THE OHIO STATE UNIVERSITY
COLLEGE OF FOOD, AGRICULTURAL, AND ENVIRONMENTAL SCIENCES

Help in Choosing an Effective Silage Inoculant

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Introduction

Microbial inoculants can make silage fermentation more efficient, thereby preserving more nutrients and dry matter, and sometimes improve animal performance. Some inoculants have also been designed to specifically improve aerobic stability. This is important because a large portion of dry matter (DM) lost in a silo is actually due to aerobic spoilage. There are so many silage inoculants and claims about them that it is no wonder producers are often confused about which inoculant to use. Here are a few tips that might help you make a more informed choice.

Research, Research, Research

An effective silage inoculant will have independent, statistically analyzed, and published data supporting its use. Of course, the more supporting data there is, the more credibility a product has. I will take an educated guess and say that no more than 10 to 15 percent of the silage inoculants in the marketplace have more than five publications showing that they work. Be cautious as I have seen brochures from companies showing "research data" from many university studies that have not been published. I personally put much more weight on research that was independently published, was statistically analyzed, and is in a form that can be cited and found in an indexed search of the literature. This would include articles published as journal articles and abstracts (e.g., Journal of Dairy Science, Journal of Animal Science, Animal Feed Science and Technology). When reviewing the published literature on a product I also check to see if there are some studies where the product did not work. No product works all the time, but the better products work a high proportion of the time. Companies with high integrity will share both the positive and negative results with you.

You may hear the claim that, because a company sells an inoculant that has bacteria with the "same name" used in other studies, those studies support its use. Many bugs have the same name, but not necessarily the same activity or properties. Thus, this is not a valid claim.

It's the Bugs

The most common types of bugs that are in our silage inoculants include what we know as classical homolactic acid bacteria, heterolactic bacteria, and sometimes, Propionibacteria. Classical homolactic acid bacteria (e.g., *Lactobacillus plantarum*, *Enterococcus faecium*, and several species of *Pediococci*) improve the initial fermentation process by speeding up the production of lactic acid

and limiting the production of miscellaneous end products that may lower the efficiency of fermentation. (Note: *L.plantarum* has been reclassified as a heterolactic acid bacterium.) A quick drop in pH can reduce protein degradation and prevent the growth of several undesirable microbes in silage (e.g., Enterobacteria and Clostridia). This can lead to improvements in the recovery of dry matter and, sometimes, improvements in animal production because of more efficient fermentations. However, homolactic acid bacteria are not always very effective in improving the aerobic stability or shelf life of silage. The reason for this finding is that lactic acid alone is a poor antifungal agent.

On a dairy farm, a large portion of dry matter loss in a silo is actually due to poor shelf life (not just fermentation losses). Thus, several bacteria have been studied to improve the aerobic stability of silages. Theoretically, Propionibacteria convert moderate levels of lactic acid to acetic and propionic acid. However, there is insufficient compelling research to support the fact that this consistently happens in silage. Thus, the effect of these bacteria in silage is questionable. Of the heterolactic acid bacteria, only *Lactobacillus buchneri* has proven itself (with multiple research publications) to be an effective silage inoculant. *Lactobacillus buchneri* by itself has minimal effects on the initial fermentation process, but during storage it converts moderate amounts of lactic acid to moderate amounts of acetic acid, which is a potent inhibitor of yeasts and molds.

Many silage inoculants contain multiple types of bacteria. In some studies, combinations of organisms have led to improved efficacy, but all combination products are not necessarily better than an inoculant with only one organism. Recently, homolactic acid bacteria have been combined with the heterolactic organism *L. buchneri* to provide stimulation of early fermentation and prolonged shelf life during storage and feedout.

Application Rate

For silage inoculants to be effective, they must be added at a high enough rate to compete against detrimental organisms and dominate the ensiling process. For homolactic acid bacteria, the industry standard is a final application rate of 100,000 colony forming units (cfu) per gram of fresh forage. The probability of a silage inoculant being effective is markedly reduced if it supplies less than this number of homolactic acid bacteria.

In some formulations containing *L. buchneri*, the final application rates are severalfold higher (400,000 cfu/g for silages and 600,000 cfu/g for high-moisture corn), which further increases its probability of success in the field. Accurate calibration of equipment and distribution of the inoculant onto the silage are also essential to using a silage inoculant. Never add half the recommended rate to save a few cents. By doing this, you have decreased the probability of the product working. Likewise, I am skeptical of companies that tell you to add more than recommended because this now makes the product much less cost effective. (If you already paid $1/treated ton for the inoculant, can you really afford to put two to four times the level and drive the cost to $2 to 4/ton?)

Service

Although technical service is not directly related to the effectiveness of a silage inoculant, this should be factored into your decision-making process. Certainly, companies that are willing to assist you in times of need should be highly considered.

Pricing

A low or premium price alone should not be the driving factor for choosing an inoculant. Remember: research, research, research. In general, homolactic acid inoculants are less expensive than those containing *L. buchneri* because this organism is more difficult to produce and because in some formulations the final application rate is very high. Additionally, one should not make a comparison between a homolactic acid-based inoculant and one that contains *L. buchneri* on cost alone because the two products were designed for different goals. In the end, most silage inoculants will only cost several cents per cow per day, yet yield some good insurance.

Examples of Use

Here are a few examples of how to choose the best type of inoculant based on some specific situations:

Situation 1

Your silage is always fresh and you never or seldom have heating total mixed ration (TMR) issues in warm weather.

Type of silage inoculant to consider: Use a homolactic acid-based inoculant.

Reasoning: You can still improve silage fermentation and quality by using a good homolactic acid inoculant.

Situation 2

A large bunker or pile silo with a face that may be too wide, causing a slow rate of feed-out.

Type of silage inoculant to consider: Use an inoculant with *L. buchneri* (with homolactic acid bacteria as an option).

Reasoning: Silage treated with *L. buchneri* will have a better ability to withstand the stress of aerobic exposure.

Situation 3

You have silage that is sold and left on intermediate feeding piles for several days or silage that will be moved from one silo to another.

Type of silage inoculant to consider: Use an inoculant with *L. buchneri* (with homolactic acid bacteria as an option).

Reasoning: Silage treated with *L. buchneri* will have better stability when sitting in the pile exposed to air.

Situation 4

You have several bag silos; three will be fed out during cold winter months but two will be fed out in the hot summer, and there are issues with heating in summer silage.

Type of silage inoculant to consider: For the winter bags, treat with a homolactic acid inoculant. For the summer bags, treat with an inoculant with *L. buchneri* (with homolactic acid bacteria as an option).

Reasoning: Winter-fed silage usually does not spoil as rapidly when exposed to air, but this silage can still be improved with a good homolactic inoculant. Summer-fed silages tend to spoil rapidly when exposed to air. Silage treated with *L. buchneri* may improve stability for this situation.

Situation 5

You feed out of one large upright silo; the top portion is fed out in the winter, whereas the bottom is fed out during the summer. The summer-fed silage (but not winter silage) spoils rapidly.

Type of silage inoculant to consider: Treat the top with a good homolactic acid bacteria-based inoculant, treat the bottom with *L. buchneri* (with homolactic acid bacteria as an option). Another option is to treat the whole silo with a *L. buchneri* + homolactic acid bacterial inoculant.

Reasoning: See Situation 4.

Situation 6

You put up very wet grass or legume forages (> 65 to 70% moisture or less than 30 to 35% DM).

Type of inoculant to consider: Consider using a homolactic acid-based inoculant.

Reasoning: When these forages are wet, the conditions often favor the growth of clostridia that produce butyric acid and may excessively degrade proteins. Homolactic acid inoculants drop the pH fast and can inhibit the growth of clostridia.

Situation 7

You put up very high DM (> 40 % DM) corn or alfalfa silage.

Type of silage inoculant to consider: Use an inoculant with *L. buchneri* (with homolactic acid bacteria as an option).

Reasoning: High DM silages are often more prone to aerobic spoilage than wetter silages. An inoculant with *L. buchneri* may help to improve aerobic stability.

Situation 8

You store silage in sealed storage structures that are oxygen limiting and don’t have shelf life issues.

Type of silage inoculant to consider: Use a homolactic acid-based inoculant.

Reasoning: Even if oxygen is limiting, a homolactic acid inoculant can improve the efficiency of fermentation.

Conclusions

Silage inoculants should not be used in place of good management. However, there are a variety of silage inoculants that are extremely helpful in improving the fermentation and shelf life of silages. Determine your needs based on the crop, silo, or challenges, and then pick a research-proven inoculant to help.

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