



Grass Silage Handbook



Guide to successful grass ensiling



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This grass silage handbook covers all the main management factors for the production of top feed quality grass silages.

The target values for the main parameters of top-quality grass silage are shown below.

Requirements for grass silages

Parameter		Target Value
Dry matter	%	28-35
pH value (function of DM)		4.0-4.8
Sugar	% DM	< 4
XP	% DM	14-18
XF	% DM	23-26
NDF	% DM	42-48
XA	% DM	< 10
NH₃-N	% of total N	< 8
ELOS	% DM	> 68
Gas formation	ml/200 mg DM	> 50
Energy Density	MJ NEL/kg DM	> 6.2



Note: high silage quality is the basis for top production performance

2. Grassland maintenance

As well as routine spring jobs like levelling and rolling, proper grassland maintenance also includes appropriate fertilizing and regular reseeding in spring or autumn.

The sward is exposed to a number of possible sources of damage in the course of a year's use. Things like intensive use, late cutting, outwintering damage, rodent attack, damage by footsteps and damage by vehicle tracks can all cause undesirable gaps in the green sward. Both DM yields and energy concentrations decline over the course of the year.

Regular reseeding, mainly with German ryegrass varieties, maintains the high quality of the grassland. This is the way to produce top-quality basic feed with high energy density. The analyses by the Lower Saxony Regional Chamber of Agriculture are provided below for reference.

Energy concentration in grass silages made from old grass and new grass sward

(mean values from 4 cuts, new grass sward = annual reseeding with 12 kg grass seed/ha)

	2004	2005	2006	2007	2008
Old grass sward NEL MJ/kg DM	5.7	5.9	6.0	5.9	6.1
New grass sward NEL MJ/kg DM	5.8	6.0	6.4	6.3	6.4
Average quantities harvested, 2004-2008					
Old grass sward	82 dt DM/ha				
New grass sward	97 dt DM/ha				

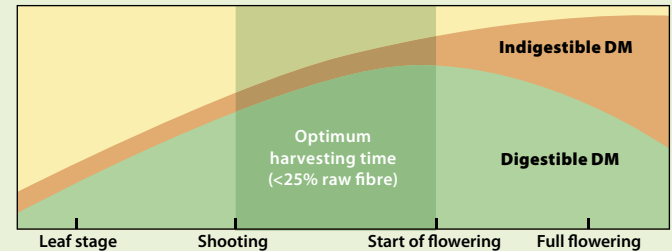
Source: Albers 2009

Note: reseeding is one of the standard maintenance operations to ensure high-quality grassland resources.

3. Cutting time

The ideal time for cutting is shortly before heading/panicle initiation of the main grasses. At that stage they have a raw fibre content of < 25% in the DM. After that, lignin storage increasingly impairs the digestibility and feed intake. With extensively managed herds this happens faster because of the higher proportion of grass stalks. In this case the cutting time intervals are even shorter.

Grass dry matter digestibility trend during the vegetation phase



- During the main vegetation phase of the first growth cycle the raw fibre content increases by 3-8 g/kg FM/day. After that, a cow's theoretical performance potential drops by 150 kg milk per year.
- The optimum raw protein content is 16-18% of the DM with the lowest possible level of free nitrogen compounds, which can have a buffering effect during ensiling.
- An early first cut establishes the basis for the high quality of all subsequent cuts.

Note: quality, not quantity, per cut increases the annual milk yield.

4. Cutting height

The minimum cutting height is 6-7 cm. It may be higher than that, depending on the state of maintenance and level of rodent infestation. If this value is adhered to, the sward will be better preserved when subsequent operations are carried out.

The minimum cutting height:

- Promotes rapid grass re-growth.
- Reduces the dirt tare and thus improves the energy content.
- Reduces undesirable spore inclusion.
- If cut when too short, the desirable grasses can be supplanted by less valuable growth.

Degrees of damage to different grass varieties when cut very short

Severe		Decreasing degree of damage				Slight
Cocksfoot	German ryegrass	Red clover	Alfalfa	Smooth-stalked meadowgrass	White clover	
Meadow fescue		Timothy	Rough-stalked meadowgrass		Couch grass	

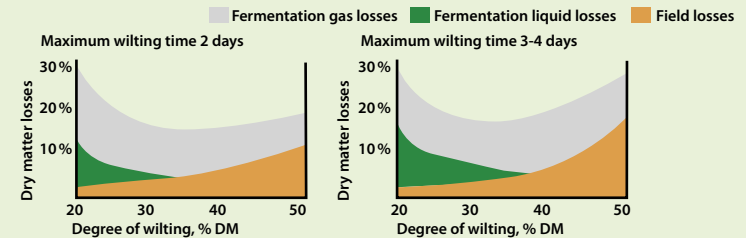
Source: according to Fisch, Bühr 2008

Note: cutting in more rapid succession and more exploitation with less sward damage will lead to a sustainable long-term improvement in the grass stock.

5. Wilting

Rapid wilting to 28-35% DM permits optimum ensiling with low losses and high feed intake (40-45% DM in the ration). If the silage is too wet, this leads to butyric fermentation, whereas if the silage is too dry, it is difficult to compact and inclined to spoil.

Relationship between degree of wilting and losses



- The aim of correct wilting is to maximise the carbohydrates for optimum ensiling.
- The wetter the silage (< 30% DM), the more the ensiling process is buffered and the higher the risk of contamination. That is why special products like BONSILAGE FORTE are needed here to avoid butyric fermentation.
- The 30-40% DM range is where the energy content, optimised ensiling and preventing spoilage are most significant and that is why using BONSILAGE PLUS is recommended here.
- At values of 45-50% DM and more, correct compaction can no longer be carried out.

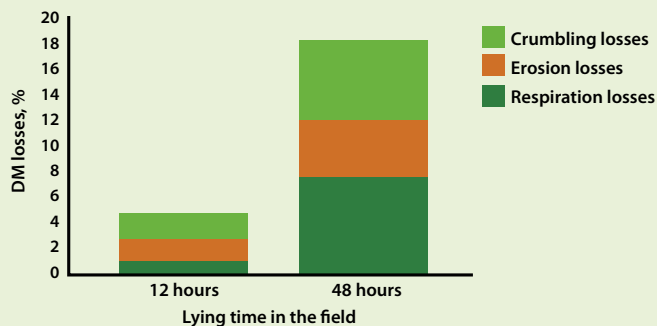
Note: rapid wilting is the basis for minimal losses and optimum yield.

6. Lying time in the field

The lying time in the field should be less than 24 hours in order to keep energy losses as low as possible. Every additional night leads to sugar consumption through respiration.

The weather risk (rain) is reduced.

Dry matter losses as a function of time in the field



Short lying times in the field:

- Reduce losses due to respiration, crumbling and erosion.
- Avoid carbohydrate losses and promote the ensiling process.
- Improve the energy density and digestibility.
- The use of mower-conditioners speeds up wilting. In warm weather the optimum crop DM content is soon exceeded.

Note:

a short lying time in the field optimises the energy yield per hectare.

7. Chop length

Optimum chop length for grass silage: 30-40 mm

Too long chop lengths make compaction more difficult.

The knives and contra-rotating blades should be sharpened at regular intervals.

The optimum chop length is essential for:

- Precision compacting, more efficient use of the silo space and lower losses.
- Better plant cell decomposition and thus more intensive, faster lactic acid fermentation.
- Reduced gas exchange on opening the silo and thus lower risk of subsequent fermentation.
- Improved feed uptake.



Note: the optimum chop length is the basis of good compaction, intensive fermentation and high feed uptake.

8. Ensiling additives

Besides the basic rules of ensiling, ensiling agents work in different ways to assist the fermentation process



The proven basic product



Group 1b

Active ingredients: homofermentative lactic acid bacteria
Aim of use: optimum course of fermentation, higher energy density, better feed performance
Area of use: grass, clover-grass, alfalfa, green rye, TPS, 22-45 % DM
Pack size: granules 25 kg, liquid 50 g
Dose/t: granules 0.5 kg, liquid 1 g
Recommended compaction: at least 180 kg DM/m³
Minimum storage time: 2-3 weeks



For greater stability and energy



Groups 1c, 2, 4b

Active ingredients: Combination of homofermentative and heterofermentative lactic acid bacteria
Aim of use: rapid lactic acid formation, more digestible energy, aerobic stability
Area of use: grass, clover-grass, alfalfa, green rye, TPS, > 30 % DM
Pack size: granules 25 kg, liquid 50 g
Dose/t: granules 0.5 kg, liquid 1 g
Recommended compaction: at least 180 kg DM/m³
Minimum storage time: 6-8 weeks



The silage professional for wet silage



Groups 1b, 5a

Active ingredients: homofermentative lactic acid bacteria
Aim of use: rapid, stable lowering of the pH value, use of the entire hydrocarbon spectrum, inhibition of Clostridium growth
Area of use: ryegrass 18-35 % DM, other grasses 22-35 % DM, clover-grass 25-35 % DM, alfalfa 30-35 % DM
Pack size: granules 25 kg, liquid 100 g
Dose/t: granules 0.5 kg, liquid 2 g
Recommended compaction: at least 180 kg DM/m³
Minimum storage time: 2-3 weeks



The specialist for sugar-rich grasses

NEW

Active ingredients: Combination of homofermentative and heterofermentative lactic acid bacteria
Aim of use: reduction of the residual sugar content by targeted conversion of the plant sugar into stable-value fermentation acids, controlled formation of acetic acid to protect the nutrients from losses due to heating up
Area of use: grassland and ley with a high proportion of sugar-rich (tetraploid) grasses and > 30 % DM
Pack size: liquid 50 g
Dose/t: liquid 1 g
Recommended compaction: at least 180 kg DM/m³
Minimum storage time: 6-8 weeks

All BONSILAGE products are approved for use in organic farming.

9. Dosing technology



A highly effective combination for specific silo protection

Active ingredients: active ingredient combination of potassium sorbate, sodium benzoate and sodium formiate

Aim of use: low-loss silo surfaces and silo edges, discourages mould and yeasts, rapid protective action, easy to use

Area of use: surfaces and edges of silage clamps

Pack size: 25 kg

Dose: grass/maize silage, etc.: 200 g/m² or 2 kg/t
Industrial byproducts (e.g. brewer's grain, draff): 300-500 g/m² or 2-5 kg/t



The liquid alternative for complete treatment

NEW

Active ingredients: active ingredient combination based on sodium benzoate and sodium acetate

Aim of use: inhibiting yeasts and mould, low-loss silo surfaces; complete treatment effectively prevents heating up (non-corrosive, user-friendly)

Area of use: grass, maize and cereal TPS and industrial byproducts

Dose: surface treatment: 0.3-0.5 l/m² in 10-15 cm layer thickness.

Complete treatment: depending on type of silage and DM content: 3-5 l/t

Minimum storage time: 2 weeks

SCHAUMANN dosing equipment ensures precision dosing of BONSILAGE products.

SILAMAT SPEZIAL / SILAMAT KOMBI (with agitator)



Application: granules

Design: corrosion-resistant plastic housing (approx. 100 kg), mounting frame.

Ready for operation with all accessories.

Output: up to 150 kg/h

Drive: 12 V DC

Area of use: forage harvesters, forage wagons and large balers

LACTOSPRAYER JUNIOR E



Application: liquid

Design: self-priming pump with filter, flow meter and speed control.

Output: 16 to 160 l/h

Drive: 12 V DC

Area of use: forage wagons and large balers

10. Compacting

LACTOSPRAYER 100 ST /200 ST



Application: liquid

Design: 100/200 l tank with mounting, pump with filter, 2-point siphoning (complete draining), flow meter. Ready for operation with all accessories.

Output: 16 to 160 l/h

Drive: 12 V DC

Area of use: forage harvesters, forage wagons and large balers

WEDA UED



Application: liquid

Design: electronically controlled compact unit. Standard unit: 2x5 l tanks for bacterial concentrate. Dosing by ultra-fine misting. Ready for operation with all accessories.

Output: choice of 180 t/h or 270 t/h

Drive: 12 V DC

Area of use: forage harvesters

Ingress of oxygen leads to heating up and thus to energy and DM losses. Therefore, the better the silage is compacted, the less atmospheric oxygen can enter as silage is removed.

The roller tractor weight determines the speed of the harvesting chain.

Rule of thumb: $\frac{\text{Mountain performance, t FM/h}}{3^*} = \text{Roller tractor weight}$

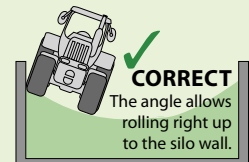
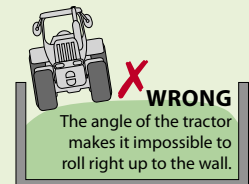
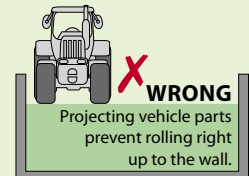
Target values:

DM	Density
20%	160 kg DM/m ³
40%	240 kg DM/m ³

* value for forage wagons;
value for forage harvesters = 4

How to ensure optimum compaction:

- Max. 20-30 cm layer thickness.
- The higher the raw fibre and the dry matter, the thinner the layers.
- Tyre pressure at least 2 bar.
- Do not use twin tyres on side walls.
- Max. rolling speed 3-4 km/h
- Start rolling right at the beginning, as otherwise the effect will not go down through the silage.
- Avoid excessive rolling at the end, because of the pump effect when the silage springs back.



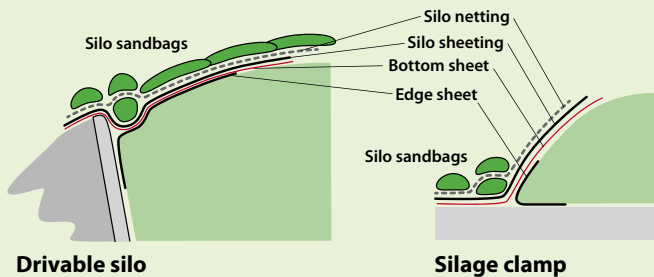
Note: well compacted silage minimises the risk of heating up.

11. Covering

As soon as rolling has been completed, the silage must be correctly covered.

- Bottom sheet, adheres directly to the silage (thickness: 40-50 μ).
- Main sheet, must be gasproof (thickness: 150-250 μ).
- SCHAUMANN silo netting protects the plastic sheets from mechanical damage and provides additional weight.
- SCHAUMANN silo sandbags as weighting for a snug fit. SCHAUMANN silo sandbags can be used to create airtight barriers 5 m apart to discourage air ingress at the silo face.
- Side wall sheeting should be used for side walls.

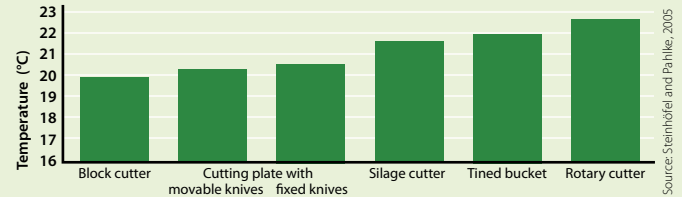
Examples of good cover:



12. Silo face

The minimum removal rate to avoid heating up should be 1.5 m per week in winter and 2.5 m per week in summer. The removal technique should be designed to do as little damage as possible to the exposed face and to minimise air ingress.

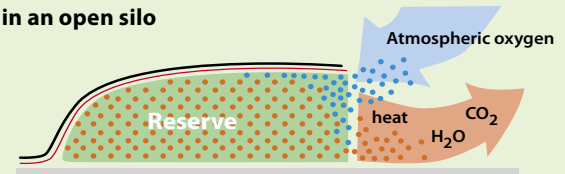
Effects of removal technique on silo face temperature (after 20 hours, 20 cm behind the face)



Preventing heating up

- Create summer silos with a smaller silo face.
- Do not have the face of the silo facing into the prevailing wind.
- Leave the silo sheet in place until near the time of silage removal.
- Calculate the silo length and removal rate according to the herd size.
- Optimise the removal technique.

Air flow in an open silo



Note: to avoid heating up, the silo face should be adapted to the requirements of the farm.

13. Economic efficiency



For greater stability and more energy



Groups 1c, 2, 4b

A model calculation has been used to illustrate the increased economic efficiency of grass silage production using BONSILAGE PLUS as an ensiling agent.

Harvest yield: 23 t fresh matter (FM) grass per hectare with 35 % DM corresponds to 8.05 t dry matter per hectare

Energy content: grass first/second growth: 6.3 MJ NEL/kg DM

The energy yield in MJ NEL/ha is increased by using BONSILAGE PLUS

DM losses: 7% reduction with BONSILAGE PLUS.

Higher energy content disregarded. 1 kg milk = 3.3 MJ NEL

	Control		BONSILAGE PLUS	
	Energy MJ NEL/ha	Milk kg/ha	Energy MJ NEL/ha	Milk kg/ha
Harvest yield	50,715	15,368	50,715	15,368
Losses	6,087	1,845	2,235	677
Yield	44,628	13,523	48,480	14,691
Increased yield			+ 3,852	+ 1,168

Potential challenge feeding saving

Ch. feed savings pot. with 7.0 MJ NEL/kg	3,852 ÷ 7 = 550 kg	
Cost reduction with ch. feed prices of	24 €/dt	17 €/dt
Ensiling agent cost	- 40 €/ha	- 40 €/ha
Additional yield with BONSILAGE PLUS	+ 92 €/ha	+ 54 €/ha

14. Product range



BONSILAGE

The basic product for all types of green silage. Rapid lowering of pH value.



BONSILAGE PLUS

For the upper DM range of all types of green silage. Improved stability and digestibility.



BONSILAGE FORTE

For the lower DM range of all types of green silage. Inhibits Clostridia.



BONSILAGE EXTRA

For all types of green silage with a high proportion of sugar-rich grasses.



BONSILAGE MAIS

For maize silage and TPS. Improved stability and digestibility.



BONSILAGE CCM

For maize grain meal and CCM. Protects against uncontrolled yeast multiplication.



BONSILAGE GRAIN

The biological solution for wet milled cereals.



SILO STAR MAIS

Biological/chemical ensiling agent for maize, CCM and TPS. Shortens the silo ripening time.



SILO STAR PROTECT

For surface and edge treatment. Inhibits yeast and mould fungi at the edges.



SILO STAR LIQUID

The liquid chemical alternative, also for complete treatment.



Group 1b



Groups 1c, 2, 4b



Groups 1b, 5a



Group 2



Group 2



Group 2



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