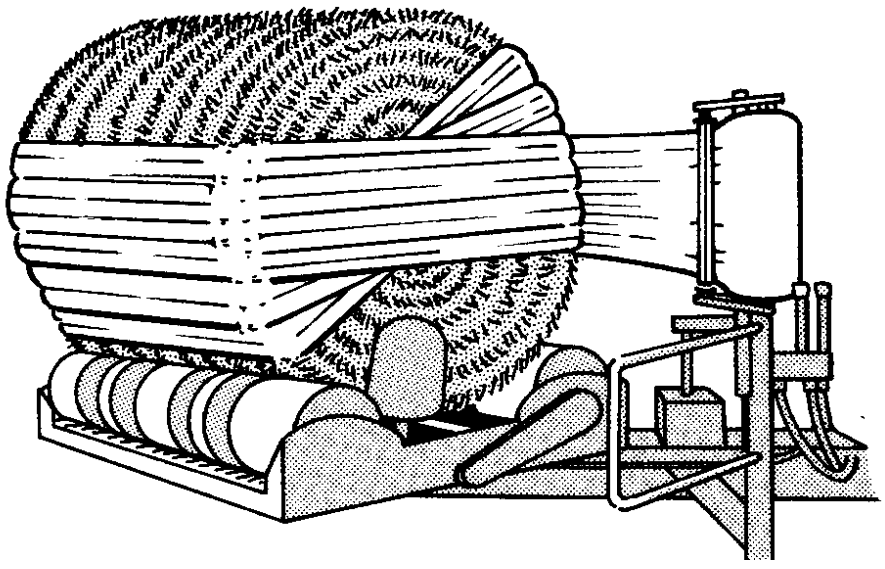
PRIFYSGOL ABERYSTWYTH UNIVERSITY

Baled Silage

A guide to efficient baled silage production

Rhun Fychan and David Davies



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Effect of film layering on silage quality

(Evaluation under commercial farm conditions)

As found in previous research, increasing the number of film layers will improve silage quality, in conditions where the film receives no mechanical stresses.

An experiment was conducted to evaluate what effect additional film layers had on silage quality under farm conditions, where bales are wrapped in the field and transported to the stacking area. Although not recommended, this is common practice in Wales.

This experiment evaluated the films ability to protect the silage to the full, with mechanical damage to the film very likely.

Ryegrass swards were mown in second cut and wilted for 24 hours before raking and baling.
Bales were alternately wrapped in the field with either 4 or 6 layers of film.
All bales were labelled in the field to record the number of layers applied.
The bales were then loaded onto trailers and carted to the storage area before being stacked in a single stack, 10 bales wide and 12 bales deep on the bottom layer, and 3 bales high.

145 bales wrapped in 4 layers – 16 revolutions with McHale 911B
145 bales wrapped in 6 layers – 24 revolutions as above

After a 6 month storage period, film seal, visible mould, chemical composition and predicted ME and milk output was evaluated.

Bales were stored three high with treatments mixed up within a single stack. The stack was un-netted but tyres were carefully placed on all the upper bales.

At least 11 of the 4 layered bales were damaged by the stubble stems as the bales were tipped off the wrapper, whereas only one of the 6 layered bales had visible stubble damage.

	4 layers	6 layers
Film seal (seconds)	73	150
Mould cover (%)	1.75	0.75
Dry Matter (g/kg)	504	507
pH	5.44	5.42
Ammonia N (g/kg N)	70	70
Lactate (g/kg DM)	14.9	15.1
Crude Protein (g/kg DM)	150	148
ME (mj/kg DM)	9.93	10.06
Predicted LWG (kg/day)	0.62	0.65
Predicted intake (kg DM/day)	14.17	14.20
Predicted Milk Yield (litres/day)	13.42	13.87

Film seal was improved substantially by the application of extra film. This in turn resulted in –

- Reduced moulding
- Improved ME
- Increased predicted live weight gain
- Increased predicted milk yield

Considerable differences were observed between the inner and outer bales within the stack. The outer bales had more mould cover and lower ME and predicted milk yield than the protected inner bales. With more than half the bales being outer bales, even in a stack of 300, it proves that protecting a stack by using a net is beneficial.

This work was funded by Hybu Cig Cymru and bpi.*agri* (manufacturers of Silotite).

Predicted ME, LWG and milk production assessed in collaboration with AFBI, Hillsborough, Northern Ireland.

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The Sheep and Beef Development Programme, run by Hybu Cig Cymru, is managed by the Welsh Assembly Government as part of Farming Connect.

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Effect of bale chopping on silage quality

Bale chopping benefits the silage fermentation in two ways

- It increases bale density – more grass thus less air in each bale resulting in a more rapid fermentation
- Chopping releases sugars – more food for the bacteria resulting in a more rapid fermentation

A more rapid fermentation results in better silage quality with higher levels of true protein and residual sugar (WSC)

An experiment in first cut evaluated the effect of chopping v not chopping.

Hybrid ryegrass was mown and wilted for 5 hours before 20 bales of each treatment were produced.

The chopped bales were 12% heavier than the unchopped bales at harvest

	Unchopped	Chopped
Density (kg/m^3)	407	457
Dry Matter (g/kg)	319	329
pH	4.52	4.30
Ammonia (g/kg TN)	46	43
Crude Protein	180	175
ME (mj/kg DM)	11.5	11.5
WSC	26	37
Ash	86	80
Lactate	45	54
Acetate	5.1	7.6
Ethanol	12.1	9.4

The results suggest that the chopped bales fermented quicker and therefore more efficiently as shown by -

- Lower pH
- More Lactate
- More Residual Sugar (WSC)
- Less Ethanol

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Effect of additive application on silage quality

On grass there are beneficial bacteria that carry out the silage fermentation, and detrimental bacteria that cause poor silage with high levels of ammonia and butyric acid. Often, numbers of the detrimental bacteria are 1000 fold higher than the beneficial bacteria.

Inoculant application benefits the silage fermentation in two ways

- They guarantee the beneficial bacteria out number the detrimental bacteria thus ensuring a better fermentation
- They have been specially selected to utilise the sugars quickly thus giving a more rapid fermentation

A more rapid fermentation results in better silage quality with higher levels of true protein and lower ammonia

An experiment in first cut evaluated the effect of inoculation v untreated.

Hybrid ryegrass was mown and wilted for 5 hours before 20 bales of each treatment were produced.

	Untreated	Inoculant
Dry Matter (g/kg)	323	325
pH	4.53	4.28
Ammonia (g/kg TN)	48	39
Crude Protein	179	175
ME (mj/kg DM)	11.46	11.48
WSC	32	31
Ash	85	82
Lactic Acid	44	54
Acetic Acid	5.1	7.6
Ethanol	12.2	9.3

Inoculation results in a more rapid and efficient fermentation as shown by -

- Lower pH
- Lower Ammonia
- More Lactate
- Less Ethanol

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Effect of film layering on Silage quality

Increasing the number of film layers applied will increase film seal, reducing the flow of air in and out of the bale.

An experiment was conducted to evaluate the effect of increased layering on silage quality.

45 bales wrapped in 4 layers – 16 revolutions with McHale 911B
45 bales wrapped in 6 layers – 24 revolutions
45 bales wrapped in 8 layers – 32 revolutions

All bales were stored in a single layer and netted

After a 6 month storage period, film seal, visible mould, chemical composition and predicted ME and milk output was evaluated.

Bales were stored in a single layer with a gap between each bale. This ensured that each bale received the same treatment.

	4 layers	6 layers	8 layers
Film Seal (sec)	47	76	111
Mould cover (%)	0.48	0.10	0.06
DM recovery (%)	89.6	91.8	92.5
Dry Matter (g/kg)	368	382	384
pH	4.2	4.2	4.2
Crude Protein (g/kg DM)	138	138	138
Ammonia-N (g/kg N)	40	40	40
Lactate (g/kg DM)	23.6	22.5	21.2
Acetate (g/kg DM)	7.3	6.8	6.3
WSC (g/kg DM)	132	140	150
ME (mj/kg DM)	11.40	11.42	11.50
Predicted Intake (kg DM/d)	13.4	13.4	13.5
Predicted Milk Production (l/d)	15.9	16.0	16.5

As expected, film seal improved with increased layering.
This results in less oxygen entering the bale during the storage period, resulting in –

- Less surface mould
- More dry matter recovered
- A more efficient fermentation
- Higher ME
- Higher predicted milk production

Increasing film layers on bales does not give added protection against bird damage. Bales wrapped on the field should always be carted to the stacking area immediately after wrapping.

Wrapped bales should always be handled and transported carefully.

This work was funded by bpi.agri and DOW Europe.

Predicted ME, LWG and milk production assessed in collaboration with AFBI, Hillsborough, Northern Ireland.

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The effect of inadequate film wrapping

To successfully preserve baled silage it is vital that sufficient film is applied to the whole bale. Skimping on wrapper revolutions when aiming for 4 layers of film will results in areas of the bale being covered by only 2 layers.

To establish the number of revolutions of the wrapper required to apply 4 layers –

Count the number of revolutions required to completely cover the bale with film, add 1 revolution and double the total

To apply 4 layers of film to the whole bale, the IGER combination of baler / wrapper requires 16 revolutions of the wrapper.

IGER evaluated the effect of inadequate wrapping by comparing 14, 15, 16 and 17 revolutions of the wrapper.

Eight bales were wrapped in each treatment.

After 5 months storage, film seal, visible mould, chemical composition and predicted ME and milk output was evaluated.

	14 rev	**15 rev**	**16 rev**	**17 rev**
Film seal (sec)	68	105	124	130
Mould (%)	0.99	0.17	0.10	0.06
Listeria (per g / FM)	61894	1081	2250	688
Dry Matter (g/kg)	538	569	595	606
pH	4.96	4.93	5.11	5.26
Ammonia N (g/kg N)	84	77	69	69
Lactate (g/kg DM)	27.7	25.9	20.3	17.5
Crude Protein (g/kg DM)	125	129	125	129
ME (mj/kg DM)	9.84	10.23	10.00	9.75
Predicted Intake (kg DM/day)	13.4	13.6	13.7	14.2
Predicted Milk Production (l/d)	12.0	13.4	12.9	13.2

Visually, there were very few differences between the silage treatments. But our scientific tests proved otherwise.

Film seal measurements accurately measure the movement of air in and out of the bale.

Reducing revolution resulted in –

- More air entering the bale
- Increase in mould
- Increase in listeria
- Wetter bales
- Lower predicted Intake
- Lower predicted milk output

Inadequately wrapped bales may not be visually different, but may contain very high levels of listeria.

This work was funded by Hybu Cig Cymru and bpi.*agri* (manufacturers of Silotite).

Predicted ME, intake and milk production assessed in collaboration with AFBI, Hillsborough, Northern Ireland.

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Effect of wilting on baled silage quality

Increasing the dry matter of grass by rapid wilting can improve the preservation of baled silage.

An experiment was conducted to evaluate the effect of increased wilting on silage quality.

Grass was mown with a spreader mower.
The grass was raked immediately prior to baling.

- 45 bales produced after a 24 hour wilt
- 45 bales produced after a 48 hour wilt
- 45 bales produced after a 72 hour wilt

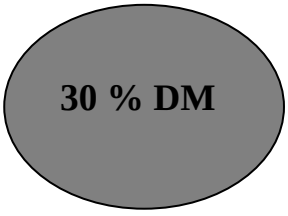
All bales were stored in a single layer and netted.

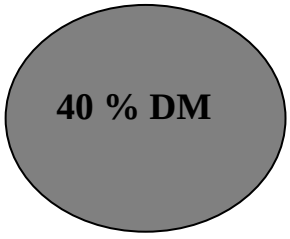
After a 6 month storage period, film seal, visible mould, chemical composition and predicted ME and milk output were evaluated.

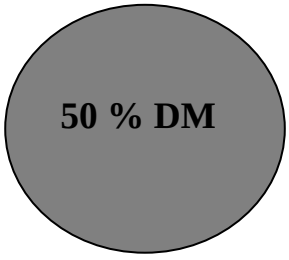
A 20 acre field was mown with a spreader mower. Areas of the field were raked and baled after 24, 48 or 72 hours.

Film seal was improved with increased wilting.

This is due to the misshaping of lower DM bales. Misshaping results in crinkling of the film allowing air to enter.







	24 hr wilt	48 hr wilt	72 hr wilt
Film Seal (sec)	53	94	87
Mould cover (%)	0.23	0.27	0.14
DM recovery (%)	87.0	92.9	94
DM (g/kg)	282	380	472
pH	3.9	4.2	4.5
Nitrogen (g/kg DM)	23	22	21
Amm-N (g/kg N)	46	39	35
Lactate (g/kg DM)	33.5	22.2	11.4
Acetate (g/kg DM)	8.9	6.4	5.1
WSC (g/kg DM)	101	153	169
ME (mj/kg DM)	11.54	11.41	11.38
Predicted Intake (kg DM/d)	12.7	13.3	14.3
Predicted Milk Production (l/d)	14.8	15.8	17.8

Less air entered the higher DM bales resulting in –

- Less surface mould
- More dry matter recovered
- A more efficient fermentation
- Higher predicted milk production

There are risks in leaving grass to wilt too long. Undesirable bacteria and moulds can multiply on the forage during a long wilting period. We recommend that wilting should be as rapid as possible by using spreader mower and tedders.

Care should be taken when wilting to very high dry matters (above 60%). Silage fermentation is unpredictable above 60% and this could lead to high levels of spoilage.

This work was funded by bpi.*agri* and DOW Europe.

Predicted ME, LWG and milk production assessed in collaboration with AFBI, Hillsborough, Northern Ireland

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Effect of Film-Wrap Colour on Silage Quality

It is claimed that light coloured film improves silage quality compared with black film. Is this true?

In theory white coloured bales reflect heat so keep silage cool during storage.
This results in less air movement in and out of the bale resulting in better quality silage.

To test this theory our experiment involved:

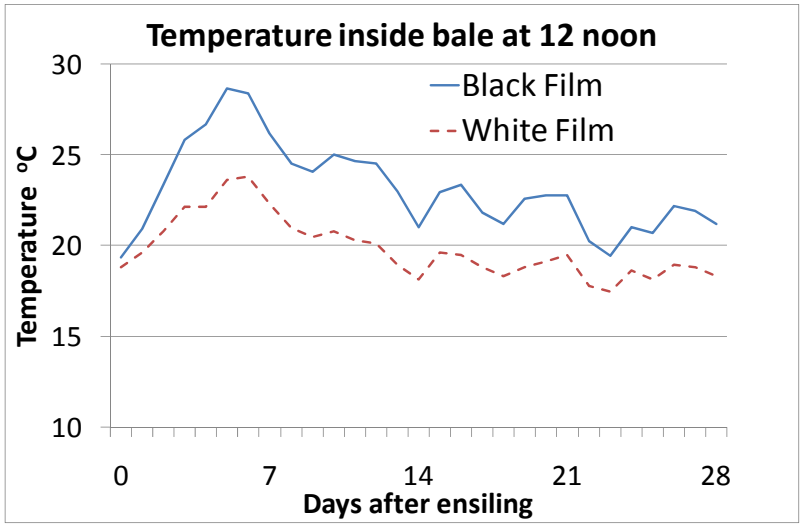
64 bales wrapped in black film
64 bales wrapped in white film

All bales were stored in a single layer and protected with a net

After a 6 month storage period, film seal, visible mould, chemical composition and predicted ME and milk output was evaluated.

Bales were stored in a single layer with a gap between each bale. This ensured that each bale received the same treatment.

The silage within the white wrapped bales was cooler than in the black wrapped bales



	Black Film	White Film
Film Seal (sec)	113	184
Visible Mould cover (%)	0.26	0.50
DM recovery (%)	93	94
Aerobic stability (hours)	139	118
Dry Matter (g/kg)	311	316
pH	4.05	4.03
Crude Protein (g/kg DM)	123	122
Ammonia-N (g/kg N)	118	121
Lactate (g/kg DM)	65	68
Acetate (g/kg DM)	6.0	6.5
WSC (g/kg DM)	106	103
Predicted ME (mj/kg DM)	10.60	10.67
Predicted Milk Production (l/d)	10.8	10.9
Predicted Liveweight Gain (kg/day)	0.62	0.62

The high film seal value on the white coloured bales suggests that there was less air movement in and out of the white bales, but :-

Even though the white wrapped bales were cooler and better sealed

- There was very little difference in silage quality
- White bales had more mould than the black bales
- Black bales were less prone to heating once opened for feeding

Wrapped bales should always be handled and transported carefully. Always remember that any mechanical damaged to the film will have more effect on silage quality than any other factor.

This work was funded by DOW Europe.

Predicted ME, LWG and milk production was assessed in collaboration with AFBI, Hillsborough, Northern Ireland.

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Pre-stretched Bale Wrap

What is it? Pre-stretched bale wrap has already been stretched during manufacture. It can be applied using a combi bale wrapper with standard pre-stretch gearing.

Pre-stretched bale wrap is thinner than standard film - 25 micron v 17 micron

Weight wise - 6 layers pre-stretched film = 4 layers standard film

Our experiment involved:

16 bales were wrapped in 6 layers of Pre-stretched film
16 bales were wrapped in 4 layers of Standard film
16 bales were wrapped in 6 layers of Standard film

After a 6 month storage period, film seal, visible mould, chemical composition, predicted ME and predicted LWG and milk production were evaluated.

	Pre-stretched 6 layers	Standard Film 4 layers	Standard Film 6 layers
Film seal (seconds)	414	104	208
Visible Mould Cover (%)	0.024	0.205	0.002
DM recovery (g/kg DM)	979	926	972
Aerobic stability (hours)	149	129	171
DM g/kg)	460	432	456
pH	5.51	5.46	5.55
CP (g/kg DM)	180	185	182
Ammonia N (g/kg N)	105	116	106
WSC (g/kg DM)	105	91	100
Lactate (g/kg DM)	8.7	8.1	9.1
Acetate (g/kg DM)	6.6	6.7	5.7
Predicted ME (mj/kg DM)	10.75	10.59	10.60
Predicted Milk Prod. (l/d)	16.8	16.2	16.4
Predicted LWG (kg/day)	0.80	0.78	0.78

Bales were handled and stored carefully to avoid any physical damage to film

Film seal was excellent in the pre-stretched film

The results indicate that 6 layers of pre-stretched film performed as well as 6 layers of standard film, but using the same amount of plastic as 4 layers of standard film

Care was taken not to damage the film in this experiment. Further tests are required to assess pre-stretched film in field wrapping conditions where bales are dropped onto stubble and may be carted for long distances

Wrapped bales should always be handled and transported carefully. Always remember that any mechanical damaged to the film will have more effect on silage quality than any other factor.

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