Reducing losses during silage harvest and storage

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Some losses of dry matter and nutritive value during silage making are unavoidable, BUT the avoidable losses are far too high on many farms in Australia. Reducing losses at each step of the ensiling process could reap financial gains for farmers (and contractors) and is possible, practical and not overly expensive, sometimes only requiring attention to detail. And there are some new technological advances to reduce these losses which farmers/contractors are not fully utilising.

Although silage may not be a major portion of the daily ration on many farms, profitability is still substantially affected by silage quality and losses throughout the entire silage making process. Table 1 shows the impact of improved quality and reduced losses on the additional value of milk production, in terms of a marginal response, from 350 tonne dry matter (t. DM) silage when milk is valued at $0.40/L and the conversion of energy in silage to milk is 8.0 MJ ME/L milk. Eight MJ ME is a conservative conversion rate to allow for some substitution and some energy being used for walking, condition gain, etc.

Table 1. Impact of improving quality and reducing losses on additional milk value

Impact of improvements in quality or reduced losses on the additional value of milk produced		
Quantity of forage stored per year	350	Tonne DM
Existing quality	9.5	MJ ME/kg DM
Target quality	10.5	MJ ME/kg DM
Existing losses estimate	25%	of total storage
Target losses	15%	of total storage
Value of milk	40	¢/litre milk
Conversion to milk*	8	MJ/litre from silage
	Quality Range (MJ ME/kg DM)	
Loss Range (%)	**9.5**	**10.5**
25	$0	$11,250
15	$14, 250	**$27,000**

If the quality of the 350 t DM silage is improved by 1 MJ ME/kg DM, the increased value of milk production is about $11,000. If the total harvesting and storage losses are reduced from 25% to 15%, income from milk is increased by over $14,000. Achieving both will result in a gain of well over $20,000! How much extra cost and effort is needed to achieve this? Possibly a new tedder, potentially paid for in the first or second year of savings?

Let's look at the loss side of the equation in this article.

There are losses at all stages of the silage making process, some of which are unavoidable, but many are in your control to avoid or at least minimise. Be aware that hay making losses are substantially higher when harvested as a paddock crop through to feed out! Although some silage

production losses are obvious such as mouldy or rotten silage, many are not such as plants continuing to 'live' (respiration) once cut, during wilting, rain damage, compaction and during storage and feed out.

Usually, when a loss of quality is occurring, a loss in DM is also happening. The only time this is not so is when a crop is cut after its best stage of growth for quality, such a pastures going to head. In this scenario the DM yield continues to increase but there is a not-so-obvious loss in quality.

Losses begin soon after the forage is mown, during its treatment before harvesting, during harvesting, during storage and at feeding out. These losses are due to material not being picked up, continued respiration of plants during wilting, harvesting and stack filling and while bales and stacks are still unsealed. There are even respiration and aerobic losses immediately after sealing, some unavoidable but compacting the stack and bales tightly and rapid sealing can substantially reduce these avoidable losses.

The fermentation process itself will, unavoidably, cause slight losses unless the material is poorly compacted or sealing is delayed. Aerobic spoilage losses when the seal is broken at stack opening or during poor feed out management, are due to aerobic bacteria, yeasts and moulds and largely avoidable.

Quoting actual amounts for losses is very difficult as many factors determine the loss at any stage. In very good silage making conditions total field and storage DM losses (excluding feed out losses) should be about 12 - 18% whilst direct cut maize should be about 10%. However, bad weather, extended wilting, slow harvesting, poor compaction, inadequate sealing, etc. can blow these losses out to over 40% in extreme situations.

Silage making losses can be are segregated into:

- Harvesting - before and during (Table 2)
- Storage (Table 3)
- Feeding out (Table 4).

Tables 2, 3 and 4 summarise the timing or operation and the reasons for these losses and suggested management strategies to minimise them during Harvest, Storage and Feeding out respectively.

Table 2. Sources of field losses during silage HARVEST

Operation or source of loss	Type of loss	Reason	Management Strategy
Closure date & length	1. Q[1]	Closed for too long or closed too late	Cut at canopy closure or just as seed heads start to appear.
Mowing	2. DM[2] Q	Cut too high/too low, paddock areas uncut	Use wide mower. Set mower to grazing height.
Wilting	3. DM Q	Respiration of sugars, protein break down by plant enzymes	Increase rate of wilting with tedder use immediately after mowing or mower-conditioner leaving wide swaths but some loss is unavoidable.
Tedding	4. DM Q	Loss of leaf	Avoid tedding above approx. 35 % DM, especially legumes. Avoid soil contamination.
Raking	5. DM Q	Some cut material not raked into windrow	Set rake tines to pick cut swath off top of stubble. Avoid soil contamination. Use rotary rakes. Graze paddock after harvest.

	6. DM Q	Leaf loss during raking	Avoid over wilting and/or raking when crop too dry, especially legumes.
Harvesting of direct cut crops	7. DM	Some crop uncut	Avoid sowing in unharvestable areas. Graze paddocks after harvest to utilise uncut forage.
	8. DM Q*	Some material not blown into truck/cart	Train or use experienced operators. Use higher cart sides.
Harvesting and baling of wilted crops	9. DM	Windrow not all picked up,	Rake into narrower windrows. Graze paddocks after harvest.
	10. DM Q*	Some material not blown into truck/cart or lost during baling	Add more flutes to blower to create more draft. Use higher sides. Avoid or work with the wind. Avoid over dry material.
Transport to storage	11.DM*	Loss of forage from truck cart during transportation	Avoid overloading and over dry material. Cover if carting some distance. Grade tracks smooth. Dump on solid clean base.

Source: Adapted from TopFodder Silage Manual (2003) Table 2.7

*Quality not always affected

[1] Q Quality

[2] DM Dry Matter

Table 3. Sources of losses during silage STORAGE

Source of loss	Type of loss	Reason	Management Solutions
Effluent	12. DM Q	Too wet at ensiling, aerobic breakdown in storage	Wilt crops and pastures > 30% DM for bulk cut and > 40% DM for bales. Cut direct cut crops at later stage of maturity. Seal stack perimeter airtight and place weights eg. tyres, on the plastic.
Respiration	13. DM Q	Too much air in stack or bale allows plant enzymes to 'eat up' plant sugars. Poor compaction. Forage too dry.	Avoid ensiling material too dry and if so, chop shorter. Mix dry material with less wilted forage in stack or add water. Harvest with dew. Fill stack/pit quickly (within 1–2 days) but roll slowly. Increase bale or stacks density. Seal airtight ASAP.
Inedible waste silage	14. DM Q	Air presence for long period will result in mouldy or rotten silage due to aerobic bacteria, moulds and yeasts.	As above and maintain airtight seal during storage. Check for holes regularly and repair immediately with specific silage plastic tapes. Ensure hole is clean, cool, dry and tape and silage plastic colours are similar.
Fermentation	15. DM Q	Fermentation of plant sugars. Losses minimal with lactic acid. DM and quality losses higher with poor fermentation, including secondary fermentation	Promote lactic acid fermentation by cutting leafy pastures. Wilt quickly to correct DM %. Use additives, including aerobic inhibitors as appropriate. Compact stack or bales tightly. Maintain airtight seal.

Source: Adapted from TopFodder Silage Manual (2003) Table 2.8

Table 4. Sources of losses during FEEDING OUT of silage

Source of loss	Type of loss	Reason	Management Solutions
Aerobic spoilage (heating & mould growth)	16. DM Q	Silage unstable, heats on exposure to air due to aerobic micro-organisms. Moulds and yeasts spoil silage. Unpalatable. Reduced intakes. Possibility of animal health issues.	Maize, sorghums and whole crop cereal silages most susceptible. Use aerobic spoilage inhibitor additives at harvesting. Maintain airtight seal. Feed out rate maximum of 2 days across silage face or remove >30 cm depth of silage face/day. Discard spoiled silage.
Waste during feed out	17. DM	Silage fouled by trampling and manure. Overfeeding. Mouldy silage included in feed out cart or TMR. Spoiled silage not cleaned out of troughs, etc.	Feed silage in troughs, along fences, behind barriers, etc. Don't overfeed. Discard spoiled silage regularly.

Source: Adapted from TopFodder Silage Manual (2003) Table 2.9

To make high quality pasture silage:

- Cut pastures in the vegetative stage and just before canopy closure for very high (10.5 – 11.5 ME) quality silage
- Avoid pastures with seed heads or dead material at the base of the sward
- Avoid including dust or mud since this will result in poor fermentation
- Wilt and harvest no longer than 24 - 48 hours after cutting, if possible
- Increase wilting rate by tedding immediately after mowing or using a mower-conditioner leaving swaths as wide as possible
- Applying an appropriate silage additive at the correct rate and ensuring thorough coverage of the material should will usually give a 3 - 5:1 return in most situations. Definitely use when forage is slightly to wet.
- Compact stacks well – roll slowly, spread forage in layers <15 - 20 cm thickness, Bale slower to increase bale density
- Seal (white side up) with UV treated plastic immediately after harvesting. Consider Oxygen Barrier (OB) technology. Place weight on stacks and around perimeters, eg. tyres, gravel sausages
- Seal bales airtight ASAP after baling – four to six layers of stretch wrap film, 55% to 70% stretch, 50% overlap.
- Applying an extra two layers in should ensure 18 months storage.
- Recently developed five layer films, stretched to 70%, are recommended by most manufacturers to apply 6 layers.
- Apply 6 layers if using continuous In-line (tube-line) wrappers and consider 8 layers at the bale joins.
- Regularly monitor silage stacks and bales for holes. Repair immediately with specific silage tape. Ensure plastic is clean, dry, cool and use light tape on light stretchwrap film.