Silage management practices – 64% of silos are insufficiently packed

With fluctuating milk and feed costs, the quality of farm-grown forage is a key indicator of farm profitability, especially when silage represents more than 50% of the daily cow intake. However, it is common knowledge that each year, tons of silage dry matter (and money!) disappear into thin air.

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Part of this loss is due to the fermentation process itself that guarantees silage preservation and cannot be avoided. However, important losses could be reduced, such as those linked to undesired fermentation and spoilage during desiling, or aerobic instability. When the silage temperature rises, dry matter (DM) is literally burnt out: it is as much as 1% DM that disappears every day when the silo temperature is only 2°C above the ambient temperature.

Silage practices, from harvest to bunker management, greatly influence the quality of the silage, and thus the profitability of the farms.

In 2010, silage experts at Lallemand Animal Nutrition developed a corn silage audit tool: the CSI (Corn Silage Investigation).

Today, the program has been validated on farms with hundreds of audits performed around the world. This has allowed Lallemand to fine-tune the audit tool and to draw a picture of silage practices in the field thanks to a multi-analysis across different regions in Europe.

149 farms audited

The multi-analysis compiled the audit results from 149 dairy farms located across France, Italy and Greece. Audits were conducted on corn silos during the spring and summer (June-July), according to the standardised CSI method.

For each farm, production parameters (dairy performances, diet) and harvest practices (crop hybrid, type of harvester, harvest speed, yield, packing, use of any additive, silo shape and size) were recorded.

Using the CSI diagnostic tools and protocol (see boxed text), silo parameters were measured: temperature and density at six different points spread across the silo face, pH. In addition, samples were collected for analysis.

Silo density: the weak element

First of all, the survey indicates that not all farms are equal in terms of silo density, a key element to ensure corn aerobic stability.

Heterogeneous results are shown from farm to farm, but, above all, 64% of the silos showed a density below the recommended value of 240kg DM/m³. Silage density is highly related to the porosity of silage. Porosity first determines the amount of oxygen that is trapped within the bunker and postpones the anaerobic phase that favours forage acidification. In the desiling phase, porosity also determines the amount of oxygen that can penetrate within the silo after opening and fuel secondary fermentations, source of spoilages (aerobic fermentation).

Fig. 1. Corn silage density across 149 farms in different locations in Europe (Andrieu et al. 2015).

Best practices pay-back

Looking at the relationship between silage practices and the density of the silo, several correlations could be found at different levels, at harvest but also at feed-out (choice of defacing technique):

- Effect of the compaction method: horizontal vs. progressive wedge layers, has a significant impact on mean density (232±46kg DM/m³ vs 212±53kg DM/m³, p<0.05).
- Effect of particle size: significant negative correlation (p<0.05; r2=0.131) between the presence of large particles and density.
- Effect of the design of the silo: increased silo height results in a higher density (p<0.05) (Fig. 2). Bunker-type silos have significantly higher densities compared with drive-over piles (237.7kg DM/m³ vs 184.6kg DM/m³, p<0.05).
- Good practices at feed-out; effect of the defacing equipment: rotary cutter compared to a loader resulted in higher average silos densities (235.8 ±40kg DM/m³ vs 209.7 ±41kg DM/m³ respectively, p<0.05).

A second analysis was performed regarding the aerobic stability of the silos. A correlation was found between some of the investigated parameters and aerobic stability:

- In line with the literature, silage density influences aerobic stability: 25±4.7°C for forages with lower density (209±47kg DM/m³), vs. 22±3.0°C for higher density forages (238±48 kg DM/m³); P<0.05.
- Silo design (linked to density): bunker silos are more likely to have better compaction and were significantly cooler than drive over pile silos (24±3°C vs. 25±4°C, P<0.05).

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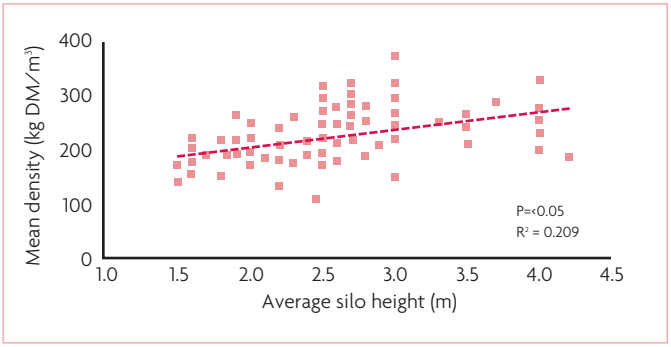

Fig. 2. Correlation between silage average density and silo height (Andrieu et al. 2015).

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● The use of an appropriate inoculant shows a significant and consistent effect on the silo temperature (Fig. 3).

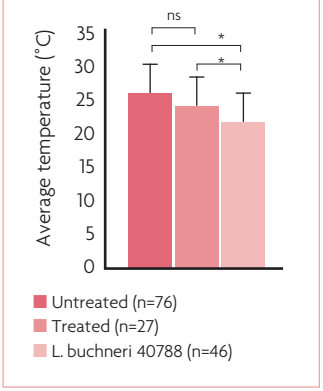
In the survey, 76 silos were not treated, 27 silos were treated with various inoculant products and 46 silos with L. buchneri 40788 (LB 40788) at 300,000 CFU/g of forage (Lalsil Fresh, Lallemand Animal Nutrition). The LB 40788 treated silos were significantly cooler than both the control and competitor's silos.

The use of a proven inoculant, having shown a consistent effect on the targeted forage ensiled, is a valuable tool at the disposal of farmers to ensure their forage quality. Not all parameters being controllable during the ensiling process (weather, harvesting and storage setup) the application of appropriate silage inoculant shows great effect reducing spoilage from acidification. Its investment fits a strategy of maximising the potential of production from the capital placed in the forage production area.

Tips to consider for a quick forage quality assessment:

● Standardised method of analysis allows proper monitoring and thus detecting margins of improvement, objectively and repeatedly.

Fig. 3. Effect of silage inoculant on corn silage aerobic density (multi-analysis from 149 silos) (Andrieu and Demey 2015).



● Silo density is key: take care of variations between different places within the silo and the material ensiled (one forage from one field can 'compact' very differently than another one, depending on DM level, starch content: continuous monitoring is essential at harvest).

Conclusions

Good silage quality is highly related to a strict respect for ideal harvesting practices.

As the whole is greater than the sum of each good silage practice, it is important to keep in mind all consequences related to inappropriate practices along the process in order not to jeopardise the total investment made in forage production and the daily balance of the diet.

As part of the best ensiling rules, the use of an appropriate silage inoculant, depending on various conditions, should be considered.

High densities are obtained when good silage practices are combined with the correct silo parameters.

All farmers can achieve a proper density regardless of the equipment used for harvesting, as long as they respect the adequacy in between packing capacity and the other parameters.

Overall, on-farm silo audits are valuable tools. Monitoring the forage quality at any moment during the preservation process is the only real way to assess the given situation.

Beyond fine-tuning some practices on a very short term basis (adjust the diet, defacing method) it helps to identify the different levers that farmers can act upon during the following harvests.

From a simple audit to a more exhaustive one, objective data to be compared to references must be the rule of thumb when producers consider improving their practices, that eventually greatly influences farm profitability. ■

References are available from the author on request

Key parameter	Effect	Recommendation
Speed of harvest	Directly correlated to silo density	Adjust the speed of the forager to the packing capacity at the silo
Silo type	Pile silos show the lowest average density, followed by semi-bunker and bunker	Bunker silos allow optimal packing, for other methods follow the golden rules of compaction
Packing	Key factor in minimising the amount of air left in the silo	Pack with adapted weight, spread thin, even layers of forage (<20cm), controlled traffic
Silo size	Correlated to density and 'natural' compaction (gravity)	The silos >1.8m show higher average density
Chop length	Longer chop length is linked to lower density	Adapt the chop length to forage DM, find best compromise between effluent loss and optimal density
Use of an inoculant	L. buchneri 40788 at 300,000 CFU/g prevents moulds and fungal growth in the silo and limits losses and heating at feedout.	Inoculant must be properly applied to ensure its effectiveness. Dose and mode of application are key to ensure homogenous application and prevent sedimentation in the tank (e.g. use of adapted HC formula specific for low volume applicators).
Defacing equipment	Type of equipment is important to maintain good front face density.	Rotary cutter gives higher average density than loader. However, a correct use of a conventional grabber can give good results and limit air penetration in the front face
Feed-out rate	Slow feed-out increases aerobic spoilage	Silo face should advance by 20-30cm/day

Table 1. Overview of the key parameters affecting silage quality and tips for optimal preservation.

LALSIL app: mobile silage expert

The CSI audit is now part of the LALSIL mobile application, a tool developed by silage experts to become a personal assistant for successful silage management. The app offers different calculators that help:

● To prepare next year's harvest according to the silo audit conducted during the ongoing year (density, pH, temperature). The aim is to detect the margins of improvement on the farm and help farmers optimise their forage quality.

● To understand the composition of an inoculant because the premix and bacteria concentration are key elements when comparing and assessing the effectiveness of forage additives (CFU/g of forage).

● To adjust the applicator on the harvesting equipment. Both self-propelled harvesters and balers can be selected to provide the flow rate of the applicators and its range of work.

● A Return on Investment calculator is under development to help producers optimising feed cost based on the combination of a forage milk potential and the farm silage practices.

The LALSIL app also provides additional services such as:

● Local weather forecast, helping producers to decide the best window of harvest according to the weather conditions, temperature and risk of rainfall.

● Information on the portfolio of silage additives developed under the LALSIL brand, detailing the specific formula and benefits for different types of silage.

● Technical support: the possibility to directly contact Lallemand Animal Nutrition's silage expert and ask questions about specific technical issues.

The app is available for iOS platform (Android version in development), in several languages; English, French, Italian, Portuguese, Brazilian, German and Spanish.