BON SILAGE

Europe's leading ensiling agent

Silage Handbook

A guide to successful grass silage

Contents

For further information please visit **www.bonsilage.com**

190806GB

SCHAUMANN
FEEDS SUCCESS

1. Target values

This Grass Silage Handbook addresses all major management factors involved in producing grass silage of superior feed quality.

The target values for the most important parameters for outstanding grass silage are set out below.

Requirements for grass silages

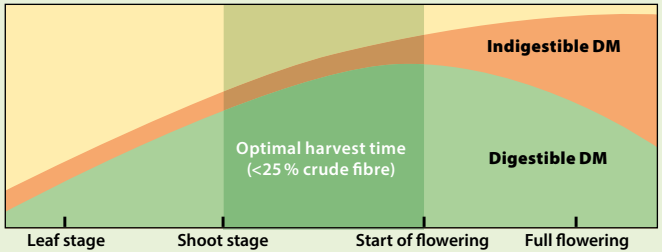
Parameter		Target value
Dry matter	%	28-35
pH level (dependent on DM)		4.0-4.8
Sugar	% DM	< 4
CP	% DM	14-18
CF	% DM	23-26
NDF	% DM	42-48
CA	% DM	< 10
NH_3-N	% of total N	< 8
D-Value	% DM	> 68
Gas formation	ml/200 mg DM	> 50
Energy density	MJ NEL/kg DM	> 6.2
	MJ ME/ kg DM	> 10

Note: High silage quality is the basis for maximising milk from forage!

2. Cutting time

The optimal cutting time is just before heading for the main crop grasses, which then have a crude fibre content of <25 % in the DM. After this time, both digestibility and feed intake deteriorate gradually due to increasing lignin accumulation. This effect is observed more acutely in extensively managed crops, as grasses then have a higher stalk content. In this case, the cutting intervals should be even shorter.

Change in grass dry matter digestibility during the vegetative stage



- During the main vegetative stage of the 1st growth, crude fibre content increases by 3-8 g/kg DM/day, causing a cow's theoretical performance potential to decrease by 150 kg milk/year.
- The optimal crude protein content is 16-18 % in the DM with as little free nitrogen compounds as possible, as these act as buffers during the ensiling process.
- An early first cut establishes the basis for high quality of all subsequent cuts.

Note: Quality over quantity in every cut increases annual milk yields.

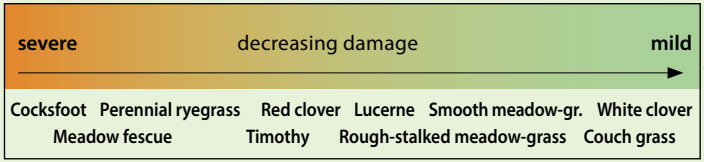
3. Cutting height

The minimum cutting height for grasses is 8 cm, for lucerne (alfalfa) 10-12 cm. Depending on ground conditions and mole numbers, possibly cut higher than this. Adhering to this cutting height helps preserve the sward during subsequent cuts.

This minimum cutting height:

- Promotes rapid grass re-growth
- Reduces dirt and thus increases energy contents
- Reduces the introduction of unwanted spores
- Prevents the displacement of desirable grasses due to insufficient cutting heights
- Reduces the risk of contamination with residual slurry

Degree of damage caused to a range of forages when cut too short



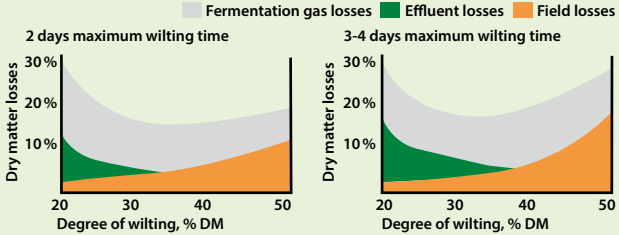
Source: adapted from Fisch, Buhr 2008

Note: Sward quality is improved sustainably in the long term by cutting and harvesting more frequently with less damage to the sward.

4. Wilting

Keeping wilting times to 28-35 % DM as short as possible provides a basis for optimal ensiling with low losses and high feed intake (40-45 % DM in rations). Excessively wet silages result in butyric acid fermentation, while excessively dry silages are difficult to compact and therefore tend to spoil.

Relationship between the degree of wilting and losses



- Correct wilting improves suitability for ensiling and minimises losses.
- The wetter the silage (<30 % DM), the more buffering occurs during the ensiling process, which in turn increases the risk of contamination. In this case, specialist products such as BONSILAGE FORTE need to be added to prevent butyric acid fermentation.
- Energy preservation, optimisation of the ensiling process and protection against spoilage are maximised within a range of 30-40 % DM, and the use of BONSILAGE products containing homofermentative and heterofermentative lactic acid bacteria is therefore recommended to achieve these goals.
- Adequate compaction cannot be achieved above 40 % DM.

Note: Rapid wilting is the basis for minimal losses and optimal performance.

5. Chop length

Optimum chop length for grass silage:
15 - 30 mm depending on NDF and DM

Longer chop lengths make it more difficult to achieve good compaction.

Blades and shear bars should be sharpened regularly.

Optimum chop length is essential for:

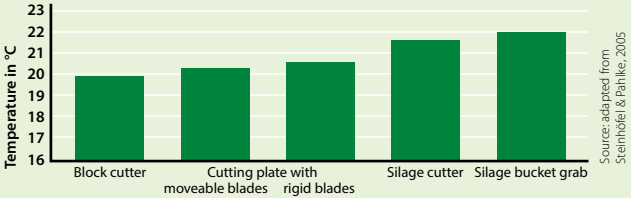
- Precise compaction, efficient silo utilisation and reduced losses
- Improved plant cell digestion and thus more intensive and rapid lactic acid fermentation
- Reduced gas exchange after silo opening and thus reduced risk of aerobic instability (heating)
- Improved feed intake

Note: Optimum chop length forms the basis for thorough compaction, intensive fermentation and high feed intake.

6. Silo face

The minimum weekly removal rate should be 1.5 m in winter and 2.5 m in summer to avoid heating. Machines used for removing silage should keep the silage face as intact as possible in order to minimise air ingress.

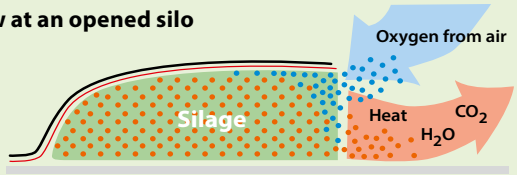
Impact of removal machinery on silage face temperatures (after 20 hours, 20 cm behind the face)



How to prevent heating

- Create summer silos with smaller face areas.
- Ensure that the silo face is away from the prevailing wind direction.
- Remove as little silage film as possible in advance.
- Calculate silo length and removal based on herd size.
- Optimise removal technology.
- Secure the silage film at the silage face with 2 rows of sandbags (distance 1 - 1.5 m) to prevent the oxygen ingress.

Air flow at an opened silo



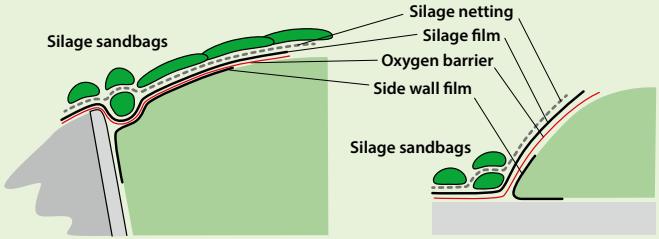
Note: A well managed silo face will help prevent heating.

7. Sealing the silage

Ensure that the silage is appropriately sealed as soon as rolling has been completed.

- Oxygen Barrier, adheres directly to silage (45 µ thickness).
- The film should be air-tight, strong, UV-resistant and acid-proof.
- Silage netting; protects films against mechanical damage and provides additional weight.
- Silage sandbags as additional weights for a snug fit. Silage sandbags allow air-tight barriers to be created at 5 m intervals to prevent air entering at silo faces.
- Side walls should be covered with side wall film, where applicable.
- During prolonged silage breaks, an intermediate cover must be applied.

Examples of good silage sealing:

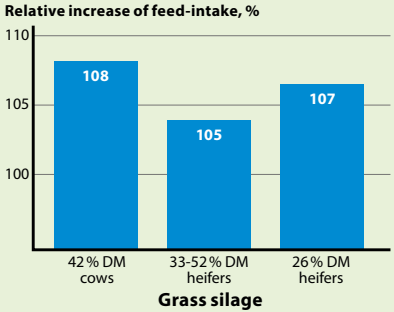


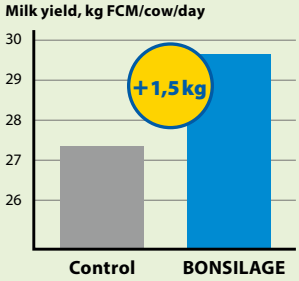
Bunker silo **Silage clamp**

8. Silage additive – BONSILAGE BASIC

Rapid reduction of pH-value

Active ingredients: homofermentative lactic acid bacteria
Purpose: optimal ferementaiton process
Field of application: grass, clover and alfalfa
Package size: liquid 50 g
Application rate/t: 1 g
Minimum Storage period: 3 weeks





8. Silage additive – BONSILAGE BASIC

An effective fermentation process is promoted by adhering to the fundamental principles of ensiling and can be further enhanced by applying silage additives for a range of action categories.

BON SILAGE FORTE

The professional silage additive for wet silages

CATEGORY 1b,5 CONTINUOUS MONITORING DLG Certificate 6501 www.DLG.org

Active ingredients: homofermentative lactic acid bacteria
Purpose: rapid, stable pH reduction, utilisation of the full carbohydrate spectrum, inhibition of the growth of clostridia
Field of application: ryegrass 18-30 % DM, other grasses 22-30 % DM, clover grass 25-30 % DM, lucerne 25-30 % DM
Package size: 100 g
Application rate/t: 2 g
Recommended compaction: min. 180 kg DM/m³ depending on DM
Minimum storage period: 3 weeks

BON SILAGE STABILITY

For greater stability and energy

Active ingredients: combination of homofermentative and heterofermentative lactic acid bacteria
Purpose: rapid lactic acid formation, more digestible energy, aerobic stability
Field of application: grass, clover grass, lucerne, WCS: 28 - 45 % DM
Package size: liquid 100 g
Application rate/t: 2 g
Recommended compaction: min. 180-270 kg DM/m³ depending on DM
Minimum storage period: 8 weeks

9. Silage additive – BONSILAGE SPEED

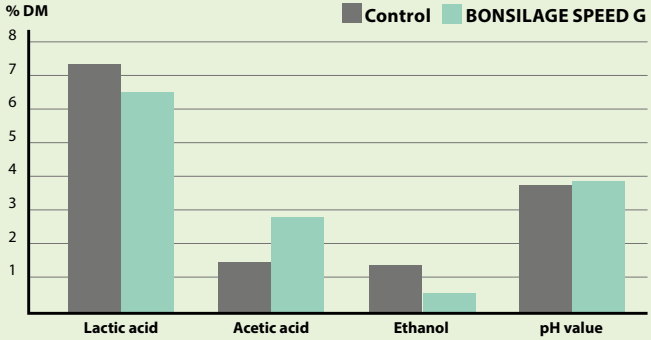
BON SILAGE SPEED G

BONSILAGE SPEED accelerates the ensiling process markedly.

The new *Lactobacillus diolivorans* strain in SPEED products accelerates silage maturity to two weeks while minimising losses and maximising energy contents.

Active ingredients: combination of homofermentative and heterofermentative lactic acid bacteria
Purpose: rapid silage maturity within two weeks, high stability of grass, clover grass, lucerne and forage rye silages
Field of application: grass, clover grass, forage rye, lucerne with 28-50 % DM
Package size: 100 g
Application rate/t: 2 g
Recommended compaction: min. 180 kg DM/m³ (at 25 % DM) - 270 kg DM/m³ (at 50 % DM)
Minimum storage period: 2 weeks

Fast acetic acid production results in aerobically stable silages just 14 days post ensiling



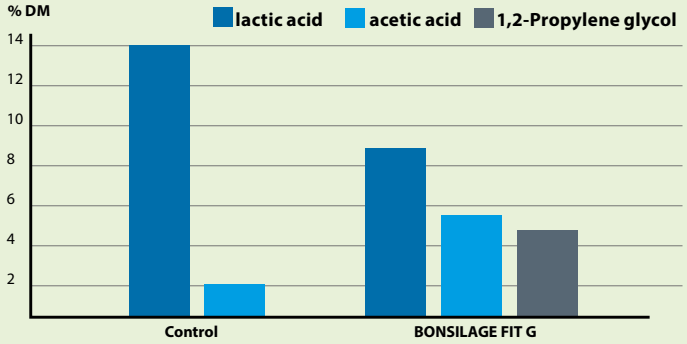
10. Silage additive – BONSILAGE FIT

BONSILAGE FIT delivers a marked increase in cow fitness.

FIT products shift fermentation acid patterns towards more acetic acid and propylene glycol while maintaining excellent aerobic stability. Metabolic stability in the cow is optimised.

Active ingredients: combination of homofermentative and heterofermentative lactic acid bacteria
Purpose: high aerobic stability in energy-rich grass silages, improved cow fitness
Field of application: grass and clover grass with 28-50 % DM
Package size: 100 g
Application rate/t: 2 g
Recommended compaction: min. 180 kg DM/m³ (at 25 % DM) - 270 kg DM/m³ (at 50 % DM)
Minimum storage period: 8 weeks

A superior fermentation gives a rumen-friendly acid profile plus the metabolic advantages of propylene glycol



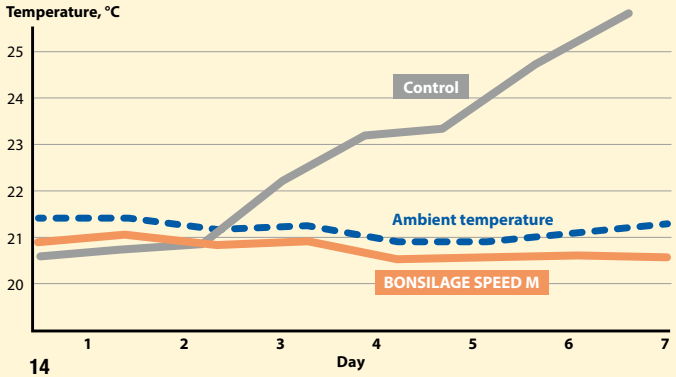
11. Silage additive – BONSILAGE SPEED

BONSILAGE SPEED accelerates the ensiling process markedly.

The new Lactobacillus diolivorans strain in SPEED products shortens silage maturity to two weeks while delivering high stability of high-energy maize silages and WCS.

Active ingredients: combination of homofermentative and heterofermentative lactic acid bacteria.
Purpose: Rapid silage maturity and high aerobic stability for maize and WCS silages.
Field of application: all starchy silages (maize, cereal WCS etc.) with a DM content of 25-45 %
Package size: liquid 100 g powder
Application rate/t: 1 g/t silage
Recommended compaction: 230 kg DM/m³ (at 28 % DM) - 370 kg DM/m³ (at 45 % DM)
Minimum storage period: 2 weeks

Stable silage after only 14 days of ensiling



Stability for whole crop silages

Active ingredients: combination of homofermentative and heterofermentative lactic acid bacteria
Purpose: perfectly hygienic whole crop silages, better palatability, reduced losses
Field of application: whole crop silage with 30-45 % DM
Package size: 100 g
Application rate/t: liquid 1 g/t silage
Minimum storage period: 8 weeks

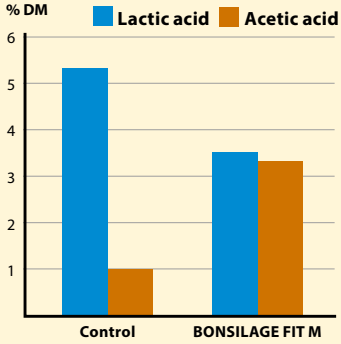
	DM % DM	Lactic acid % DM	Acetic acid % DM	1,2-Pd % DM	pH	Yeast Cfu/f FM
untreated	36.27	2.78	0.23	n.d.	3.87	1,280,000
BONSILAGE WCS	38.81	2.13	1.08	0.45	4.01	< 100

BONSILAGE FIT delivers a marked increase in cow fitness.

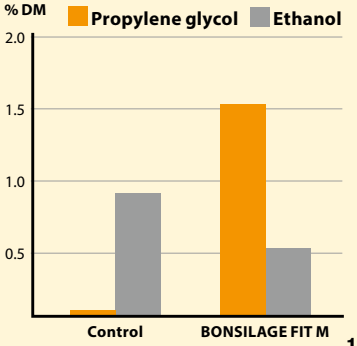
FIT products shift fermentation acid patterns towards more acetic acid and propylene glycol while maintaining excellent aerobic stability. Metabolic stability in the cow is optimised.

Active ingredients: combination of homofermentative and heterofermentative lactic acid bacteria.
Purpose: High stability for energy-rich maize and WCS for enhanced cow fitness.
Field of application: all starchy silages (maize, cereal WCS etc.) with a DM content of 25-45 %
Package size: 100 g
Application rate/t: 1 g/t silage
Recommended compaction: min. 210-370 kg DM/m³ depending on DM
Minimum storage period: 8 weeks

Acetic acid ensures high aerobic stability



High propylene glycol content delivers easily metabolised energy



7. Effects of silage additives

The SCHAUMANN range comprising BONSILAGE MAIZE, BONSILAGE WCS, BONSILAGE SPEED M and BONSILAGE FIT M includes the right product for any maize silage and wholecrop.

Objectives of using silage additives in silage maize and wholecrop silages

- Suppression of undesirable microorganisms (acetobacter, yeasts, moulds and other toxin-forming spoilage agents)
- Prevention of heating and fermentation failure
- Improved feed qualities (palatability)
- Increased digestibility (substrate digestion)
- Targeted control of the fermentation process (development of defined quantities of acetic acid, propylene glycol and lactic acid)
- Substantial reduction of dry matter losses

8. Whole-crop maize ensiling

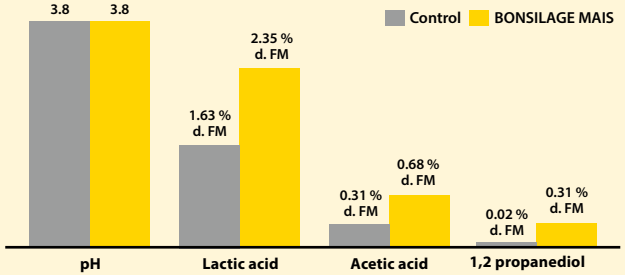
BON SILAGE MAIZE

CATEGORY 2 CONTINUOUS MONITORING DLG Certificate 6502 www.DLG.org

High-performance silage, easy handling

Active ingredients: Homofermentative and heterofermentative lactic acid bacteria
Purpose: Optimised fermentation process, increased energy density, aerobic stability
Field of application: maize silage, cereal WCS
Package size: liquid 100 g, powder
Application rate/t: liquid 1 g/t silage
Recommended compaction: min. 250-330 kg DM/m³ depending on DM
Minimum storage period: 8 weeks

Bonsilage Maize optimises fermentation processes for more energy

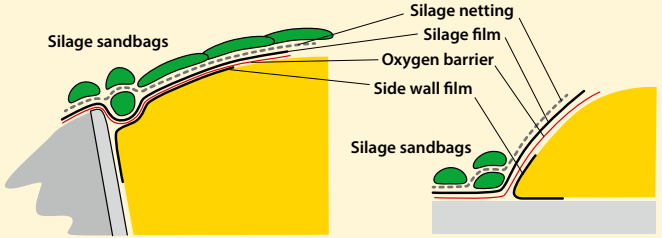


5. Sealing the silage

Sealing

- Oxygen barrier, adheres directly to silage (strength: 45 µ)
- The film should be air-tight (strength: 150-250 µ), strong, UV-resistant and acid-proof.
- It is recommended to add temporary cover for extended breaks during the ensiling process (over 6 hours).
- Silage netting; protects films against mechanical damage and provides additional weight
- Silage sandbags as additional weights for a snug fit. These allow air-tight barriers to be created at 5 m intervals.
- Side walls should be covered with side wall film, where applicable.
- During prolonged silage breaks, an intermediate cover must be applied.

Examples of good silage sealing:



Bunker silo **Silage clamp**

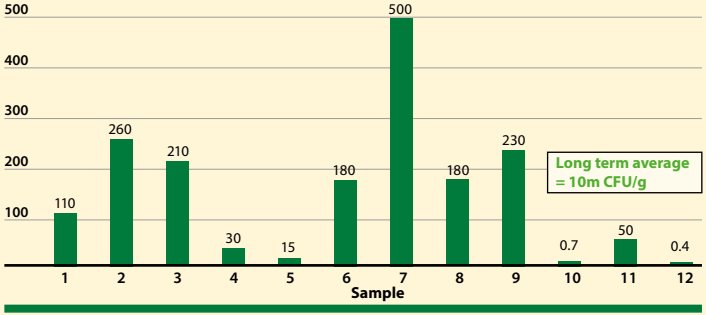
6. Yeasts in maize silage

Yeast loads are always higher in maize silage

High yeast loads frequently result from high surface yeast loads of maize plants in the field, as has been confirmed by annual silage analyses conducted by various laboratories.

Example:
Studies conducted by ISF Schaumann Forschung have shown that 71 % of untreated silages carry excessive yeast loads. This has been confirmed by analyses performed as part of the ensiling competition of the LUFA North-West Institute of Agricultural Analysis and Research, where 62 % of maize silages exceeded the threshold of 100,000 CFU/g FM.
As a result, the official consultancy agencies issued a general recommendation that silage additives should be used as a matter of principle in order to improve aerobic stability.

Yeast numbers in million CFU/g of fresh silage



ISF GmbH, 2017

3. Chop lengths (whole-crop silage maize)

Optimum for cattle: 6-8 mm
Optimum for biogas: 4-6 mm
(theoretical chop length)

As a rule: The drier the material, the shorter the chop length

Compliance with these recommendations delivers:

- Basis for optimal compaction (above 230 kg DM per m³ silage)
- Minimal energy losses during ensiling and removal
- Increased feed intake (+ 0.7 kg DM intake/day compared to 20 mm particle length)
- Improved digestibility (larger contact surface for ruminal microorganisms)

4. Compaction

The entry of oxygen into silage causes heating and thus losses of energy and DM. The better silage is therefore compacted, the less oxygen is able to enter from the air whenever silage is removed.

The weight of the compaction tractor determines the speed of the harvest chain.
Steep ramps or side walls (on drive-over piles) make compaction difficult.

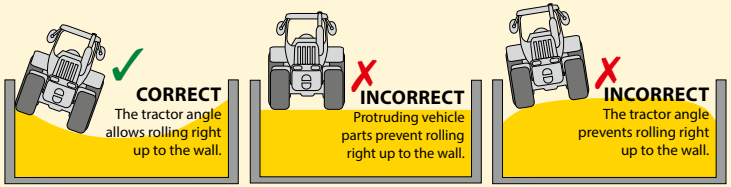
Rule of thumb: $\frac{\text{Pick-up rate in t FM per hour}}{4^*} = \text{Compaction tractor weight}$

* for forage harvesters; for forage wagons = 3

Target compaction values:

DM	Density
30 %	246 kg DM/m³
40 %	326 kg DM/m³

Rule of thumb for compaction: **(8 • DM [%]) + 6**
Example: *(8 • 35) + 6 = 286 kg DM/m³*



1. Characteristics of maize silage

- Low crude protein content
- High content of fermentable carbohydrates (beneficial fermentation properties)
- Low buffering capacity
- High fermentability coefficient
- DM contents in maize kernel and maize cob products near the upper limit of biological ensilability
- High surface yeast loads
- Extremely high spoilage potential (mould and yeast activity, heating)

Target values for whole-crop maize silages:

Parameter		Target value Maize
Dry matter	%	30-35
pH level (dependent on DM)		3.8-4.2
Starch	% DM	> 30
CP	% DM	7-8
CF	% DM	< 20
NDF	% DM	35-40
CA	% DM	< 4.5
NH_3-N % of total N	% of total N	< 6
D-Value	% DM	> 70
Gas formation	ml/200 mg DM	> 52
Energy density	MJ NEL/kg DM	> 6.5
	MJ ME/kg DM	> 10,5

Note: High silage quality is the basis for optimal forage milk yield!

2. Harvest time (whole-crop silage maize)

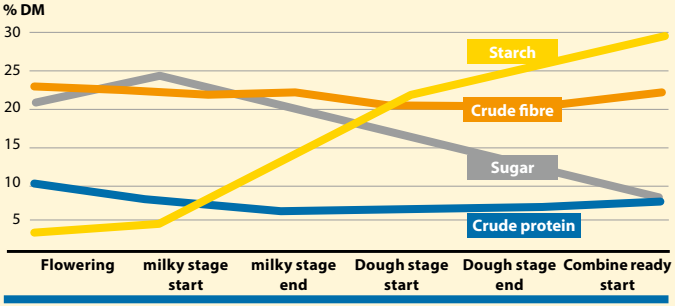
Harvest time recommendation:

- DM content of whole plants between 29 and 34 %
- Completed starch deposition in kernels
- High cob portion and easily digested vegetative parts
- Maize is considered to be ready for ensiling when its dry matter in kernels has reached 56-60 %
- The target is silage with about 300 g starch and 40 g sugar/kg DM (depending on the intended silage ration)

Compliance with these harvest time recommendations delivers:

- Optimal compaction characteristics
- Reduced susceptibility to heating and moulds
- Reduced susceptibility to the formation of Fusarium toxins
- Good feed qualities

Changes in analysis during maize crop maturation



Source: n. Jeroch et al.,1993

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