Pioneer Forage Solutions

The Forage Concept

by PIONEER

Maximising Grass Silage Intake Potential and Rumen Health
by Treatment with Pioneer Combination Silage Inoculants

PIONEER® 11G22 and PIONEER® 11GFT

DUPONT®

PIONEER®

PIONEER® 11G22 and PIONEER® 11A44 are advanced silage inoculant products that combine different unique strains of bacteria which improve silage fermentation, aerobic stability and digestibility.

The Forage Concept by PIONEER

Analysis of the quality of grass silage treated with PIONEER® 11G22 and PIONEER® 11A44 has clearly shown that these inoculants produce silages that are rumen friendly and hygienic. In addition to improving silage fermentation quality these two products:

- Reduce the likelihood of high lactic acid levels
- Reduce the likelihood of a very low final silage pH
- Reduce the likelihood of silage aerobic instability
- Reduce the likelihood of silages being infested with yeasts and moulds

The ensiling and fermenting of forages is accepted as the most effective and efficient way of preserving many different crops. However excessive acid production in the fermentation of grass silage, that sometimes results in silage of a very low pH level, is often considered to adversely affect the feeding quality of such silages.

Three aspects of silage quality that are always critical to achieving good feeding results are:

1. The nutritional composition and quality of the grass to be ensiled, which strongly impacts final feed intake
2. The rapid and complete acidification following the conversion of sugar in the forage to lactic acid
3. The aerobic stability of the silage i.e. the resistance of the silage to heating and decomposition

Factors affecting Grass Silage Quality

Nutritional Quality and Feed Intake	Silage Acidification	Aerobic Stability
Forage composition		
Silage energy density	pH	Silage density
Digestion rate	Volatile fatty acid composition	Air exclusion
Silage physical structure	Ammonia (NH_3)	Forage hygiene
Associated dietary effects		

Source: Dr. Bill Mahanna, 2013

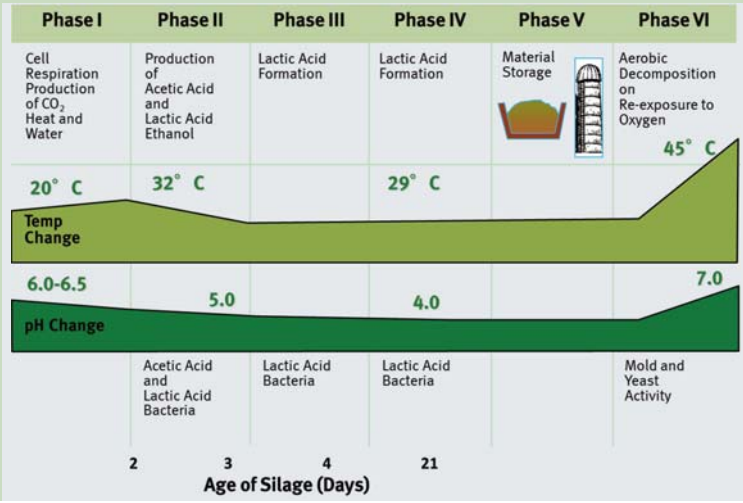
The Six Phases of Fermentation

Fermentation can only begin once all the air has been removed from the clamp. This depletion of oxygen by cell respiration often leads to an increase in silage temperature. Once the conditions become anaerobic lactic acid bacteria start to convert sugars into organic acids - the most important being lactic acid.

Preventing clostridial organisms becoming active is essential as their actions will lead to the breakdown of protein and an increase in butyric acid and ammonia. These compounds will have a negative and costly impact on silage feed value. Clostridial organisms do not tolerate acidic conditions hence the need for a fast and efficient fermentation.

All the six main phases of ensiling are characterised by specific needs and limitations.

Six Phases of Silage Fermentation and Storage - Without Inoculation



Source: Pioneer Hi-Bred Int., 2012

The growth of yeasts and moulds in the silage must be minimised. Such growth will result in energy loss in the form of heating, rejection, waste and the possible development of mycotoxins. The quantity of lactic acid produced and the pH level achieved will have no effect on reducing the likelihood of silage heating.

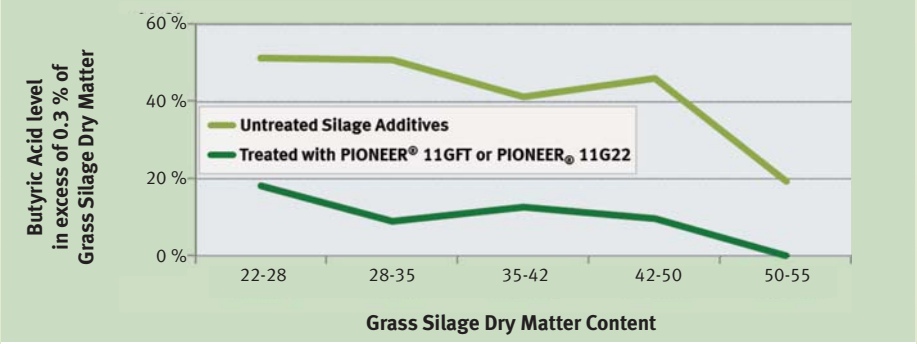
Silage quality is more than just composition. Preservation success is an important factor.

Pioneer Silage additives support, control and enhance the fermentation process

During the early phases of fermentation a fast and efficient drop in pH is essential. An evaluation by Pioneer of 764 silage samples revealed that up to 50 % of silages not treated with a silage inoculant had undergone an inadequate fermentation resulting in the potential for reduced feed intakes and lower animal performance.

Rapid and proper acidification is achieved by the Pioneer strains of *Lactobacillus plantarum, Lactobacillus casei* or *Enterococcus faecium* which are present in the Pioneer combination inoculants PIONEER® 11G22 and PIONEER® 11GFT. Fibre Technology inoculants such as PIONEER® 11GFT (grass silage), PIONEER® 11CFT (maize silage) or PIONEER® 11AFT (lucerne silage) also enhance overall and speed of ruminal fibre digestion and should be used with more mature forage.

Risk of Butyric Acid Fermentation



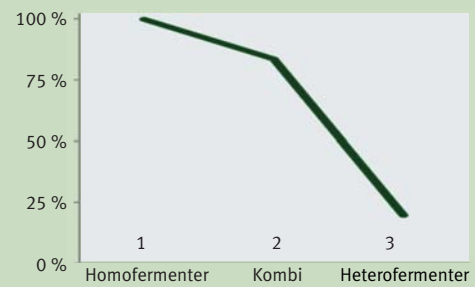
Source: Pioneer Silage Lab, Germany (2012);
n=764 farmer silage samples; *treated with PIONEER® 11G22 or PIONEER® 11GFT

Using Pioneer silage inoculants may decrease the risk of a poor fermentation by as much as 75 %.

Terminal pH related to lactic acid release

Concerns have been raised by nutritionists and farmers about the negative impact of excessively low pH silages on rumen pH. Silage inoculants that contain bacteria that produce just lactic acid (known as homofermentative type bacteria because they produce only one end product) maximise the efficiency and extent of lactic acid production. Such products should be used whenever acidification is the main challenge e.g. in low dry matter conditions. In such situations PIONEER® 1188 would be the product of choice.

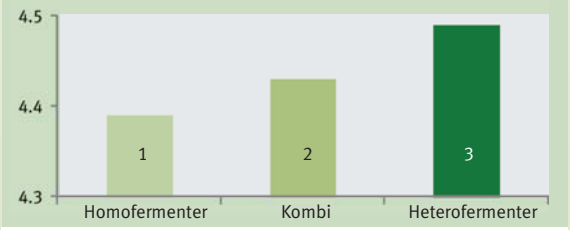
Lactic Acid content relative to the level in silage treated with homofermentative Lactic Acid producing bacteria



1) Treatment with silage inoculant containing homofermentative bacteria producing Lactic Acid only e.g. PIONEER® 1188 2) Treatment with silage inoculant containing both homofermentative and heterofermentative bacteria producing latic acid, acetic acid and propandiol e.g. PIONEER® 11G22 and PIONEER® 11GFT 3) Treatment with silage inoculant containing heterofermentative bacteria producing acetic acid and propandiol e.g. PIONEER® 11A44;
Source: Dr. Bill Rutherford, personal communication, 2012

Silage terminal pH is determined by lactic acid content. The use of heterofermentative strains of *Lactobacillus buchneri* can moderate levels of lactic acid so that excessively low pH values are avoided.

Silage Terminal pH



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The charts show that inoculant products containing homofermentative strains of Lactic Acid producing bacteria generate both the highest levels of Lactic Acid and the lowest pH. This may be essential in a wet grass silage situation (i.e. less than 25 % dry matter), but undesirable in a drier grass silage situation where less lactic acid is needed to complete the fermentation.

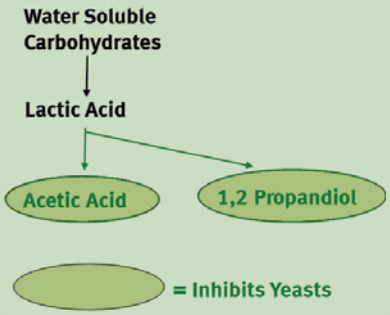
PIONEER® 11A44, a product that contains heterofermentative bacteria which produce acetic acid and propandiol from lactic acid, generates the lowest level of lactic acid and the highest terminal pH. PIONEER® 11A44 should only be used however in higher dry matter grass silages (›30 % dry matter) where less lactic acid is needed to reach a terminal pH. Silage inoculants that combine homofermentative lactic acid producing bacteria with heterofermentative types that produce acetic acid and propandiol e.g. PIONEER® 11G22 and PIONEER® 11GFT, moderate the production of lactic acid and the terminal pH whilst improving silage stability and reducing dry matter losses through aerobic deterioration.

Hygienic Status of Silages

Air is a root cause for aerobic spoilage of silages. Significant growth of yeasts and moulds can only happen if sufficient air is present. Thus, minimising air influx into the clamp is a key approach to prevent heating. Additional measures should be considered to help reduce the growth of yeasts. Certain compounds have been shown to be effective in reducing heating if applied in sufficient amounts during ensiling. A relatively inexpensive and convenient way of generating such compounds is through the application of effective strains of *Lactobacillus buchneri* which will produce acetic acid and propandiol.

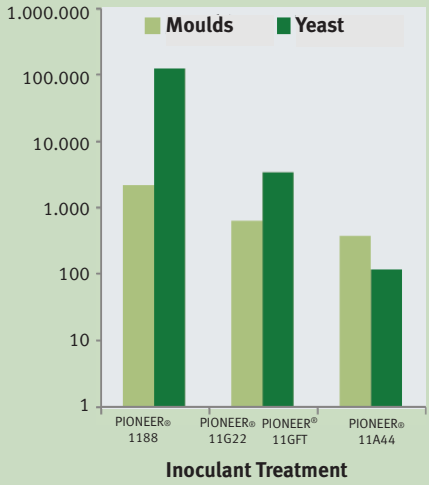
The combination of these compounds is very effective at controlling yeasts. Thus, the lactic acid: acetic acid ratio is shifted in a beneficial way in respect of its effect on reducing heating.

Mode of Action of L. buchneri Bacteria



Source: After Oude-Elfering et. al, 2001

Yeasts and Moulds (cfg/g)

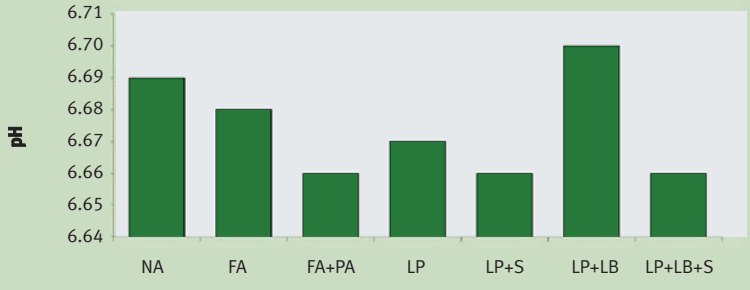


Source: Dr. Bill Rutherford, personal communication, 2012

Rumen Health

The results from trials on the effect on rumen pH from using different types of silage additive are reported in the graph below. The results from this work show the benefit to rumen pH by using the combination of *L.plantarum* and *L.buchneri* against other additives and no treatment.

Effect of silage additives on Rumen pH



Source: Navarro Villa et al 2012, Animal and Grassland Research and Innovation Centre, Teagasc, Grange, Dunsany, Ireland; NA - no additive, FA - formic acid, FA+PA - formic + propionic, LP - *Lactobacillus plantarum*, LP+LB - *Lactobacillus plantarum* + *Lactobacillus buchneri*, S - sugar

Inoculant efficacy in Grass Silage at varying ensiling conditions

Initial Situation	Recommendation	Benefits
EFFICIENCY	Mid-Late Cut Grass: 11GFT	More fibre digestibility for mature grasses. Improved ensiling success and less heating.
	Early Cut Grass: PIONEER® 11G22	Improved ensiling success and less heating with immature, less lignified grasses.
Challenging Ensiling Conditions or major issues with heating		
RAIN	PIONEER® 1188	Pure homofermentative Bacteria convert available sugars effectively to Lactic Acid and this ensure a rapid acidification.
30°C HEATING	PIONEER® 11A44	Controlled release of Acetic Acid by pure heterofermentative Bacteria to inhibit yeast growth.

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