mination numbers. For this reason the DLG quality mark is granted for the effect of the preparations and not for the germination number within the framework of the tests.

Is the number of bacterial strains or species important for the efficiency of the bacterial cultures?
No. The effect of cultures is being tested. It does rarely happen that a high-performance strain of *Lactobacillus plantarum* achieves a better effect than a mixture of 5 different lactic acid forming strains.

We often hear of enzymes in lactic acid bacteria preparations. What does it mean?
Enzymes, such as amylases, cellulases and others are able to spilt polymolecular carbohydrates, thus making them easily available to lactic acid bacteria. Nevertheless, their use is disputed amongst scientists. For instance, they criticize that additional plant cells are destroyed by enzymes which may result in an increased production of effluent, thus in increased losses. Furthermore, enzyme additions make the product more expensive, however, the economic benefit could not be exactly shown until now. We think that the addition of enzymes is not necessary at present if all known techniques of a specialized silage production are praticed.

Shall the liquid application of lactic acid bacteria be preferred compared to granulates?
Liquid as well as granulated products showed their efficacy in DLG tests. The application of granulates often seems to be easier since the availability of water can be dispensed with. However, this is just a matter of organization and it can be solved easily with all types of liquid dosers. Another disadvantage is, that the granulates are more uneven distributed in the ensilage material than the liquids. In addition the inoculated, granulated lactic acid bacteria must then be brought into an effective form by the moisture of the ensilaging material.

Fig. 3 Effectivity of biological additives in gras silages (Richter and Büchele, BLW 16, 31-33, 2000)

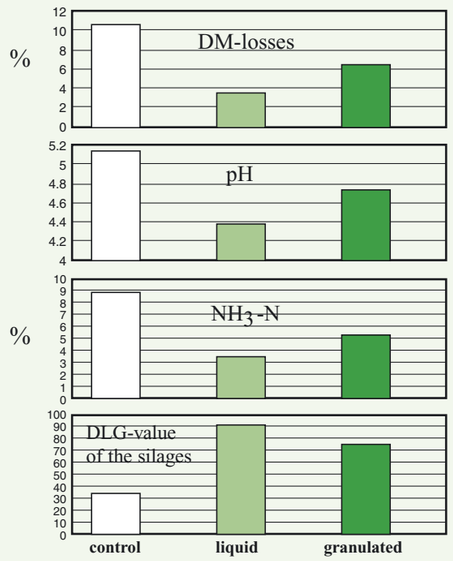


Figure 3 shows the influence of application form liquid or granulated on dry matter losses, pH drop down and NH_3-N content. These are results from recent studies. The scoring of DLG (100 is maximum) shows the benefit of the liquid versus the dry inoculants.

First results of Zierenberg (table 4) demonstrates, that the BIO-SIL® product reduces the concentration of the undesired Enterobacterias, described as their metabolism products, the Endotoxins. These biotoxins may cause diseases as mastitis and others.

Tab. 4: Reduction of the Endotoxin concentrations by BIO-SIL® (%)
In ryegrass- and red clover silage (Zierenberg, 2000, unpublished)

	Ryegrass	Red clover
Control	100	100
BIO-SIL®	**23**	**7**

To sum up we think that the liquid application should be preferred since it implicates considerable advantages compared to granulates.

Why do you prefer homofermentative rather than heterofermentative lactic acid bacteria?
With homofermentative bacteria we ensure a high feed intake because of lower contents of acetic acid. Cows do not like the pungent smell of acetic acid. Furthermore the homofermentatives show the smallest losses of dry matter.

Is there a positive effect on protein by the use of BIO-SIL®?
Yes, the protein degradation is lower, and therefore the protein quality of the silage is better. This is caused by the rapid decrease of pH (less than 3 days) which prevents the activity of the proteases.

Can the use of BIO-SIL® be recommended for all ensiling systems (AG BAG plastic bag, bunker silo, clamps, bales)?
The principle of the fermentation process is independent of the ensiling system. The optimal effect of BIO-SIL® can only be achieved if principles of a good ensiling technology are practiced during all phases of silage making.

Is the use of BIO-SIL® useful in all ensiling materials?
In principle, yes. The bacterial strains of BIO-SIL® have a very good effect in wet silages due to their very high multiplication rate. Moreover, their osmotolerance is very high and they multiplicate very fast and have a very good effect even if they are applicated to high dry matter forages.
An assured effect can be expected at :

- Legumes up to about 55 % dry matter
- Gras, WCS up to about 60 % dry matter
- Maize silage up to about 60 % dry matter
- Ear mais silage and CCM up to about 70 % dry matter

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LITERATURE: Allert, H.; Pieper, B.; Klabunde, H.-G.; Schuster, F. u. Poppe, S.: Vorrichtung zur Dosierung flüssiger Dosierzusätze, Patent DD 276 931, 1987
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ACTIVE LACTIC ACID BACTERIA FOR TOP SILAGE

BIO-SIL® ... FOR SILAGE, THAT TASTES DELICIOUS!

1. What's BIO-SIL® ?

BIO-SIL® is a freeze-dried bacterial culture consisting of the homofermentative strains *Lactobacillus plantarum* DSM 8862 (1) and *Lactobacillus plantarum* DSM 8866. Under defined circumstances they can produce also small amounts of acetic acid. An inoculation rate of 300,000 cfu (2)/ gram of ensilage material is guaranteed if applied correctly. Before delivering the number and the activity of the bacteria in the product are tested twice as an insurance of quality control. These high performance strains of lactic acid bacteria were isolated from nature. They haven't been modified genetically. Thus BIO-SIL® can be recommended for an intensive milk production and it is also suitable for the organic farming (controlled and certificated by Alicon GmbH, D-73728 Esslingen).
BIO-SIL® has been DLG (3)-approved in the categories 1 b, 1 c, 4 b and 4c.
1 b: Improvement of fermentation in moderate ensilable forages in DM range ≤ 35 %, forages with sufficient fermentation substrate (grasses, legumes, maize silages, whole crop silage [WCS])
1 c: Improvement of fermentation in easy ensilable forages in DM range 35–50%, forages with sufficient fermentation substrate (grasses, legumes, maize silages, whole crop silage [WCS])
4 b: Improvement of digestibility
4 c: Improvement of milk yield

2. Application instructions

BIO-SIL® may be dissolved in water immediately before being applied. BIO-SIL® is supplied in 100 g packages in aluminium bags. This quantity is dissolved in 100 l non-chlorinated water, sufficient for 100 t ensilage material (1 g BIO-SIL® per t ensilage material). Whenever water is chlorinated we recommend our product **Chlor$_{ex}$**.
Preferably, the liquid bacteria cultures are applied with the forage harvester (injection before the chopper chamber), self loading forage trailer (injection on the material flow over the pick up) or the AG BAG machine directly over the pressing rotor. In all cases an even distribution of the cultures in the ensilage material is achieved. Automatic, all-electronic dosing devices depending on the mass flow rate of the forages are available for application. They guarantee an easy, universally tested and safe handling of the product.

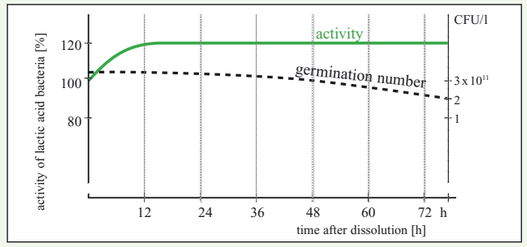
Is it possible to decrease the liquid quantity per ton of ensilage material in the forage harvester ?

Due to the ideal distribution the liquid quantity may be reduced to about 0.4 l per tonne of ensilage material. It is not necessary to refill it during one day. If the liquid quantity is reduced, the bacteria concentration must be increased accordingly.

How long keeps this inoculant well ?

The durability of the inoculant (suspension) is very important for the use on the farm. Our measurements concerning the lactic acid bacteria activity resulted in an ensured activity up to at least 72 hours (see also fig. 1). Compared to the DLG approval scheme in which the inoculant is tested after a swelling period of about 1 to 2 hours the activity of BIO-SIL® increased to 120 % after 12 hours and maintained up to at least 72 hours. This implicates that the bacterial solution can be used for at least 3 days without any reduction in activity of living bacteria. Practically, this is very important (short-term interruptions in case of bad weather, breakdown of machinery, etc.). However, the temperature in the solution should not exceed 24°C over a longer period.

Fig. 1: Activity and number of lactic acid bacteria in the inoculant as a function of time after dissolution



How long is the freeze-dried product durable?

When stored in a refrigerator (4 - 6°C) the storage time is at least 1 year and 2 years at minus 18°C.

3. Why is the addition of efficient DLG tested lactic acid bacteria as BIO-SIL® useful for the production of high-quality silages?

The epiphytic lactic acid bacteria population on plants is characterized by a huge variation. Moreover, especially the first cut on gras and whole crop silages are infected by a variety of other undesired microorganisms like yeasts and moulds (see table 1).

Table. 1: Microorganisms on the forage and their demands to develop

Microorganism	Oxygen demand yes	option.	no	Activity limit for pH	Suppression by
Lactic acid bacteria			×	3.6	-
Butyric acid bacteria			×	4.2	rapid pH value decrease to pH 4 by inoculant addition
Enterobacteria		×		4.3	
Yeasts		×		2.2	Measures against post fermentation
Bacillus species	×			4.5	Oxygen removal
Mould fungi	×			3.0	

Source: H.Jeroch,G Flachowsky, F.Weißbach: Futtermittelkunde; Jena/Stuttgart 1993, amended

- The ability of lactic acid bacteria to produce fast much lactic acid varies a lot. This ability can neither be related to species or types, nor to maturity stages, crop rotations, fertilizers or fertilization intensity; thus it can't be defined precisely.
- In about 80% of all cases the natural lactic acid bacteria population is not sufficient in order to achieve a fast drop down of pH value (in less than three days). This applies also to maize silage although maize silage is rather easy ensilable due to a high amount of fermentable carbohydrates.
- The addition of active lactic acid bacteria as BIO-SIL® is an important implication for the production of top silages.

(1) DSM (**D**eutsche **S**ammlung von **M**ikroorganismen und Zellkulturen = German collection of microorganisms and cell cultures)
(2) colony forming units
(3) **D**eutsche **L**andwirtschafts **G**esellschaft = German Agricultural Society

4. What are the specific advantages and effects of using BIO-SIL® at ensiling ?

- Fast drop down of pH value (a stable pH value is achieved after 1 to 2 days, where yeasts and moulds are rapidly eliminated)
- Reduction of protein degradation
- Reduction of the dry mass losses by up to 5 % (depending on the type of forage)
- Increase of digestibility by 2 to 3 %
- Increase of energy concentration by 0.2 to 0.3 MJ NEL/ kg of dry matter
- Increase of forage intake (0.5 to 1.5 kg per cow and day)
- Increase of yield milk of about 1 liter per cow and day
- Reduction of heating during the ensilage process by about 5 °C, thus lower nutrient losses and increased storage stability.
- Increase of lactic acid content and strong reduction of acetic fermentation, particularly in wet silages (hence, a higher forage intake)
- BIO-SIL® treated forage may be already fed after about 7 days.

Benefits may only be achieved if the principles of a good ensiling technology are practiced during all phases of silage making:
- Fill the silo rapidly,
- Pack it properly
- Best covering with 2 plastic sheets
- Ensure a proper feed out rate (winter 1.5, summer 2.0 to 2.5 m/week)

Results from DLG tests

Fig. 2: Energy concentration

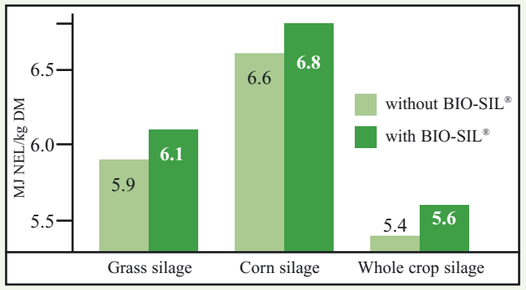


Table. 2: Fermentation parameter and dry matter losses

	moderate ensilable forages (test 1b)		easy ensilable forages (test 1c)	
Parameter	Without BIO-SIL®	With	Without BIO-SIL®	With
Dry matter %	27	29	33	33
pH	5.2	4.4	4.3	4.0
Lactic acid % in FM	0.88	1.58	2.21	2.73
Acetic acid % in FM	0.30	0.26	0.52	0.40
Butyric acid % in FM	0.66	0.19	0.09	0.01
Propionic acid % in FM	0.10	0.02	-	-
Alcohol % in FM	0.27	0.15	-	-
NH_3-N in % of total-N	19	7	6	3
Dry matter losses	5.7	3.8	4.8	3.7

5. Economic considerations on the use of BIO-SIL®

The following calculation bases on an increase of energy content (+0.2 MJ NEL/kg dry matter), an increase of dry matter intake (+0.5 to 1.0 kg dry matter per day) and an increase of milk yield (1.7 to 2.7 kg/cow and day), which has been shown in different trials as well as on farm level. A rather high benefit can be achieved by the use of BIO-SIL® although the proven reduction of nutrient losses was not taken into account.

Table 3: Benefits achieved by the use of BIO-SIL®

Example		Control	1	2
Settlement with natural bacteria		high	high	low
Treatment		without	with BIO-SIL®	with BIO-SIL®
Silage intake	kg fresh matter/day	34.3	35.7	37.1
	kg DM/day	12.0	12.5	13.0
NEL	MJ/kg DM	6.3	6.5	6.5
	MJ/day	75.6	81.3	84.5
Milk yield from silage (3.3 MJ NEL/kg milk)	kg/cow and day	22.9	24.6	25.6
Difference in milk yield	kg/cow and day		+1.7	+2.7
Additional output (kg milk x 0.3 €)	€/cow and day		0.51	0.81
	€/cow and 305 days		156.70	246.80
Input for BIO-SIL® (0.9 €/t and approx. 35 kg silage/cow and day)	€/cow and day		0.032	0.033
	€/cow and 305 days		9.80	10.20
Benefit (Additional output - input)	**€/cow and 305 days**		**146.90**	**236.60**

6. Questions often asked by the users when applying BIO-SIL®

How often must the liquid dosing device be cleaned?
The dosing device should be thoroughly cleaned once per week and at the end of the season.

Must corrosions be expected on agricultural machinery by BIO-SIL®?
No.

Why is the inoculation concentration of BIO-SIL® 300,000 cfu/g ensiling material and not 1,000,000 cfu/g?
Not only the inoculation concentration is important for a successful silage but also the efficiency and activity of the lactic acid bacteria. There is a great number (thousands) of lactic acid forming strains with different properties and activities. When selecting, developing and producing an inoculant, it is the know-how to select strains with a high efficiency (fast lactic acid fermentation, broad utilization of various sugars....) which develop a high activity also under sub-optimum conditions. Physiological properties (such as activity and rate of survival in the inoculant) play also a big role.
By a specific selection and production technology-related treatment of the strains it is possible that a high-performance bacterial culture such as BIO-SIL® achieves the same or even better effect than cultures with other strains or much higher ger-