AGRICULTURE VICTORIA

Getting high quality silage into the bale or stack

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Contents

Summary 2

Introduction 3

Why make high quality silage? 3

What is high quality silage? 4

How do you know your silage quality? 5

1. Silage analyses 5

2. Visual Appraisal 5

3 "Eyeballing" the paddock 5

How to make high quality silage 5

Stage of growth 5

Timing and length of shut up 6

Other factors 6

Quality vs Quantity 6

What are the losses in silage making? 7

Summary

To make high quality pasture silage:

- Cut pastures in the milker quality i.e. vegetative stage
- Avoid pastures with seed heads or dead material at the base of the sward
- Mow, wilt and harvest no longer than 24 – 48 hours after cutting
- Increase wilting rate by using a mower-conditioner or tedding immediately after mowing
- Compact stacks well – roll slowly, spread forage in layers < 15 - 20 cm thick
- Seal stacks (white side up) with UV treated plastic immediately after harvesting. Place weight eg. tyres, gravel sausages on stacks
- Seal bales airtight ASAP after baling – 4 layers stretchwrap film, 55 % stretch, 50% overlap. Use 6 layers to ensure 18 months storage. A new 5 layer film, stretched to 70%, is recommended to apply 6 layers
- Maintain airtight seal
- Regularly monitor silage stacks and bales for holes. Repair immediately with specific silage tape
- If silage is heating at feedout, you're feeding out too slowly.

Introduction

Many farmers (and contractors) have been making silage for many years and know how to make and store good quality silage with bugger-all losses! Why is there such a wide variation in the FEEDTEST summaries for each season? Why do so many experienced farmers AND contractors, after having completed a TopFodder Silage course, make such statements as "I did not realise the importance of quality and how to get it" or "I didn't realise where ALL the losses were occurring and how much it was really costing me."

Many farmers accept that the silage quality they end up with is all they can get and a few holes here and there aren't a big problem. However, there are many finer points in silage making not being adhered to by farmers and contractors and there are many new technological advances with which farmers/contractors are not fully acquainted. These can lift profits substantially.

Silage being produced on many farms ranges from that which will provide good milk production to silage which only just keep animals alive! It can be so poorly managed that occasionally animal health problems or worse occurs. Good quality silage is *no more* expensive to make than poor quality silage in most situations.

Why make high quality silage?

High quality silage will allow your cows to maintain (possibly even increase) high levels of milk production at any time in the lactation, not just at mid – late lactation. If high quality silage, 10 megajoules metabolisable energy/kilogram dry matter (MJ ME/kg DM) is fed during the dry period (why would you?) less is needed to supply the same amount of energy as poorer quality silage. Feeding average quality silage (8.5 - 10 ME) should maintain or slightly increase milk production but poor quality silage (<8.5 ME) won't maintain it.

Always aim to make good quality silage because there are many influences which cause you to end up with average to poor quality silage. Such influences, often not in your control, are bad weather before or after cutting, machinery breakdowns and contractor delays. However, some factors that can reduce quality and ARE in your control are:

- having your plastic film on hand
- having the laneways graded, fences dropped, storage sites prepared
- having the mower, tedder, rake, etc. sharp and adjusted correctly
- communicating with your contractor early and regularly
- Knowing the importance of having good quality silage.
- cutting the right crop or pasture fat the correct time to optimise quality
- watching the most useful and up-to-date weather forecast, including using the web, http://mirror.bom.gov.au/products/IDR022.loop.shtml
- Following ALL the best practises for making silage, No shortcuts!

Although silage may not be a major portion of the daily ration on many farms, profitability is substantially affected by silage quality and all losses. 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 200t DM silage when milk is valued at $0.30/L and the conversion of energy in silage to milk is 8 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

Reduction of Losses (%)	Increase of Quality (MJ ME/kg DM)	
	9.8	**10.8**
25	$0	$11,250
15	$14,700	***$27,450***

Source:www.topfodder.com.au

If the quality of the 300 t DM silage is improved by 1 MJ ME/kg DM (9.8 to 10.8) the increased value of milk production will be about $11,250. If the total harvesting and storage losses are reduced from 25% to

15%, income from milk is increased by over $14,700. Achieving both will result in a gain of over $27,450! How much extra cost and effort is needed to achieve this? Possibly a new tedder? Paid for in the first year of savings!

Research work carried out in Victoria, and indeed worldwide, repeatedly shows that the better the silage quality, the better the milk production. Recent New Zealand research (Table 2) shows the effect of silage quality on animal performance during various stages of lactation when fed as a supplement to pasture in the farming system.

Table 2. Responses to silage quality when fed to grazing cows as a supplement on pasture during various stages of lactation.

	Silage Quality		
	High	**Medium**	**Low**
Silage Composition			
ME content (Mj/kg DM)	10.4	9.4	8.3
Crude Protein (%)	17.6	15.1	11.8
Neutral Detergent Fibre (%)	50	56	58
Animal Production			
Winter			
Liveweight change (kg/day)	0.84	0.40	0.62
Spring			
Milk production (kg/day)	18.4	17.9	17.2
Milk solids (kg/day)	1.78	1.67	1.57
Summer			
Milk production (kg/day)	12.3	11.5	10.9
Milk solids (kg/day)	1.28	1.17	1.09
Autumn			
Milk production (kg/day)	6.9	6.1	5.9
Milk solids (kg/day)	0.89	0.77	0.63

Source: TopFodder Silage manual (2003) Table 13.19 Adapted from MacDonald et al (2000)

The cows were provided with enough pasture to provide an intake of 10 kg DM/cow/day during lactation and 5 kg DM/cow/day during the dry period. Silage was offered at 5 kg DM/cow/day during lactation and 3 kg DM/cow/day during the dry period

What is high quality silage?

High quality pasture silage (Table 3) will allow milking cows to perform slightly below that of its original parent material if harvested at the vegetative stage and weather and management at all stages is spot on.

Table 3. Characteristics of high quality pasture silage

Silage Characteristic	Target levels
DM content (%)[1]	30[2] - 40[3] Forage harvested, 40 - 50 Baled
Metabolisable Energy (MJ ME/kg DM)	>10.5
Crude Protein (%)	>15
Neutral Detergent Fibre (%)	<50
pH[4](between 30% – 35% DM)	Grasses 4.50 - 4.65, Legumes 4.70 - 4.80
Ammonia – N (% of total N)	<10

[1] DM content should be about 3 - 5 % units higher for forage harvested legumes at the lower end of range

[2] Longer chopped material, eg. Loader wagons, should use lower end of range,

[3] Very short chopped material eg. Precision choppers, may extend to drier end of range

[4] Baled silage pH values are not reliable due to its restricted fermentation due to their higher DM contents

How do you know your silage quality?

If you have never had your silage analysed a few times over the years, you won't really know. If your cows dropped in milk yield when fed silage, was it due to a drop in intake (silage DM content misjudged?), poorer quality silage (digestibility or ME lower than you thought?), or due to a palatability problem (cows don't like this particular brew?),etc. Knowing your silage quality allows the ration to be adjusted accordingly. Knowing the analyses also informs you of what needs to be done next season to improve its quality. Three techniques for assessing the quality of your silage are:

1. Silage analyses
2. Visual appraisal of the silage
3. "Eyeballing" the pasture before cutting

1. Silage Analysis

Silage quality is most accurately assessed by having it analysed by such laboratories as FEEDTEST. The sample collected must be representative of the stack or batch of bales. Take twelve grab samples from behind a fresh face of a stack, mix and sub-sample, squeeze air out of sample material bag, freeze sample overnight and send to the lab early in the week. Each batch of bales should have about 10 – 12 bales core sampled and treated as described above.

Be aware that the silage fermentation itself can affect intakes and milk production. An apparent high quality silage based on the analyses may not perform as expected, and is often because the fermentation process (and your management and/or weather) has produced some silage characteristics which affects its palatability. Top**Fodder Silage** has encouraged feed testing laboratories to carry out pH and ammonia-N analyses to determine the success or otherwise of the fermentation process itself.

Table 3 shows most of the analyses routinely carried out, although the 2 new tests (pH, Ammonia- N) are additional and must be requested on the forms when sending off the samples. Some laboratories also provide a range of other analyses and you may need assistance to interpret the results.

2. Visual Appraisal

Some indication of quality can be obtained by a visual appraisal of a fresh silage sample but can be misleading if not "calibrated" with actual silage analyses. Silage should have a sweet, pleasant odour, not be too wet or dry, contain no mould and have a light green (grasses) to a darker green (legumes) colour. A very helpful guide is the amount of leaf and/or clovers (higher quality) versus stem or seed heads (lower quality) in the silage.

3. "Eyeballing" the paddock

Another technique is to "eyeball" the paddock before cutting. Milk production will be high if the cows are allowed to pick and choose the pasture if eaten now, leaving the longer stemmy pasture and clumps behind. BUT you are now harvesting ALL that pasture and THIS is what they will eat when offered, no picking and choosing. How will they milk now? Then we have the weather, delayed contractors, etc.

How to get high quality silage

Pasture silage quality is mainly influenced by stage of growth at cutting, timing and length of shut up, prevailing weather conditions and the harvesting, storage and feedout management.

Stage of growth

The single most important determinant of high quality silage is the stage of growth at cutting.
The more vegetative (leafier) the crop and the closer to the correct grazing stage (2.5 - 3 green leaves) it is at cutting, the closer will be the silage quality to the original pasture being ensiled. The analysis of this silage should be well over 10.5 MJ ME. Table 4 indicates the quality (ME) of ryegrass throughout its growth.

Table 4. Ryegrass quality (MJ/kg DM) at different stages of growth

Description of ryegrass	Metabolisable Energy (MJ/kg DM)
Leafy tiller	11.5 - 12.5
Stem starting to develop, nodes <5 cm from ground	11.5 - 12.5
Flag leaf appearing, nodes >5 cm from ground	10.5 – 11.5
Seed head developing, 1 cm long	10 - 11
Seed head starts to emerge	9 - 10
Seed colour changes, seed starts to fill	8 - 9
Seed shedding	6 - 8

Timing and length of shut up

The timing of when paddocks are dropped out of the rotation and how long they are left before cutting will affect quality and yield.

Early closure

If pastures are closed early enough, i.e. dropped out of the rotation, well ahead of when the grasses are due to head, quality will be dictated by the amount of dead ryegrass tillers and clover plants in the base of the sward due to shading. If the pasture stubble is yellow after harvest, then the shut up period was too long, resulting in "unseen" waste and some decrease in quality. However, quality drop off at this stage is much less than later in the season.

Late closure

Length of closure is most detrimental to pasture/silage quality if closure is near when the ryegrass plants are approaching their reproductive stage. Once ryegrass enters its reproductive phase, i.e. start to head, they can change from vegetative to full ear within 10 – 14 days, and correspondingly, decline in quality very quickly. Once closed pastures will decline about 0.3 MJ ME/kg DM and 1.9 % CP per week.

Other factors

- If harvesting paddocks which were sown with a mixture of early and later maturing species, quality will begin to decrease earlier due to the earlier maturing species going to head earlier.
- Pastures containing over 25 – 30% rubbish grasses egs. winter grass, barley grass, will also be low in quality as they will be in head at harvest.
- Most clovers, egs. white, Balansa, sub clovers, maintain high quality well into flowering.
- Use silage additives as appropriate
- Clumpy pastures and those which were poorly grazed last rotation, will be lower in quality.
- Unfavourable weather
- Harvesting, storage and feed out issues such as too long a wilting and/or harvesting period, inadequate compaction, delayed and/or inadequate sealing and poor feed out management will also affect final quality and DM losses to varying degrees. These are covered in more detail in the losses section.

Quality versus quantity

There must be some compromise in yield vs quality. Many farmers and contractors simply look at the extra silage (stack size or number of bales) from a longer and/or a later cut (quantity) completely, and this may be satisfactory for a maintenance or low production diet. However many factors should be considered in the whole farming picture and no one answer will fit all farmers. The more important considerations are:

- Quality of the silage produced from early (lighter) vs later (heavy) cuts
- Quality and quantity of the regrowth and effect on total spring growth
- Effect of early closure on increased grazing pressure on remainder of the farm, i.e. pastures maintained in vegetative stage (higher quality) over greater area for longer time
- Baled silage more suited to earlier, short closures due to flexibility, and potentially of higher quality, albeit more difficult to reach desired DM (40 – 50% DM) content.
- Paddocks only out for 1 rotation, or less, in irrigation districts
- Pasture quality and density reduced by longer closures and/or later cuts
- Greater weed control of annuals with earlier cuts

Table 5, although complicated on first sighting, may provide useful information to help decide quality vs quantity dilemmas.

Table 5. Effect of date and duration of closure on pasture and silage yield and Silage ME over spring from ryegrass pastures in SW Victoria.

Closure Date	Duration of closure (weeks)	Pasture and silage yield (t DM/ha)			
		16 Aug to closure	Silage cut	Regrowth* to 13 Dec	Total 16 Aug to 13 Dec
16 August	6	-	1.07	1.53	2.60
	8	-	1.86	1.35	3.21
	10	-	3.14	0.84	3.98
	12	-	3.96	0.44	4.40
6 September	6	0.66	1.29	1.38	3.33
	8	0.72	2.28	0.78	3.78
	10	0.49	3.64	0.35	4.48
	12	0.66	5.60	0.04	6.30
27 September	6	1.13	1.61	0.77	3.51
	8	1.30	2.55	0.25	4.10
	10	1.31	3.72	0.05	5.08
	12	-	-	-	-

Source: TopFodder Silage Manual: Adapted from Jacobs et al (1998) Table 3.2

*Regrowth was poor due to season in this year

Legend: Quality Estimated ME (MJ ME/kg DM) **> 11.0** **10.5 - 11.0** **10.0 - 10.5** **<10.0**

Some comments on Table 5:

- This is South West Victoria data but the principles would still apply to NIR and Gippsland regions
- What is the effect of irrigation on ryegrass (and paspalum) regrowth and quality?
- Drier districts, eg. NE Victoria, may use slightly earlier shut up times?
- Note the reduced total spring pasture growth when closure is very early
- Note the increased regrowth from early shut up dates
- Note the effect of closure dates and lengths on subsequent regrowth
- Try to estimate the amount of high quality silage and pasture in the total spring growth. Relate these to potential milk production
- Not many farmers would have 10 – 12 week closures these days! More important to look at leaf stage, decay at the base, extra green leaves on the reproductive tillers, etc.

What are the losses in silage making?

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. However be aware that hay making losses are substantially higher! Some losses in silage production are obvious such as mouldy or rotten silage, but some are not such as plants continuing to “live” (respiration) once cut, while wilting, during compaction or in storage!

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. In this scenario the DM yield continues to increase but there is still an “invisible” quality loss.

Losses begin to occur soon after the forage is mown, during its treatment before harvesting, harvesting, during storage and at feeding out. These losses are due to forage not ensiled, continued respiration of plants during wilting, harvesting and stack filling and while bales are unsealed and immediately after sealing and to aerobic fermentation while air remains in the silo or bale can lead to large losses. The fermentation process itself will, unavoidably, cause slight losses. 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.

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 - 16% 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.

The losses can be are segregated into:

- Silage making - before and during (Table 6)
- Storage (Table 7)
- Feeding out (Table 8).

Table 6 summarises losses before and during harvesting, the reasons for these losses and suggested management strategies to minimise them.

Table 6. Sources of field losses during silage MAKING

Operation or source of loss	Type of loss	Reason	Management Solutions
Closure date & length	1.Quality	Closed for too long or closed too late	Cut at 3 green leaves stage before decay starts or heads appear
Mowing	2. DM Quality	Cut too high/too low, paddock areas uncut	Set mower to grazing height, graze after harvest to utilise uncut forage
Tedding	3. DM Quality	Loss of leaf	Avoid tedding above approx. 35 % DM, especially legumes
Wilting	4. DM Quality	Respiration of sugars, protein break down by plant enzymes	Increase rate of wilting with tedder or mower-conditioner but some loss is unavoidable
Raking	5. DM Quality	Some cut material not raked into windrow	Set rake tines to pick cut swath of top of stubble, Graze paddocks after harvest, use rotary rakes
	6. DM Quality	Leaf loss during raking	Avoid over wilting/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
	8. DM Quality	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,	Graze paddocks after harvest
	10. DM Quality	Some material not blown into truck/cart or lost during baling	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, avoid over dry material, cover if carting some distance, grade tracks smooth,

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

Table 7 summarises losses during the storage of silage, the reasons for these losses and suggested management strategies to minimise them.

Table 7. Sources of losses during silage STORAGE

Source of loss	Type of loss	Reason	Management Solutions
Effluent	12. DM Quality	Too wet at ensiling, breakdown in storage	Wilt crops and pastures > 30% DM, cut direct cut crops at later stage of maturity, seal storage airtight
Aerobic losses			
Respiration	13. DM Quality	Too much air in stack/bale allows plant enzymes to "eat" up plant sugars. Poor compaction. Forage too dry.	Avoid ensiling material too dry or chop shorter. Mix less wilted forage in stack or add water. Harvest with dew. Fill stack/pit quickly (within 1 – 2 days). Compact bales/stacks well. Seal airtight ASAP.
Inedible waste silage	14. DM Quality	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 regularly and repair holes immediately.
Fermentation	15. DM Quality	Fermentation of plant sugars. Losses minimal with lactic acid. DM and quality losses higher with poor fermentation, incl. 2nd.'y fermentation	Promote lactic acid fermentation by cutting leafy pastures, wilt quickly to correct DM %, use additives, including, aerobic inhibitors, as required, compact stack or bales tightly, maintain airtight seal.

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

Table 8 summarises losses during the feeding out of silage, the reasons for these losses and suggested management strategies to minimise them.

Table 8. Sources of losses during FEEDING OUT out of silage

Source of loss	Type of loss	Reason	Management Solutions
Aerobic spoilage (Heating & mould growth)	16. DM Quality	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 inhibitor additives at harvesting as required. Maintain airtight seal. Feed out rate maximum of 2 days across silage face or average of >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.

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

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