Vita Plus Custom Harvester Meeting

Bales and Baleage

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Silostop Technical Support Team

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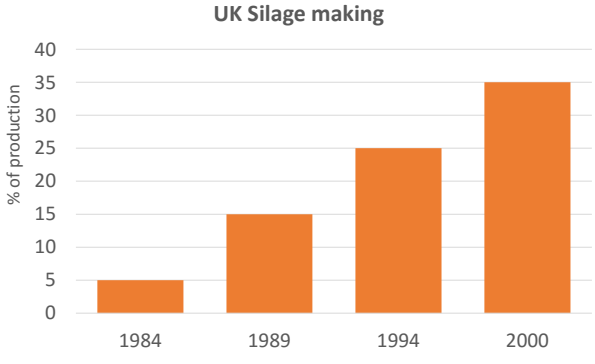
How much Baleage is made?

- W Europe
  - 10 – 25% of all silage



(Wilkinson, 2003)

Why make baleage / haylage (1)

- Conserving small amounts of forage
  - Less equipment and fewer workers are required
  - Small numbers of animals being fed at certain times of the year
    - Smaller farms, goats, sheep, (horses)
  - Small areas of grassland surplus to grazing requirements
  - Specialist crops such as low DCAB grass silage for cattle
- Reduced spoilage at feed-out.
- Easier to move than silage made in a silo.
- Baled silage trades well : UK, USA, Indian sub-continent etc.

Why make baleage / haylage (2)

- Less weather dependent and easier to store than hay.
  - Big issue on coast, Scotland etc.
- Reduced machinery requirements at feed-out.
  - Fore-end loader and 'un-winder' for use in field (Australia, Russia)
- Lower capital costs than a silo
  - Costs of building a silo can be high (UK - £110/Tonne stored)
  - Minimal capital costs for storing bales
  - Can be strict environmental controls and constraints for silos.
  - Fewer environ regulations on baled silage storage
  - However baled silage is more expensive to make than silo silage (UK - £30/T cf £24/T).

Why make baleage rather than hay?

- Shorter drying window
  - Approx 2 days for baleage
  - Approx 4-5 days for hay
  - (UK) Weather forecasts cannot predict that far ahead
- Less dust and poss. fewer mould spores
  - Esp for horses and small ruminants
- BUT washed-out / failed hay will not be saved by baling and wrapping
  - Baling and wrapping is not MAGIC!

Target dry matters?

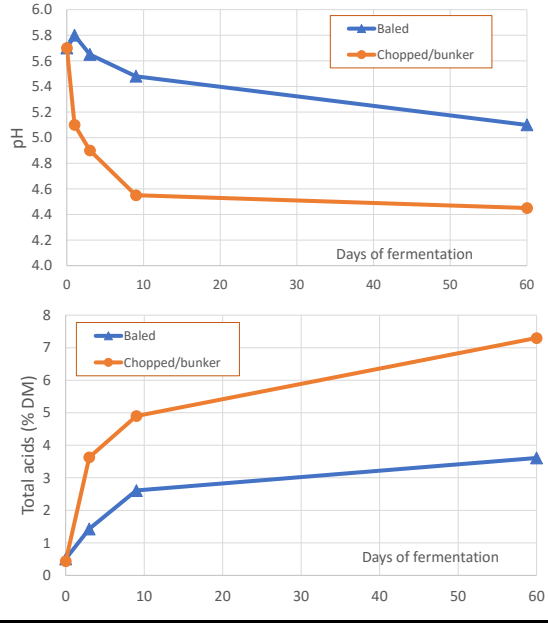
- Aim for 45 – 55%
- Too wet
  - Slump
  - Layers of plastic can split open
  - Clostridial / butyric fermentation
- Too dry
  - Restricted fermentation – high pH
  - Not stable
  - Can heat up when opened

What can be baled?

- Just about everything can be baled.
- Grass, alfalfa and mixtures
- Corn silage (Holland, Pakistan)
  - Chopper harvested
  - Bales and wrapped in yard
  - Making 1 Tonne bales for selling
- Kale, sorghum, etc, etc.

Baled compared to chopped, bunker silage

- Baled silage
  - lower moisture
  - Restricts fermentation
  - Less acid needed to lower pH
- Usually not 'conditioned'
  - Lower available sugars
  - Slow fermentation

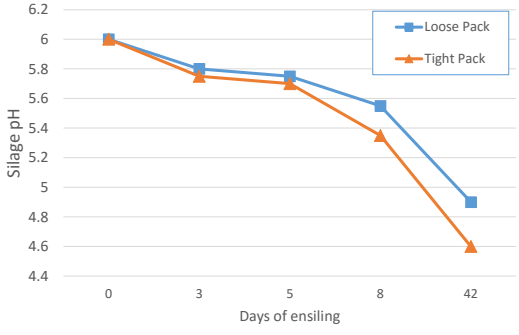


Muck (2006), alfalfa/grass, 61% moisture

Compaction in bales

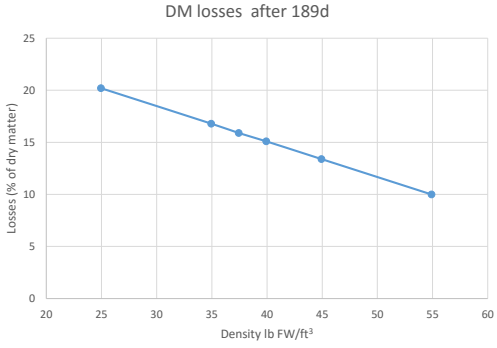
- All silage making is an anaerobic process
- Silos: compaction target = 44 – 48 lb. FW/cu ft.
  - Less air within the silage pile
  - Fewer routes for air to move along – porosity
  - Smaller piles
- Bales
  - Make as dense as possible (>25 lb FW/cu ft)
  - ? Over 2000 lbs

Effects of looseness on DM losses



- Tighter compaction gives faster and lower pH fall in bunks.

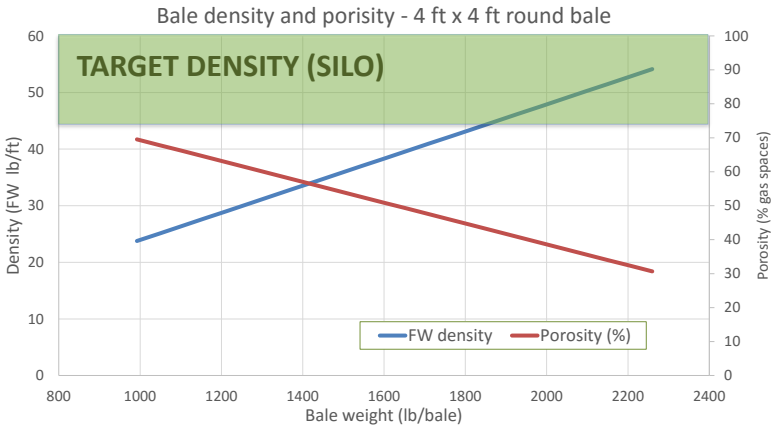
Lynch and Kung (2000)



- Denser bunker silos have lower dry matter losses (spoilage) after 6 months

Holmes and Muck (2002)

How much air are you baling?



- **Porosity**
- Proportion of bale that is air
- Problems
  - Initial air in bale
  - More channels for air to move around
  - Air penetrates deeper
- Make bales as heavy as you can lift

Weight of bales

- Make as heavy as possible
  - Better compaction – less air tracking in
    - Lower dry matter losses
  - Lower wrapping costs/Ton
  - Lower transport costs/Ton
- All those involved need to be able to lift them

Baler and wrapper developments

- Baling of forages started in 1970's
- Mature industry
  - Continual developments
- Modern machines highly automated
  - Computer controlled
  - Operator has become distant from the process
    - How many layers/turns, overlap etc.

Developments 1970's – 2010's

- Balers purpose built for heavy forages
- Moved from bagging to wrapping

- Less air incorporated and less plastic involved

Chopper knives

- Knives just behind pick up reel
  - Chop down to 3”-6” long
- Advantages
  - Heavier bales : less wrapping and transport
  - Less air : Better fermentation
  - Easier to mix into a TMR – less ration sorting
- Disadvantage
  - Needs increased power at baling and slows baling

Wrapper balers

- Combines the baling and the wrapping
  - Quicker
  - Faster to get weather-proof
  - Fewer staff and tractors involved
- Bales wrapped in field
  - More prone to film damage
- Newest combo’s allow for continuous baling and wrapping process.

In line ‘tube’ balers

- Long ‘sausages’ of bales
- Much less wrap per bale
- No handling after wrapping
- BUT
  - Need good access when feeding out
    - Frozen ground (N America)
    - Feed out in drought – dry ground (Australia)
    - Not suitable for UK climate – too wet

In chamber film wrapping

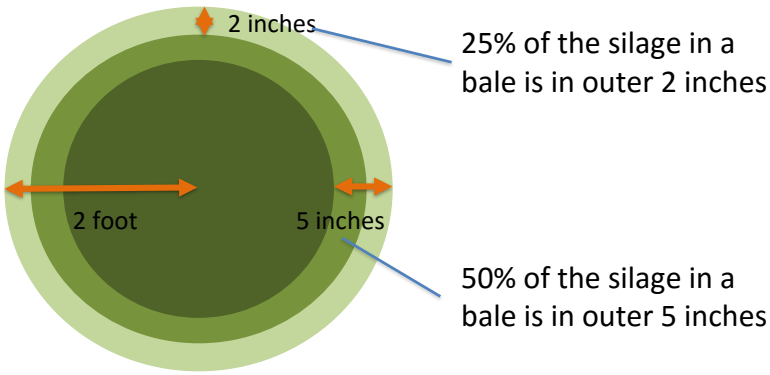
- Use a film rather than a net to wrap bale
  - Less expansion on release from chamber
  - Denser bale, better fermentation
- Film improves the oxygen barrier
- Easier to unwrap/use – esp. when frozen in winter

Wrapping film – New type of film

- Original film = polyethylene
  - Stretchy, tacky, low cost
  - Poor as an oxygen barrier
  - High Oxygen Transmission Rate (OTR)
- Low OTR film being developed
  - Feed grade novel plastic – lower OTR
  - Layered with PE film
  - Same stretch and tack, higher cost

Why is an oxygen barrier important with bales?

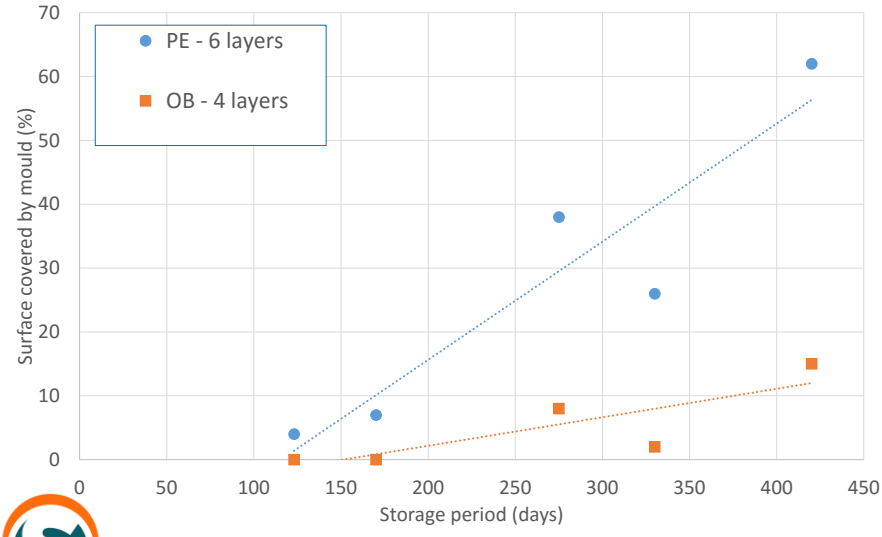
- In silage piles we are concerned about outer 2ft of silage
- Most of silage in a pile is more than 2ft below surface
- Bales are smaller so have higher Surface Area : Volume ratio



How does this affect silage quality?

- Mold cover
  - Oxygen supports molds which break down acids
- Dry matter losses
  - As silage rots nutrient-rich dry matter lost
- Ash
  - As organic matter rots proportion of ash remaining increases
- Appearance / palatability / disease risk

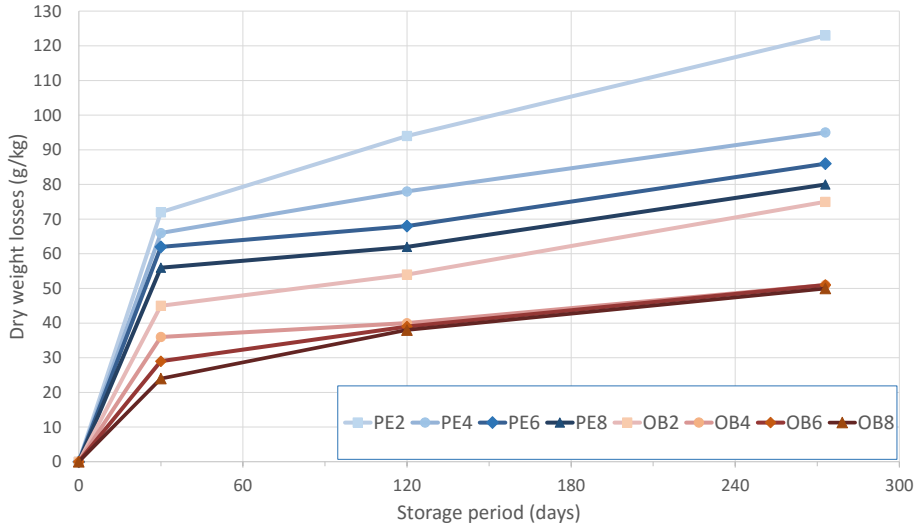
Mould cover cf storage period



Dry weight losses at 273 days correlated with surface mold counts at this time ($r^2 = 0.66$)

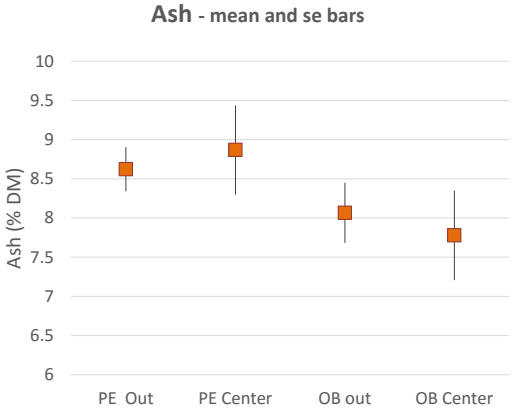
Borreani and Tabacco, (2008)

DM losses increase with storage period

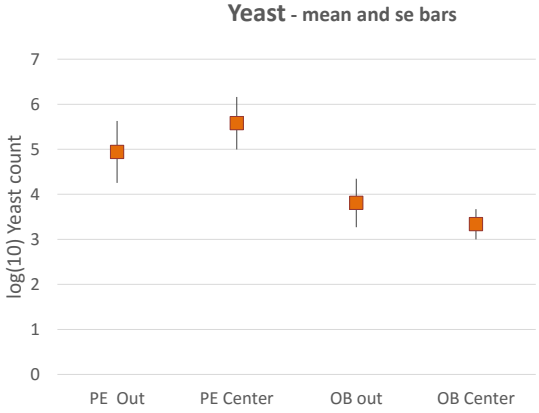


Borreani and Tabacco, (2008)

Silostop wrapping of baled grass silage



p = 0.098 for diff between PE and OB



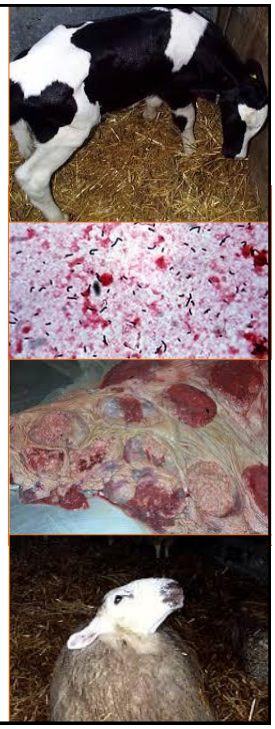
p = 0.005 for diff between PE and OB

n = 5 bales for OB and PE wrap treatments
n.s. for effect of site within bale and any interaction

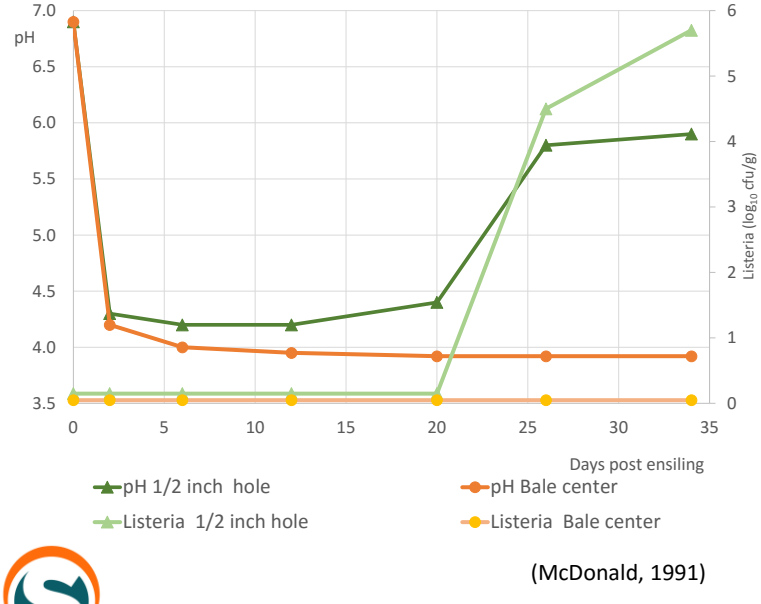
D Lewis, Lallemand, Australia, opened at 7.5 months
Lewis et al (2016) 17th ICFC

Listeriosis *(Listeria monocytogenes)*

- Disease of all ruminants - esp. small ones
  - High mortality (+abortion), often related to Baleage
  - Food poisoning and abortion in humans (cheese)
- Likes MILDLY aerobic conditions
  - Does not grown if entirely anaerobic
  - Out-competed if in aerobic conditions
  - Does not grow below pH approx. 5.5
- High OTR film – mildly aerobic, lactic acid broken down by molds – pH rises
- Low OTR reduce Listeria growth rates
  - Has been seen to reduce listeria eye problems in sheep



pH and Listeria changes in baled silage



(McDonald, 1991)

- pH initially falls at both sites
- Background Listeria cannot multiply
- Air ingress through tie-hole
  - Molds grow
  - Break down of lactic acid
  - pH rises
  - Listeria can grow

Combo wrapping – using different colours

N Carolina, USA

- With more than 1 PSU can use combinations
  - Silostop bale wrap on one spool
  - Normal PE on other(s)
  - Need min 2 layers of Silostop bale wrap in the stack of layers of plastic

Bale colors

- What color films should you use?
- Growing rainbow of colors
- Dark will get hotter than light colors
- Does it matter?

Temperatures inside bales

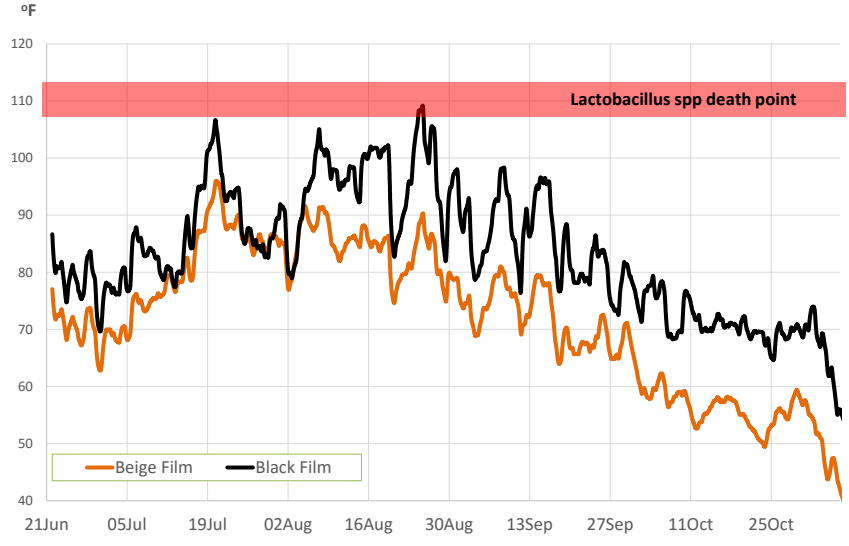
- Fermentation / ensiling is a bacterial process
- Bacteria work faster in hotter conditions but have an upper limit
- Black plastic will heat up more in hot and in sunny weather
- Does this impact on silage quality just below the covering film?
  - Are desirable bacteria killed?

Bacteria death temperatures

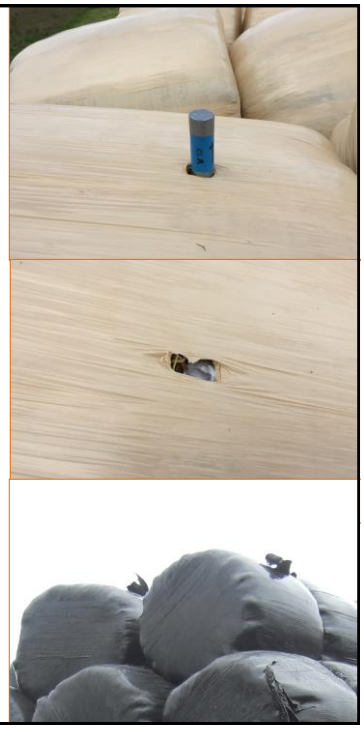
	Death point	
	°C	°F
L plantarum	42	108
L buchneri	45	113

Quoted by Marley, G (2016) 17th ICFC

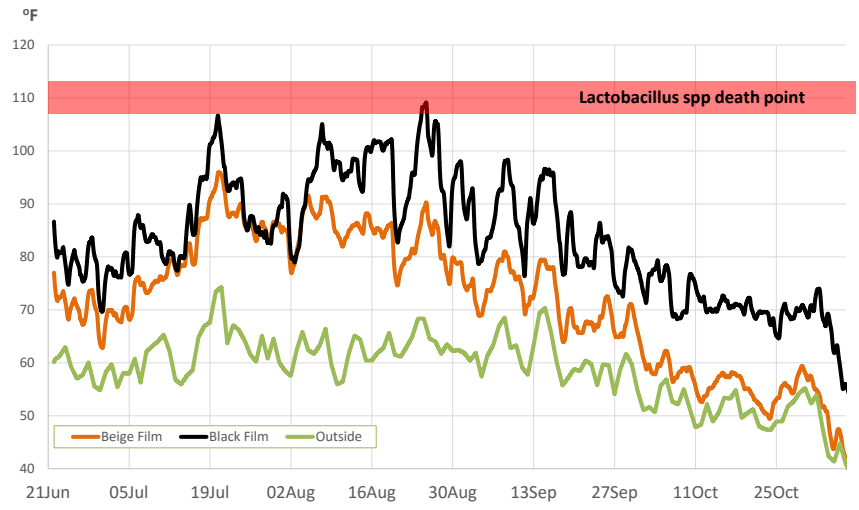
Temperature inside wrapped bales



Data collected in England summer 2016



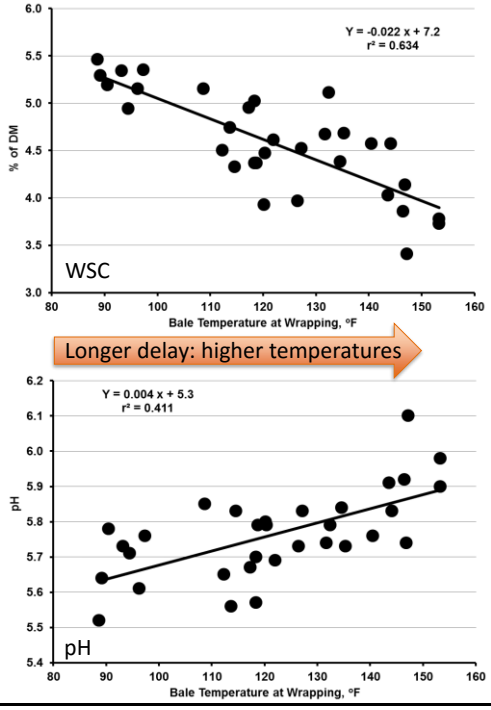
Environmental temperature and temperature inside wrapped bales



- England is a temperate, maritime climate
- Average daily temperatures rarely above 70°F
- Mid-west USA may be 25° F higher
- Risk of Lactobacillus death just under bale wrap in dark bales

How quickly do bales need wrapping?

- Coblenz et al (2016), US DFRC, WI
  - 59% moisture alfalfa (4ft x 4 ft round)
  - Wrapping delayed by 0,1,2 or 3 days
  - Delayed wrapping raised temps
  - Delayed wrapping:
    - Lowers sugars, raised buffering
    - Lowered ferm. acids, raise pH
  - SO: Wrap as soon as possible



How many layers?

- How long will you store the silage for?
- What type of film are you using?
  - What is the OTR?
- How tolerant are you of molds etc?
- How much do the wrapped bales need moving?
- How careful is the team?
- How stemmy is the material?

How many layers?

- Each layer is 50% overlapped
- When bale fully covered 2 layers have been applied
  - count number of turns needed to cover bale
- On simple balers 18 – 22 turns applies around 6 layers.
- Can determine number of layers by careful dissection

Physical damage to bale wrap

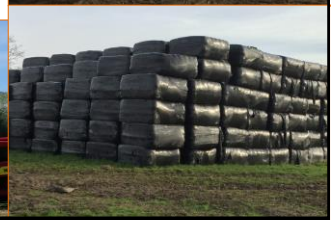
- 6 layers of stretched PE film = 6 mil
  - Human hair about 2 mil
- The film is very thin and very fragile
- Move bales as little as possible after wrapping
  - In line wrappers better
- Big differences between operators
  - Being careful
  - Not going too fast – eg lower don't drop.

SO – How many layers?

- Very user, crop and end-use dependent
- Research workers can make good baleage with 4 layers (Alfalfa, Coblenz, Prof Anim Sci 2016)
- 6 - 8 layers is general starting point
  - V stemmy crops – old alfalfa
  - V low mold tolerance – e.g. horses
  - ?listeria control
- 4 layers
  - Only v soft crops (grass) in round bales and great care
  - Will get damage and mold – is this acceptable?

How to store bales – which way up?

- On their sides or on their end?
  - More layers of plastic on the ends
  - Open up more on ends if bales 'slump'
- In rows or stacks?
  - Rows – easy access
  - Stacks – good protection



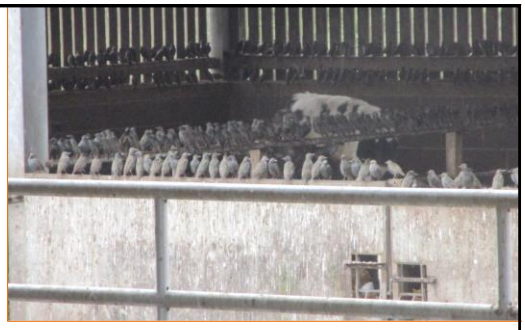
Holes in bale film – and other coverings

- Many bales get holes
  - Few (4%) are patched
- Causes
  - Stems, handling material, transport, vermin, birds
- 3mm hole – 8% loss of edible silage (6 months)
- 24mm hole – 33% loss of edible silage

Silopatches

- Size: 4 inch x 6 inch
- 36 yards long roll
- 216 patches per roll
- perforated between patches
- Very strong glue

Birds and other vermin



- A global problem
  - Birds, badgers, raccoons, parrots, koala bears, etc
- Ireland (McNamara, 2001)
  - 53% of farms report damage to bales when in field
  - 63% report damage in stack yard

Birds and other vermin

- Puncture oxygen barrier
  - As much as 5% of DM made inedible
- Spread disease: Salmonella, TB, etc
- Eat food conserved for the cattle
  - $50/day losses
- Control – ideas please
  - Many vermin are protected

THANK YOU – questions please