and other silage management practices. In alfalfa and grass silages, silage inoculants decrease the final pH of silages, increase lactic acid concentration, increase dry matter recovery, decrease mold counts; thus improving silage fermentation. However, these responses were not seen in corn or sorghum silages. Scientists speculated the lack of response was due to the harvested corn or sorghum plants already containing sufficient water soluble carbohydrates to support adequate lactic acid synthesis resulting in an adequate drop in silage pH, lower buffering capacity of the forage itself, and the inability of the added LAB bacteria to outcompete those already present in the harvested crop. If these conditions were not met, a positive response might be seen; thus providing insurance during the ensiling of a corn or sorghum crop.

One positive response across forage types and in most studies was a small, but significant, increase in daily milk production (0.8 lbs/day) and a tendency for an increase in milk fat and protein percentage and dry matter intake. Scientists could not easily explain this increase in milk production, but speculated that it might be related to an inhibition of detrimental molds and toxins and changes in rumen fermentation.

Responses can also vary by bacterial species and strains (letters and numbers after the bacterial name); thus it is impossible to give a generic recommendation regarding the effectiveness of a silage inoculant.

Studies using that particular species and strain as well as application rate are needed to assess the effectiveness of a particular inoculant and must be compared to a control where no inoculant was applied to forage harvested identically across multiple fields, silos, and farms. This result needs to occur in multiple studies, not just one. In addition, dry matter content of the harvested forage as well as concentration of water-soluble carbohydrates and natural bacteria on the leaves of the ensiled forage impact the response to the silage inoculant. Bottom line, many factors are involved in the response actually observed.

Forages treated with this type of inoculant generally have lower acetic acid content and, consequently, contain higher yeast counts. Acetic acid acts as an anti-fungal agent and higher lactic acid concentrations act as a growth substrate for spoilage yeasts. These changes decrease the stability of silages at time of feedout resulting in heating at the feedbunk or open face of the silo.

Inoculants to Extend Bunk Life

Different from LAB bacteria, the group of bacteria, known as obligate heterofermentative bacteria, improve the stability of silages at time of feedout and on the face of an opened silo. The most common example of this type of silage inoculant is *Lactobacillus buchneri*. These type of bacteria convert lactic acid found in the silage to acetic acid, lowering yeast counts, resulting in less heating of silage in the feedbunk and exposed face of silos. These increases in acetic acid content take 30 to 60 days post ensiling before they are detected. Combining results across multiple studies, aerobic stability of corn silage, as noted by a 2 to 3.5ºF increase in silage temperature, was 25 hours for untreated silage and increased to 503 hours for silage treated with *L. buchneri* at application rates greater than 100,000 cfu/g. Feed placed in a feedbunk should be consumed before these times. However, this longer stability is more important in helping maintain the quality of silage found just interior to the exposed face of silos. Removing silage from the face allows oxygen to enter the stored pile just interior to the exposed face. The depth of this oxygen- infiltration is dependent on how deep from the face packed silage is disturbed when removing silage for feeding. Researchers also noted that silage pH increased somewhat in silages inoculated with *L. buchneri*, but still within an acceptable range (i.e. 4.2 vs 4.4 pH for grass and small grain silages). Just like the LAB inoculants, effects are strain and dose-dependent.

Combination Inoculants

Commercial products are available that combine both types of inoculants. The LAB bacteria would help control the early fermentation process resulting in a more rapid drop in pH, suppressing undesirable microbes, reducing the breakdown of proteins, and decreasing losses of dry matter especially in grass and alfalfa silages. The *Lb. buchneri* bacteria (or similar acting bacteria) would improve the stability of the ensiled forage at feedout and at the open face of the silo. When selecting a product, one needs to request research showing that the product works as advertised. Different species and strains are used in different products along with various inclusion rates. Very limited peer-reviewed, published data are available showing the effects on animal performance as to whether the effects seen with the LAB bacteria separately are found when used in combination with *Lb. buchneri*.

Should You Use Inoculants?

Success when using a silage inoculant starts and is dependent on one practicing sound silage preservation management practices. Preserving quality silages starts with harvesting the crop at the proper stage of maturity and moisture, adequately packing to exclude as much oxygen as possible, and covering the silage to prevent water and oxygen infiltration.

From the published research trials, the use of LAB bacterial inoculants seems to be prudent for alfalfa and grass silages. With corn and sorghum silages, the effects with the use of LAB bacterial inoculants are less definitive as they relate to changes in the fermentation process. Use of these products may act as an insurance policy for times when conditions are not optimal for a successful fermentation. The question becomes, is that cost justified? The use of *Lb. buchneri* extends the stability of silages at feedout irrespective of crop.

The response from any product depends on the species and strains included as well as the inclusion rates of stated bacteria. To determine whether a particular product is effective, one should request the research supporting the product's effectiveness. These results should be compared to a control where no product was used and the untreated ensiled silage was treated identically to the treated silage. Multiple studies should show that the product is effective with the crop in question conducted over multiple years and multiple locations.