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## Silage additives

DairyCo

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# Objectives of silage additives

The purpose of silage additives is to control the preservation process so that by the time of feeding it has retained as many of the nutrients present in the original fresh forage as possible. However, the exact nutrient status of the silage will depend on many factors that can only be controlled via management.

**The main two being:**

- Crop quality at harvest
- Silage management from field to feeding.

**It is important to remember that silage additives will not make poor quality forage into good silage but they can help make top quality forage into excellent quality silage.**

To get the full benefit of using an additive, it is vital to pay attention to detail for all aspects of silage making, from cutting date to bale and clamp management to feed-out.

**More information on general silage making, planning and management can be found in Grass+.**

# Why use a silage additive?

The aim of the silage making process is to ensure the naturally occurring lactic acid bacteria present on the crop converts the forage into silage. They do this by converting sugars in the grass into lactic acid and acidifying the crop to inhibit further degradation of the plants' nutrients either by the plants own enzymes or undesirable bacteria, yeasts and moulds. However, most bacteria present on the crop are either detrimental to silage preservation or carry out an inefficient fermentation.

This may result in a silage fermentation that is slow, leaving little sugar with considerable protein broken down into non-protein nitrogen, thus, the silage has a lower nutrient content and is utilised less efficiently by the ruminant animal. This also reduces palatability and dry matter intake.

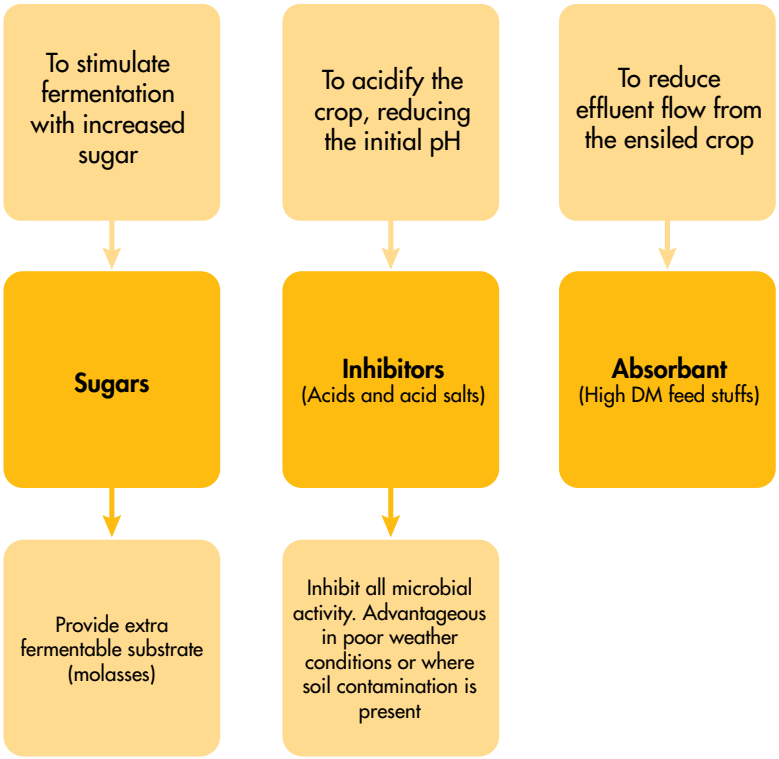
# Silage Additives

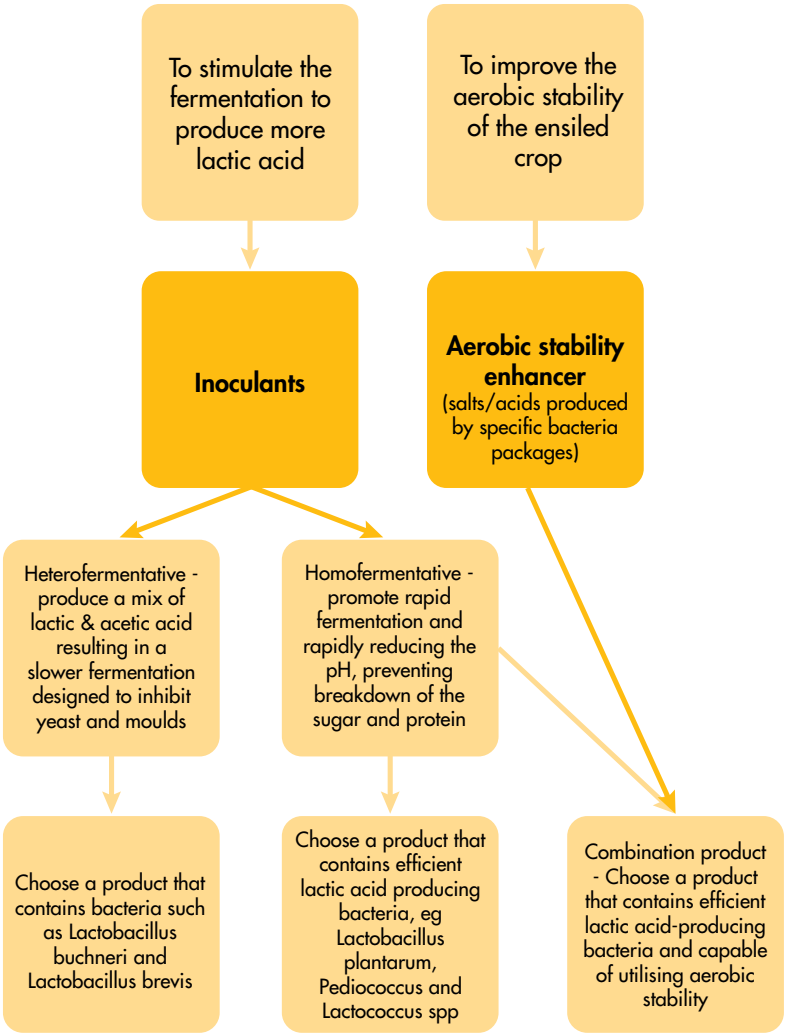
**There are many different silage additives available on the UK market and these should all have met the EU 1831/2003 Feed Additive Regulations.**

## The basic types of additives

- **Homofermentative inoculants** – contain bacteria such as Lactobacillus plantarum, Pediococcus and Lactococcus species. They promote a rapid fermentation producing mainly lactic acid and bring the pH down to 4 rapidly, preventing further breakdown of the sugar and protein in the crop.
- **Heterofermentative inoculants** – contain bacteria such as Lactobacillus buchneri and Lactobacillus brevis. They produce a mix of lactic and acetic acid which results in a slower fermentation than the homofermentative inoculants. They are designed to inhibit yeast and moulds that initiate the process of aerobic deterioration during feed-out.
- **Combination products** – these contain homofermentative inoculants plus sorbate and/or benzoate salts. The inoculant promotes a rapid fermentation while the salts act as a preservative to inhibit yeasts and moulds.
- **Acids and acid salts** – contain mainly formic, propionic acids or their salts. They directly acidify the crop when applied at 3-4 litres per tonne. They are designed to inhibit all microbial activity. They can be expensive and corrosive but can have advantages in poor weather conditions or where soil contamination is a problem. New formulations of these products have reduced their corrosive nature. Relatively new to the market are chemical-based additives containing mixtures of Benzoate, Nitrite and Sorbate that have a similar mode of action to the traditional acids but are non-corrosive.
- **Molasses and sugars** – these are designed to add additional fermentable substrate to the crop to support the growth of lactic acid bacteria. Studies have shown no benefit of this approach to the silage fermentation and the conclusion was that it was better to apply these types of products at feeding, if required, to increase the energy content of the diet.

## How different additives work and their primary modes of action




To stimulate the fermentation to produce more lactic acid
To improve the aerobic stability of the ensiled crop
Inoculants
Aerobic stability enhancer
(salts/acids produced by specific bacteria packages)
Heterofermentative - produce a mix of lactic & acetic acid resulting in a slower fermentation designed to inhibit yeast and moulds
Homofermentative - promote rapid fermentation and rapidly reducing the pH, preventing breakdown of the sugar and protein
Choose a product that contains bacteria such as Lactobacillus buchneri and Lactobacillus brevis
Choose a product that contains efficient lactic acid producing bacteria, eg Lactobacillus plantarum, Pediococcus and Lactococcus spp
Combination product - Choose a product that contains efficient lactic acid-producing bacteria and capable of utilising aerobic stability

## Things to bear in mind when making your decision

**1. Under UK conditions for making grass or clover silage, an inoculant needs to supply 1 million bacteria per gram of fresh forage to dominate the fermentation. Not all inoculants do this.**

How to calculate how many bacteria you are applying.

- The product label should say there are A grams in the bottle, sufficient to treat B tonnes of fresh crop
- The product contains C bacteria per gram (expressed as CFU/g).
- So A x C bacteria treats B tonnes of forage = D bacteria
- D ÷ B bacteria treat 1 tonne forage = E
- So E ÷ 1,000,000 (number of grams per tonne) bacteria treat 1g of forage, which should be at least 1,000,000.

**Example**

| | |
|---|---|
| Bottle contents (A) | 200g |
| Fresh tonnes of crop (B) | 200 tonnes |
| CFU per gram (C) | $10^{12}$ |

A x C = total bacteria (D)
$200 \times 10^{12} = 2 \times 10^{14}$

D ÷ B = CFU/tonne
$10^{14} \div 200 = 10^{12}$ (E)

E ÷ 1,000,000 = CFU/g
$10^{12} \div 1{,}000{,}000 = 1{,}000{,}000$ CFU/g

It is important to follow manufacturers' guidance regarding storage and application to ensure that the product allows maximum CFU per application to achieve optimal results.

**2. If mould growth on your silage is controlled by good silage management, eg using six layers of film-wrap on bales and storing them well then an additive that controls moulds will not be required but an additive that controls fermentation may benefit.**

# When to use an additive

- Additives were traditionally seen as the option when things weren't quite right, such as poor weather, high residual fertiliser or risk of soil contamination. This remains the case as they will help preservation under these conditions.
- When conditions and the crop are considered ideal, additives will further improve silage quality and animal performance, compared to no additive. Much trial work has been conducted to complement this. For example trial work using a high sugar perennial ryegrass ensiled under ideal conditions with a homofermentative inoculant or with no additive showed an increase in sugar content equivalent to adding £3 of molasses/tonne of silage.
- Legumes (Red Clover and Lucerne) are difficult to ensile because they are low in sugar and high in buffering capacity so an effective additive to control the fermentation is essential.
- If you are making specialist dry cow baled silage aiming for high fibre and low digestibility, in order to improve rumen function and achieve high levels of intake, additives may improve intake characteristics and reduce the risk of harmful pathogens and moulds.

# Which additive to use

- If the weather has been poor and there is a high risk of soil contamination, a chemical additive may give you peace of mind that the silage will be sufficiently good to feed.
- If the clamp management is good, particular consolidation during filling and feed-out rate is high, such that the face will not be exposed for longer than four days, then the additive should not need to control yeasts and moulds. The choice should be based on improving fermentation quality.
- If the feed–out rate is slow and the clamp face is wide or the silage is to be used for summer buffer feeding then an additive that controls yeasts and moulds and thus aerobic deterioration is very desirable.
- Baled silage should only ever be treated with additives that either inhibit all microbial activity or promote a rapid fermentation, eg homofermentative inoculants. Correct bale management should be sufficient to control moulds, although if the bale becomes damaged, the mould challenge will be too great for an additive to control.
- Legumes are difficult to ensile but, interestingly, are less prone to aerobic spoilage so these types of crop require an additive that either inhibits all microbial activity or promotes a rapid fermentation, eg homofermentative inoculants.

# Application

In order to ensure accurate application, it is important to know how much crop you are harvesting per minute. If the application rate is not high enough, insufficient CFU/ tonne will be applied, whereas over-application would not show any benefit but would increase the cost.

For example, if the manufacturer states you need to apply the product at 2 litres of additive per tonne of fresh forage to deliver the required number of CFUs, in order to work out the required rate of application, you need to know:

- The capacity of the trailers being filled, in tonnes, (the weight of forage will vary depending on DM and packing density of the crop)
- The time taken to fill the trailer (the time should be calculated with crop passing through the machine and should not take into account turning on headlands when the machine is not picking up).

## Example

- It takes eight minutes to fill a 10 tonne trailer; therefore, the harvesting rate is 1.25 tonnes of fresh crop per minute. If the application rate is 2 litres of product per tonne the applicator should deliver 2.5 litres of product in one minute.
- The delivery rate can be checked and calibrated using a measuring jug and timer.

**As with any product, optimum results can only be achieved by following the manufacturers' instructions regarding storage, application and management. It is also important that the operators of the forage machinery are aware of the product specifications and application rates.**

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