BIO-SIL®

Silage additive

Maize silage

A·B·CERT

CERTIFIED DLG EXCELLENT ✓Origin ✓Ingredients ✓Production ✓Taste DLG Control-No. AN011111

IFTA AG Natürlich. Für Zukunft.

DLG TestService

GMP+ Feed Safety Assurance

BIO-SIL® is a sublimated bacterial culture consisting of the homofermentative Lactic Acid Bacteria, Lactobacillus Plantarum DSM 8862 and Lactobacillus Plantarum DSM 8866 strains. Every batch of **BIO-SIL®** is tested twice for bacterial quantity and activity prior to shipment. These highly effective strains are specially selected naturally occurring bacteria that have not been altered or genetically modified in any way, therefore **BIO-SIL®** inoculant is also approved for organic status forage preservation. An inoculation rate of 300,000 cfu / gram of fresh material is sufficient to ensure stable fermentation if applied correctly.

BIO-SIL® is supplied in 100-gram aluminium foil packs with each bag being sufficient to treat 100 tonnes of fresh silage material. This dosing rate will ensure the correct 300,000 cfu/ gram application is achieved. Each pack should be dissolved into 100 litres of un-chlorinated fresh water. Where un-chlorinated water is not available, **BIO-SIL®** offer the Chlor-ex additive to counteract the effects of chlorine on the bacterial culture. If preferred, each 100g pack of **BIO-SIL®** can be dissolved in just 10 litres of water with application rate reduced to just 0.1 litres per tonne of maize silage.

Is it beneficial to use high productive DLG tested lactobacillus on maize silage?

- ✓ The naturally occurring lactobacillus bacterial populations that are found on maize plants are subject to wide fluctuations.
- ✓ The ability of the naturally occurring lactobacillus bacteria to rapidly produce lactic acid is also extremely variable.
- ✓ The naturally occurring bacterial populations variability is independent of crop variety, ripeness, crop rotation or growing conditions.
- ✓ Maize silage naturally has a high proportion of fermentable carbohydrates which means even poor bacterial populations will produce a drop in pH.
- ✓ In 80% of cases, the naturally occurring bacterial population is insufficient to achieve a rapid drop in pH (less than 3 days).
- ✓ The addition of highly productive lactobacillus bacteria in **BIO-SIL®** is essential to ensure rapid pH drop, reduce losses and preserve a high quality maize silage.

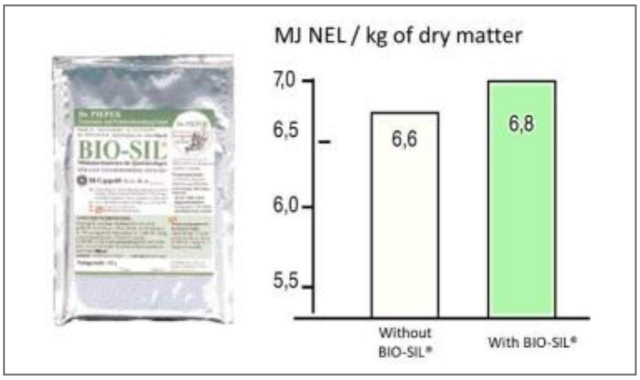
What are the advantages of using **BIO-SIL®** *in maize silage?*

- Rapid decrease in the pH value – a stable pH is reached in 1-2 days
- Reduction in dry matter losses by around 5%
- Increase in digestibility by up to 3%
- Increase in energy value by up to 0.3 MJ NEL / kg CM – Pic 1
- Improved palatability and increased milk production – by at least 1kg/cow/day
- Reduction in heating of clamp during fermentation by around 5°C reducing the loss of nutrients and increasing storage stability.
- Increased lactic acid content and a strong reduction in acetic acid fermentation, especially in wet silage with dry matter of only 30%. Reduced acetic acid levels give increased forage intake as the silage is more appetising.
- Silage treated with **BIO-SIL®** can be fed out after only 5 days in the clamp

These benefits can only be fully achieved if good silage making techniques are employed:

- Rapid filling of the clamp
- Intensive compaction
- Fast and effective sealing of the clamp
- Sufficient feed out – at least 1.5m per week during winter and 2.5m during summer

Picture 1



More Milk – More Biogas

There are two types of lactobacillus bacteria; homofermentative which produce only lactic acid and heterofermentative which produce both lactic acid and acetic acid. A great advantage of homofermentative lactobacillus bacteria over heteroenzymatic bacteria is a relatively low level of fermentation losses. Not only are dry matter losses reduced by 2% but an increased energy value of around 0.2 MJ NEL / kg LM can also be achieved. As a result more energy is available for the production, giving up to 33kg more milk during feeding period or 5% more biogas (table 1). The biogas yield calculation from the maize silage is based on the measurements of energy required for the production of milk production in MJ (KRIEG, 2002).

Table 1

Corn mass with 33% CM, kg Dry weight (CM), kg	1000 330	
	With BIO-SIL®	Without BIO-SIL®
Fermentation losses,% of dry matter	2,0	4,0
Loss during fermentation, kg of dry matter	7	13
Remaining dry matter minus fermentation losses, kg of dry matter	323	317
The energy value, MJ NEL / kg of dry matter	6,8	6,6
Total energy content, MJ NEL / 1000 kg of corn silos	2196	2092
Relative,%	105	100
Difference from untreated mass, MJ NEL / 1000 kg of corn silage	+104	

33kg more milk
5% more biogas

For every 1 euro spent on BIO-SIL® there is an additional profit of 12 to 16 euros from increased milk yield or increased biogas yield.

Improving the quality of silage

Silage quality is an essential factor in the productivity, and a major cost, of milk production. Quality silage is characterised by high digestibility of nutrients, which contributes to an increase in the dry matter consumption by cows. From a nutritional and physiological point of view, the dry matter of maize silage should not exceed 40%.

A move to lower dry matter silage can provide the following benefits:

- high digestibility at the point of harvest;
- reduced fungal infestation on the maize crop;
- better clamp compaction;
- early release of land for subsequent cropping.

In conclusion: Lower dry matter maize silage can lead to better milk yield. To avoid excessive effluent production, the following restrictions should be applied, see table 2

Table 2

Stack height, m	Limiting indicator of dry matter content,%
1	28
3	30
5	32

To produce good quality stable maize silage, butyric fermentation must be avoided. Acetic fermentation also needs to be controlled with acetic acid levels below 0.5%. Levels of acetic acid of just 0.5% to 1.0% have been shown to reduce dry matter digestion in dairy cattle (HOFFMANN: 1997) Maize silage should not contain more than 20% crude fibre and should have energy values of more than 6.5 MJ NEL / kg CM.

High cut level

By harvesting maize with a high cut height – just 100mm below the lowest cob – it is possible to:

- increase the dry matter content by 2-3%
- reduce the crude fibre by 1-2%
- reduce the ash content by 1%
- reduce mycotoxins as lower leaves are left in the field;
- increase the energy levels by 0.1-0.3 MJ NEL / kg LM;
- increase dry matter consumption by at least 1kg/cow/day in diets with high maize content.
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Picture 2

Stubbles up to 400mm high can be readily ploughed after harvest but for taller stubbles an intermediate cultivation (such as heavy discs) or mulching may be required.
Picture 3 shows sections of maize stalks cut at a height of 200mm to 500mm above the ground level. It can be clearly seen that these sections of the crop are not suitable for feeding high yielding dairy cows.

Picture 3

Table 3

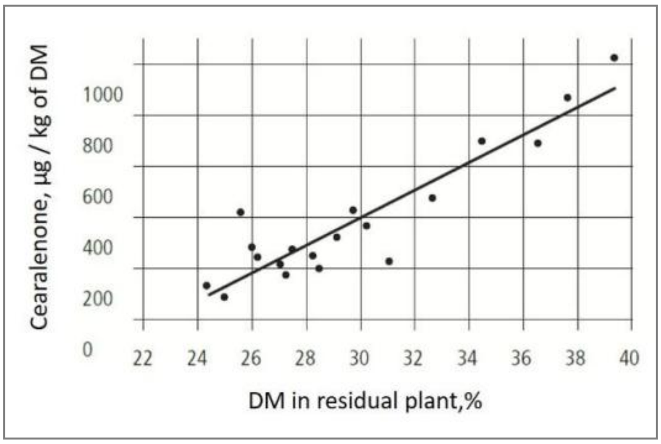
Parameter		Corn stalks, 20-50 cm	Corn stalks, 30-50 cm	Silage corn mass after high cut
Dry matter	g / kg	205	242	380
Crude ash	g / kg of DM	61	69	43
Crude protein	g / kg of DM	43	47	82
Crude fiber	g / kg of DM	336	339	177
Starch	g / kg of DM	-	-	277
Sugar	g / kg of DM	202	157	80
Crude fat	g / kg of DM	3,7	-	37,4

The stalks of maize are low in dry matter and high in crude fibre. High cut maize silage contains a higher energy density than traditional harvesting techniques and forage consumption is also increased by 1kg per cow per day. Therefore the overall intake of crude fibre remains similar for high cut and traditional maize silage. This increased density and intake more than compensate for the overall silage yield reduction of a round 6%.

Using the high cut system, harvesting can start earlier in the season as the upper parts of the plant reach the target dry matter of 28% to 32% before the stalks. The stalks left in the field will have a dry matter of only 18-20% at the same point. At this point the stalks only have an energy content of between 4.7 and 5.3 MJ NEL/kg CM. Delaying cutting until the stalks reach the target dry matter levels sees the energy value fall below 4.3 MJ NEL/kg CM (WEISSBACH, AUERBACH 1999)

Studies on the presence of the mycotoxin ceralenone also favour high cut harvesting. Produced by fusarium fungi, ceralenone levels on the crop stems increase as the dry matter levels rise as shown in pic 4.

Picture 4



Fermentation control for maize silage

The use of **BIO-SIL®** homofermentative lactobacillus bacteria to achieve higher energy concentrations (0.2 MJ) and higher feed intake (0.5-1 kg/cow/day) are common practice in many successful dairy enterprises using lower dry matter maize silage. This type of silage is more susceptible to acetic acid fermentation so the addition of a suitable inoculant is vital to produce high quality silage.

BIO-SIL® can be used in combination with Urea to aid aerobic stability on the surface of maize silage.

Cover for maize silage

In order to produce high quality maize silage it is extremely important that the clamp is well compacted and effectively sealed. For this we recommend our high performance Wepelen Multisilofolie 500 in combination with a "cling-film" membrane.

Wepelen Multisilofolie 500

- Can be used for 5 years minimum
- Creates protection from rainfall and birds
- Low oxygen permeability
- Can be walked on

The use of Wepelen Mulitsilofolie 500 does not eliminate the need to correctly weigh down the entire surface (with for example old tyres). Particular attention should be paid to the edges of the clamp to ensure airtight seals.

Lining film "super-stretch" green (cling film)

- This is close fitting to the surface of the silage and significantly reduces gas exchange on the clamp.
- Provides protect against contamination form the top sheet.

Preventing formation of brown layers in Maize silage

Aerobic stability of maize silage

According to the results of tests carried out by the German Agricultural Society (DLG) there is currently no inoculant that can promote fermentation, feed intake, milk production, reduce losses during ensiling and significantly improve aerobic stability of silage.

Heterofermentative bacteria inoculants lead to the production of not only lactic acid but also significant amounts of acetic acid. Whilst helpful in counteracting yeast and mold and offering better preservation once the clamp is opened, it remains impossible to control the duration and intensity of the acetic acid production during fermentation (GRASSLER 2002) This leads to increased losses during ensiling as the fermentation is less efficient. In addition the strong odour associated with higher acetic acid levels makes silage less appealing to cattle leading to reduced intake.

The key activities to control aerobic stability are detailed below:

1. Aerobic stability control measures
    - Effective sealing of the clamp
    - Use of oxygen barrier films
    - Ensure feed out rate is at least 1.5m/week in winter and 2.5m/week in summer
    - Only expose the silage to be fed out.

2. Duration of storage

New research results have shown that when **BIO-SIL®** is used, aerobic stability also increases with storage time. If silage is opened after 90 days (compared to 30 days) then the period of aerobic stability is increased by one day.

The importance of acetic acid

Three years of testing in Switzerland (WYSS 2002) has found no correlation between acetic acid, lactic acid and the aerobic stability of silage from a variety of maize cops. It can be concluded that introducing heterofermentative bacteria to increase acetic acid levels has no beneficial effect on aerobic stability. It can also be concluded that high levels of lactic acid do not have a negative effect on aerobic stability of maize silage.

Frequently asked questions

At what dry matter percentage for the kernal and stem of the maize plant does the optimal harvesting period start?

The optimal harvesting period depends on the proportion of cob to stem but with a traditional cutting height of 200 to 300mm this occurs at 30% to 36% (whole plant) and with the high cut technique from 33% to 40%. The optimal dry matter for the maize kernals is 55% to 60%. At any higher dry matter the proportion of undigested grain increases. Maize silage with a high dry matter should only fed after a long storage period as the crushed kernals can become more digestible by absorbing more moisture.

Is it possible to predict the harvest date?
Yes, in two steps

Firstly define the current dry matter content of the plant (assume 25%)
Secondly by evaluation of the daily growth of the dry matter content as follows:

$$= \left(\frac{\text{max. daytime temperature + min. daytime temperature}}{2} - 6 \right) \cdot f$$

where f =0,06 with, on average, good corn stalk

f =0,07 when all the leaves are still green and there is enough moisture in the soil

f =0,05 when some of the leaves have already dried up and there is not enough moisture in the soil

Example $\left(\frac{26 + 14}{2} - 6 \right) \cdot 0{,}06 = 0{,}84$

In this example the daily growth in dry matter content of the maize kernal will be 0.84%. The daily increase in dry matter for the whole plant will be around half this figure: 0.42%. Therefore after about 12days, the dry matter content of the whole crop will increase from 25% to 30% (25 + (12 x 0.42) = 30.05). If the weather changes the a re-assessment is required. The detailed data on maize silage ripeness management can be found in research by Amler (AMLER 2005)

When should drought damaged maize be harvested?
If the entire stem is damaged and has little or no cob formation, harvest should be carried out when about 30-50% of the leaves have turned brown. Any further yield increase is unlikely and the crop is at risk of mold damage. In crops suffering varied drought damage due to varying soil conditions, the harvest should be carried out when the bulk of the undamaged crop reaches 30% dry matter. If the risk of fungal infestation increases the harvest should be carried out immediately.

How should drought damaged maize be ensiled?
If the crop has not formed cobs, then the dry matter content will be very low as the main dry matter component of the yield is the plant cob. The fermentable fraction of the crop will be mostly carbohydrates as the plants contain mainly sugars with very low starch. Fermentation in these conditions often produces high levels of acetic acid and large volumes of effluent. The use of **BIO-SIL®** will promote lactic acid fermentation leading to lower losses, less effluent production and increased palatability of the silage.

Is the sugar in dry maize suitable as a substrate for lactobacillus?
Yes, relatively high dry matter whole crop maize silage (38% dry matter and 33% starch) still contains a sufficient amount of sugar – 88g/kg dry matter. In addition, the crops own enzymes together with the natural epiphytic flora will break down some of the maize starch and release sugars. This enzymatic process stops at low pH levels and the elimination of oxygen.

Is it possible for lactic acid to form in extremely dry forage?
The main parameter is not the dry matter content in the silage but the osmotic pressure of the silage clamp. (ZIERENBERG 2000) Bacteria do not die from a lack of water (there are bacteria that can survive on very dry substrates), but from an increase in osmotic pressure. The strains contained in **BIO-SIL®** are highly osmotolerant and can be used on silage with even 70% dry matter content.

Does maize smut affect quality of the silage?
Bubble smut reduces the energy value of maize silage and negatively affects the palatability

What special attention should be taken when feeding out maize silage?

The silage must be cut smoothly from the face using a silage shear grab or cutter. The covering film should be moved at the daily feed out rate. The top sheet may be pulled back 2m (or once a week) whilst the oxygen membrane or cling film should only be cut back to suit each daily use. The covering film must be weighted to maintain close contact with the surface of the silage. This prevents gas exchange and flushing of the lactic acid by rainfall.

Can a silo be too clean?

Certainly not, a clamp is never too clean. Maize silage is a rich source of easily fermentable nutrients which if not kept clean, are quickly attacked by intestinal bacteria and deteriorate. At the same time, various toxins are formed that contribute to the development of mastitis and hoof disease in cattle. Feeding hygiene starts at the silo.

Silage clamp layout: what is the idea size?

Herd size and diet composition are critical in determining the clamp size. Based on a high maize diet with 30kg fresh weight per day (10 kg DM / cow/day) and a herd of 200 cows, 6 tonnes of maize silage will be required per day.

Feed out should be at least 300mm per day so with a silage density of 700kg/m³ we get 210 kg silage per m² - sufficient for 7 cows per day. Therefore we need 30m² per day for 200 cows is required.

A silage clamp 10m wide and 3.0m high has a face area of 30m². A feed out rate of 2m per week gives 42 tonnes per week – corresponding with the 6 tonnes per day or 30kg/cow/day requirement. For year round maize silage feeding we need a total clamp length of 100m.

Table 4

Number of cows	Maximum cutting area, m^2 at 2 m / week advance	Silo width	Silo height, m
50	8	6	1,3
100	15	10	1,5
200	30	15	2,0
600	90	25	3,6

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