The Zimbabwe Herd Book

2018 Beef School

Forage Management

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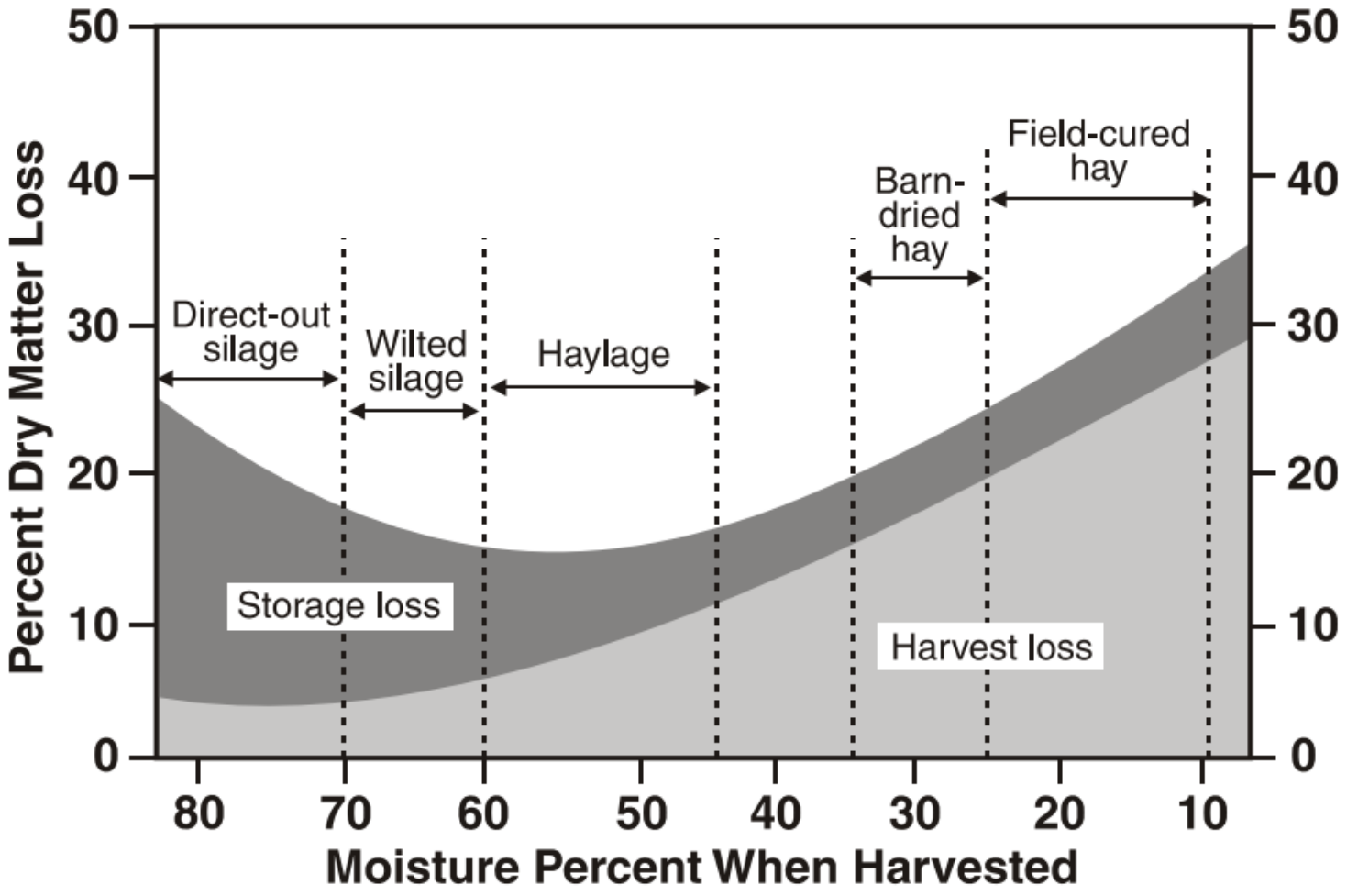
Forages

- Plant material which is harvested for roughage feeding to animals.

Silage

Hay

Moisture levels of forages



Adapted from: Hoglund, 1964

Adapted from data generated by Michigan State University

Silage

Silage – Why make silage?

- Forage preservation
- Preservation of available forage during periods where pasture grows past useable levels (high growth)
- Decreased waste of grazing/ forage from trampling and wastage
- Storage of forage for periods when supply is limited
- **Generally lower nutrient losses than when producing hays**
- **Require less storage space than hays and are not impacted by external conditions such as leaching/ bleaching etc**
- Utilisation of whole plant

Silage making process

1. **Harvest** – crop is harvested and cut from the field
2. **Wilting** – cut crop is placed out to dry to optimal moisture levels for ensiling (60-70% moisture).
3. **Chopping** – crop is chopped to around 1.5 cm in length
4. **Compaction & Product Application** – chopped and wilted crop is placed into silage system (e.g. bunker) and compacted in layers, with very good compaction essential to ensure a good quality final product. If a silage inoculant or other product such as molasses is added to enhance fermentation rate or final product quality it is added on each layer which is compacted.
5. **Sealing** – The compacted layers are sealed off (Oxygen exclusion), removing as much air as possible to enhance the rate of fermentation. This is often achieved by weighting down the covering with soil / tyres

Cutting

- Maize is cut in the hard dough stage.
- Small grains is in the soft dough stage.
- Cut when the starch is well developed.
- DM 28-50% (ideal 35%).
- Less than 25% DM is too wet.

Chopping

- > 19mm → too long
- < 7.5mm → too short
- 8 – 12mm → “unprocessed”
- 15 – 19mm → “processed”

Cracking corn (Kernel Cracker) - Advantages

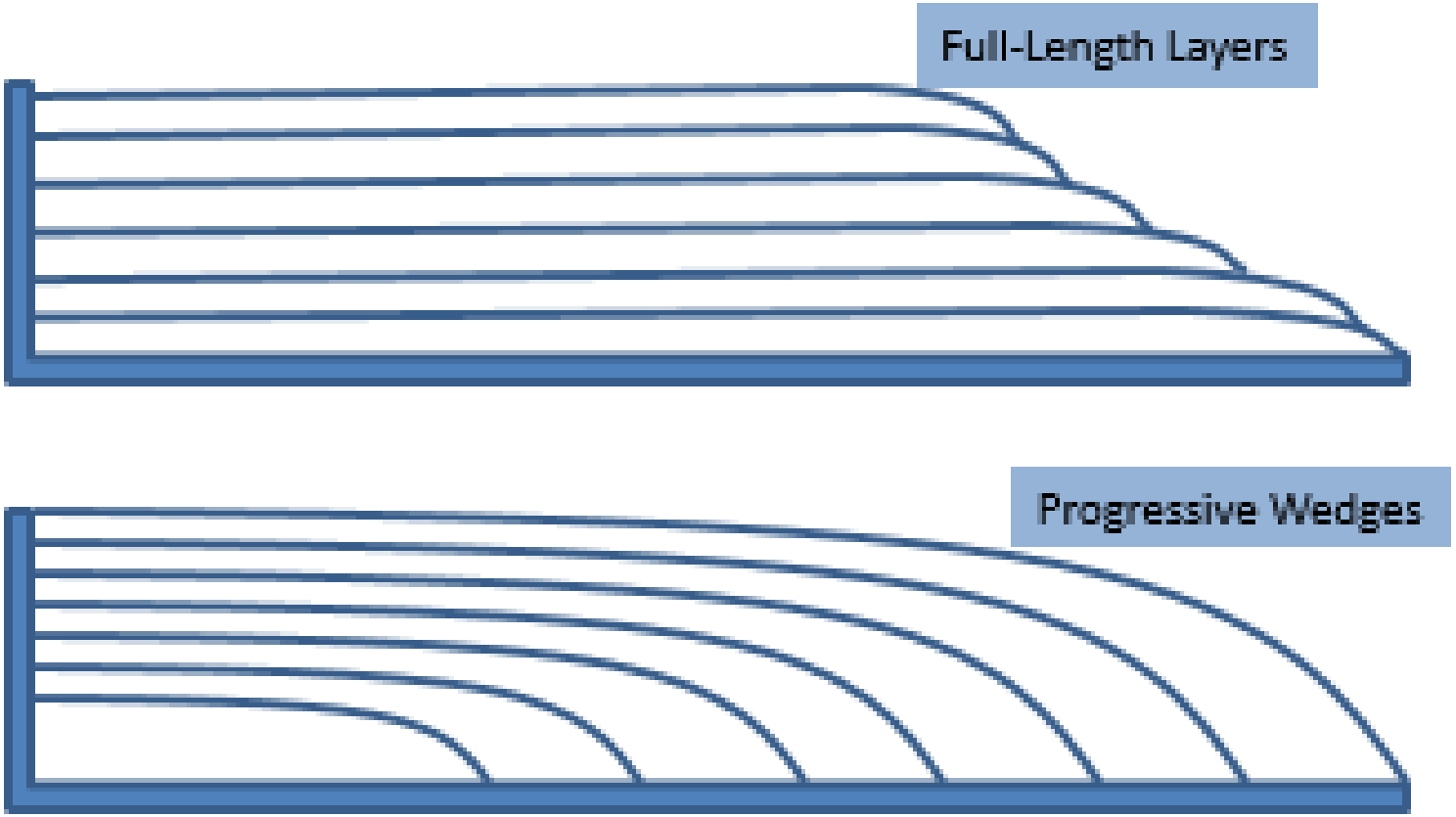
- Improve kernel digestibility
- Especially important when kernels are more mature
- Improves compaction by crushing the plant
- Energy is lost if kernel is not digested (whole kernels in faeces)

Silage filling rate

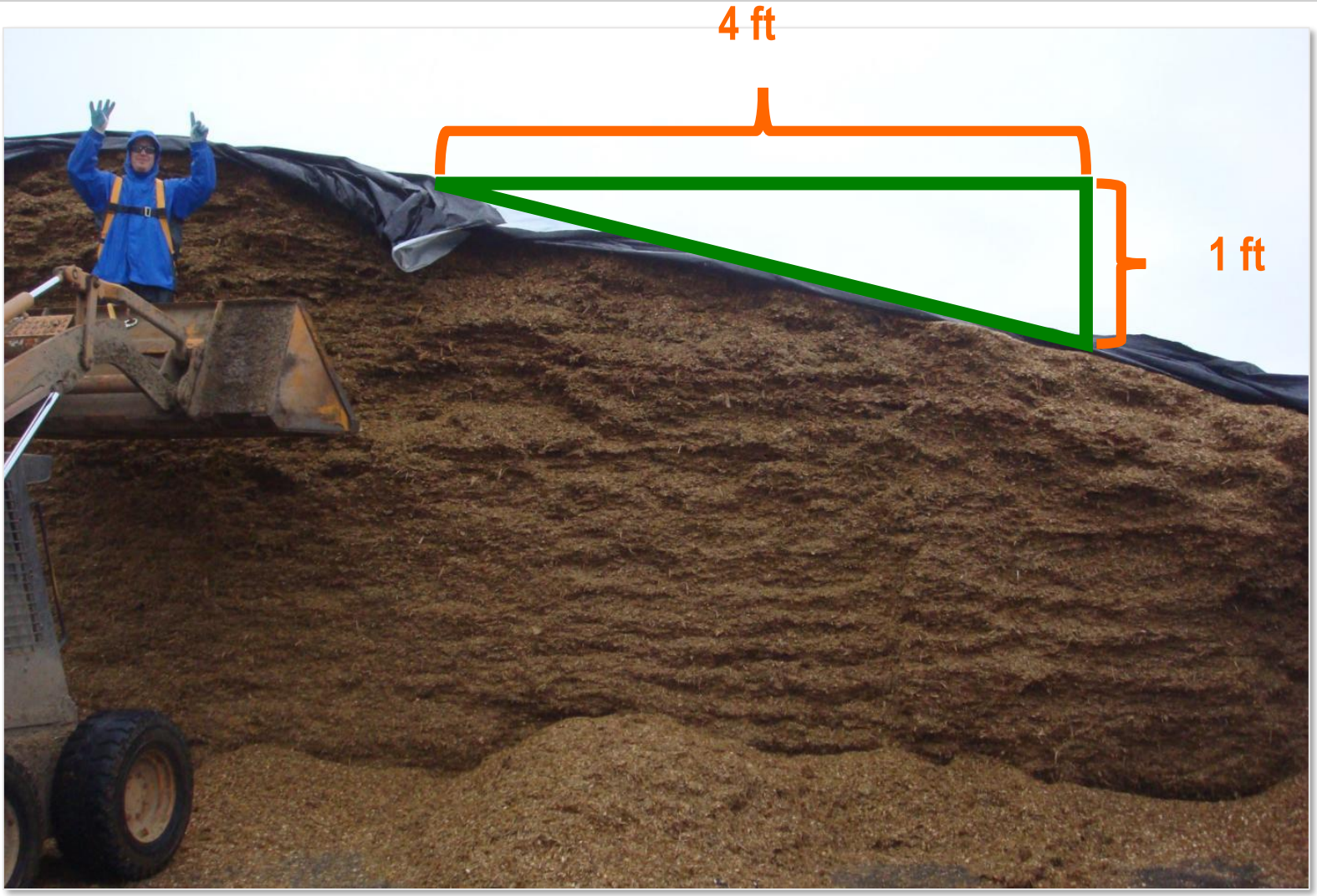
- Fill fast, preferably fill storage structures/bunker in a day.
- Exclude oxygen as soon as possible.
- *Lactobacillus* spp. most efficiently convert sugar to lactic acid during anaerobic fermentation.
- Lactic acid fermentation is efficient and minimise losses.



Compaction – Bunker filling methods



Bunker Slope Recommendation



Compaction

- Packing excludes oxygen & stops respiration

  → stops nutrient loss

- **<u>Bunkers / buns:</u>**
- Maize silage: 650 - 750 kg silage / m^3
- Grass silage: 550 kg silage / m^3
- Compaction time: 3 minutes / ton wet material

- **<u>A way to determine how you are going to be compacting:</u>**
- Wisconson362 Formula

  (tractor weight (kg)) / 362 = t/hour compaction rate

Example: Wisconsin 362 Formula

- **<u>Wisconson362 Formula</u>**
- 15 000kg / 362 = 41 tons a hour
- 8 X 7 ton wagons a hour = 56 tons/hour
- **You need:**
- 2 X 15 000 kg tractor

Silage Inoculants – Why?

- Improve rate/ speed of fermentation
- Reduce pH levels rapidly through specific bacteria strains
- Lower nutrient losses
- Reduce heating
- Reduce moulding/ spoilage
- Reduced Dry Matter/ Shrink losses
- Improved digestibility
- Insurance policy

Silage Inoculants – The 2 types

1. **Homofermentative Inoculants**
   - Produce lactic acid
   - Facilitates quick fermentation (pH drop)
   - Examples: Many species, including *Lactobacillis plantarum*, *Pediococcus spp.*, *Enterococcus spp.*
2. **Heterofermentative Inoculants**
   - Produce lactic acid, acetic acid and ethanol
   - Acetic acid can improve the aerobic stability.
   - Example: *Lactobacillis buchneri*

Silage Inoculants – Application

1. Silage machine spray (pick-up or chute/arm)
2. Boom spray
3. Watering can

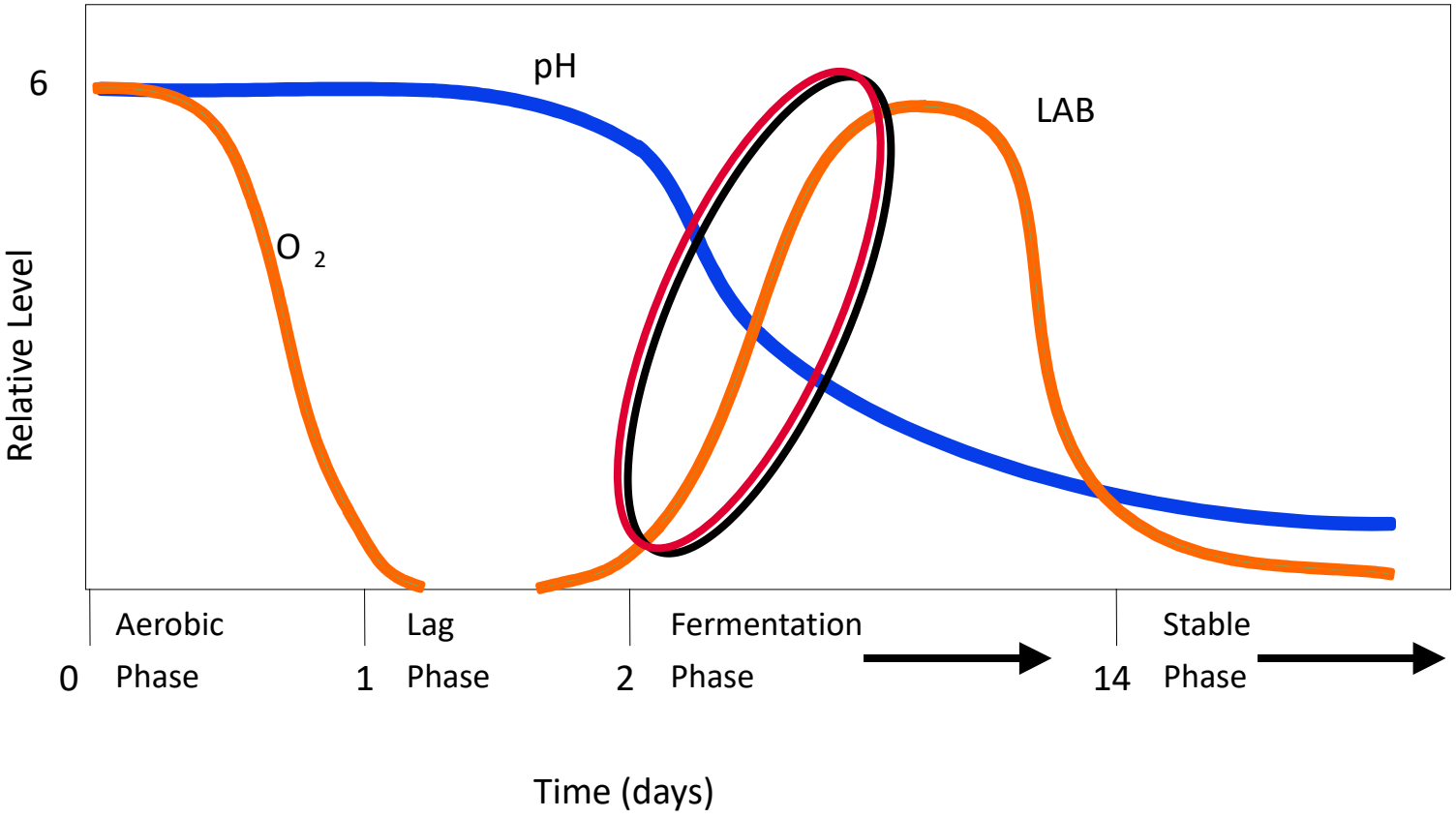
Silage – Sealing & protecting your top layer

- Applying a organic acid blend.
- Applying a layer of salt.
- Packing tyres or other weights on top of the plastic covering.

Silage Covering

- Thicker plastic is better (>150 micron)
- White plastic is better than black
- Oxygen barrier plastic
- Overlap covering of 1 meter

Phases of silage fermentation



Silage – Risk phases

1. **Pre-sealing** – first few days of filling silo, some DM loss and respiration occurs
2. **Fermentation** – few weeks after closing silo, bacterial fermentation, pH decrease, DM loss continues, hemi-cellulose degraded, aerobic respiration stops
3. **Sealing / Infiltration** – some oxygen infiltration, limited microbial respiration occurs, some carbohydrates lost as heat and gas
4. **Feed out/ Emptying** – exposure of surface, additional losses, increased rate of loss

All phases have effects on the quality of final product fed to livestock, depending on management factors such as compaction, sealing, silage removal for feeding etc.

Silage – Where spoilage occurs

Packing / Pre-sealing

- During packing of silage before sealing sometimes a bunker is left open for an extended time/ overnight whilst filling and compacting bunkers.
- This can result in additional losses due to respiration and potential for mould & yeast growth.

Sealing – Damaged covering

- Once a bunker is sealed, if any oxygen penetrates the top layer (especially around the edges/ sides of a bunker) there may be spoilage due to mould and yeast growth. Also when covering is damaged by livestock, rodents, birds, etc.

Feed Out

- Open face of silages exposed to oxygen allow for heating and spoilage organism growth during feed out phase.

Silage – Facing off the bunker

- Proper facing.
- Only face enough for one feeding.
- Match pile height to equipment.
- Feed off 12” (30cm) per day.

Silage – Spoilage & losses

- Dry matter losses (8 – 46% seen)
- Increased NDF and ADF (lower fibre digestibility)
- Nutrient losses (vitamins, sugars, minerals – used by microbes during spoilage)
- Lower intakes (decreased palatability, up to 12% decrease common)
- Decreased fibre mat in the rumen
- Increased risk for LDA (displaced abomasum)

Silage – Improving your silage

- **Improve yield and quality of forages at harvest.**
  - Harvest at appropriate maturity and moisture for the specific crop.
  - Ensure proper chop length and processing of all forages.
  - Utilise buffered acids and inoculants to increase dry matter recovery and bunker ‘shelf’life.
- **Cover the silage – apply an acid treatment and good plastic.**
  - Practice good feed-out management.
  - Reduce surface exposure to air and elements.
  - Reduce seasonal effects on spoilage.

Silage quiz

- **What is the 5 steps of making silage?**

1.
2.
3.
4.
5.

Silage quiz

What is the 4 phases of silage fermentation?

1.

2.

3.

4.

Silage quiz

Name 3 cases/phases where silage may spoil

1.

2.

3.

Silage quiz

Name the two types of inoculants

1.

2.

Hay

Hay - Management and quality:

- Hay production is still a common practice for the preservation of grass & legumes such as lucerne for farm animals.
- All animals require a constant water supply when being fed with hay.

- **Advantages of making hay:**
  - Feed in the winter.
  - Feed during drought.
  - Extra income source - cashflow

Hay – The options

Dry, baled hay - >80% dry matter:

- Small square bales – high surface area to volume.
- Large square bales - moderate surface area to volume.
- Large round bales – low surface area to volume.

Baleage or wrapped bales - 40-60% dry matter:

- Heavier than dry hay, require robust handling equipment.
- Wrappers are required – expensive.
- More labour may be required.

Haylage or hay silage – 50-65% dry matter:

- Clostridial fermentation can occur if too wet.
- Treat this crop as you treat corn silage – pack, pack, pack!

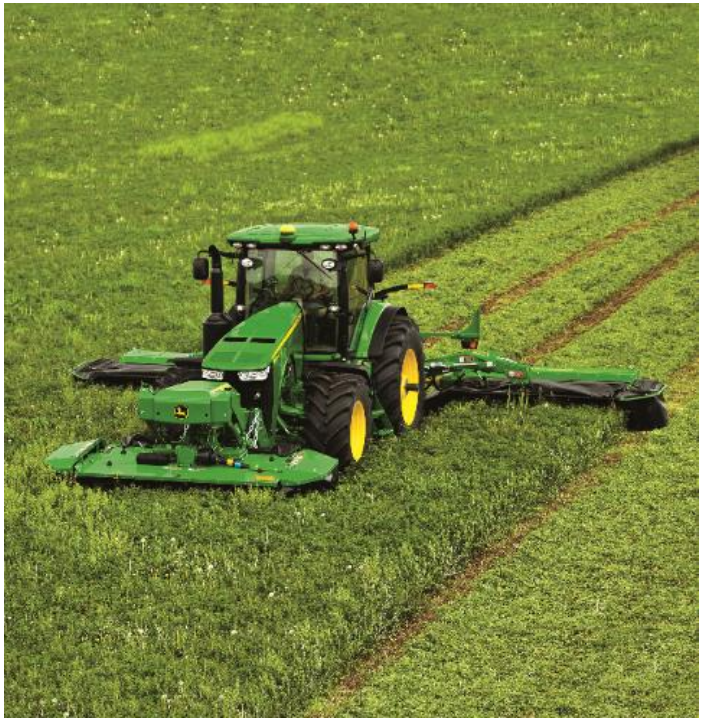
Hay – The baling process

- Aim to bale when the dew sets in.
  - Baling too early → Hay may be too dry.
  - Baling too late → High moisture could be a problem.
- Test windrow moisture
- Always do a test bale or two and measure the moisture.
- Check baler chamber of pressure and set accordingly (option)
- Land topography differences

Baled hay – Curing and moisture

- Ideally curing time should not take longer than 7 days if possible.
- Raking and turning means losses.

- **Ideal moisture:**
  - Small block bales – 16-20%
  - Round bales -16-18%
  - Large square bales – 12-16%



Round bales vs Large square bales

- **Handling**
- **Round:** Round bales are fairly simple to handle with a two-spike loader fork or bale grab.
- **Square:** A three or four-spike loader fork is recommended for the large bales.

- **Storage**
- **Round:** It's harder for water to penetrate a round bale so they're less susceptible to weather. Takes up space when stacked.
- **Square:** Ideal for stacking. Rain will penetrate a square bale which can lead to significant losses.

Round bales vs Large square bales

- **Time/Speed**
- **Round:** Stopping and starting as each bale is finished.
- **Square:** Baler can operate non-stop.

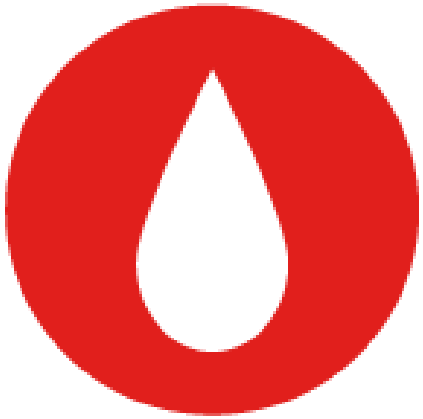
- **Feeding out**
- **Round:** Feeding large herds of cattle by running out hay in long strips from a trailed bale feeder is efficient and fast. Round bales are also good for dropping into large feed mixer wagons.
- **Square:** Those with horses or who are on smaller, less intensive properties prefer small square bales because you can easily break off a section and keep the rest neatly stored.

- http://www.weeklytimesnow.com.au/machine/crop-gear/when-making-hay-theyre-just-two-options-but-many-variables-to-consider

Baled hay – Curing and moisture

- Problems in haymaking vary according to the crop, climate and prevailing weather at harvest:

- **Biggest problem with curing is weather:**
  - Rain
  - Humidity
  - Wind



Baled hay – Your goals

- Minimise dry matter loss due to respiration.
- Minimise rain damage.
- Minimise leaf loss.
- Turn Lucerne into:
  - Revenue for large commercial operators.
  - Milk or meat for livestock producers.
- Maximise yield and nutritional value.
- Goal is to maximise nutrition/hectare.
- Harvesting later to increase the tonnage will lead to poor digestibility

Bales hay – Save more leaves

- 70% of the protein, 90% of the feed value is in the leaves.
- 15% moisture hay means a loss of 30% of your leaves.
- 10% moisture means a loss of 50% of your leaves!
- However, high moisture hay may heat, spontaneous combustion, and burn.

Baled hay – Moisture testing

1. Test by hand
2. Microwave method
3. Moisture probes

Hay – Moisture testing

- **<u>Test by hand:</u>**

  Twist and turn method. Take some hay from the windrow and twist and turn the hay. If the hay starts to break moisture should be fine.

Hay – Moisture testing

- **Microwave testing:**

Preferably a microwave with a turn-table. If your microwave doesn't have a turn-table, be sure to rotate the sample each time you place it back in the oven. Use a microwave-safe plate or pan to hold the sample. **Don't use a paper plate.**

A gram scale accurate to at least 1.0 gram.

A sample of grain or forage representative of the entire lot to be tested. (If the sample is not to be tested immediately after sampling, seal it in an airtight container such as a glass jar or a good quality freezer bag to avoid changes in moisture content.)

More information: https://cropwatch.unl.edu/using-microwave-oven-test-moisture-content-forage-unl-cropwatch-aug-9-2012

Baled hay – Dangers of high moisture

- When moisture levels are higher the bales will lose large amounts of dry matter caused by excessive heating and mould growth.
- Moulds will consume nutrients and as they grow they generate heat. If the hay reaches 55º C or higher, severe browning reactions begin.
- Amino acids and sugars combine to form insoluble nitrogen compounds that are unavailable to animals.
- Mould organisms under heat stress may produce mycotoxins which can be harmful to livestock. Moulds also produce spores that if inhaled can cause lung disease or exacerbate existing respiratory problems.

Controlling your risk of spoilage

- **<u>Organic acid products:</u>**
- Designed to stop microbial activities in the bale
- Keeps the bale cool
- Prevents mould growth
- Safer storage option

- **<u>Making wrapped bales:</u>**
- Use a silage inoculant
- Wrap bale at least six times
- Moisture needs to be between 55 – 70%

Baleage – What is it?

- **Wrapped wet bales – typically round bales of Lucerne.**
- Baled at 45-65% moisture.
- Wrapped with one mil (about 25 microns) thick plastic.
- Covered at least 5 times with at least 50% overlap.
- Wrapped within 4 hours of baling.
- **Advantages:**
- Speed – can get hay off fields before rain.
- Nutritious – by baling at higher moisture, leaves are retained.
- **Disadvantages:**
- Special equipment is needed.
- Usually fed, cannot easily sell the extra production.

Baleage – Equipment?

- **Balers:**
- Cut hay with a mower-conditioner for narrow, even swaths.
- Heavy duty bearings on bales for greater weight of bales.
- Scrapers to clean build-up on belts.
- Drive slower with a high PTO speed.
- **Wrappers:**
- Platform, swinging arm, in-line and bale spear.
- Wrappers can be expensive.

- **Minimise movement of bales.**
- **Store on a well-drained site away from trees.**

Baleage – Equipment?

In-Line

Swing Arm

Platform

Bale Spear

Wrapped bales - Preservation

- Fermentation is required for long term storage.
- Fermentation is slow in Lucerne haylage and baleage.
- For bales with a moisture of 55-65%, use a bacterial inoculant.
- When hay is stressed, frost damaged or not within the ideal moisture range, use an acid blend.

Hay quiz

What is the ideal moisture levels?

1. Small block bales:
2. Round bales:
3. Large square bales:

Hay quiz

Name 3 ways with which you can test your moisture levels

1.

2.

3.

Hay quiz

Name two types of products which can be beneficial for dry hay bales or baleage production

1.

2.

Hay quiz

Advantages or disadvantages of baleage production

Advantages:

1.

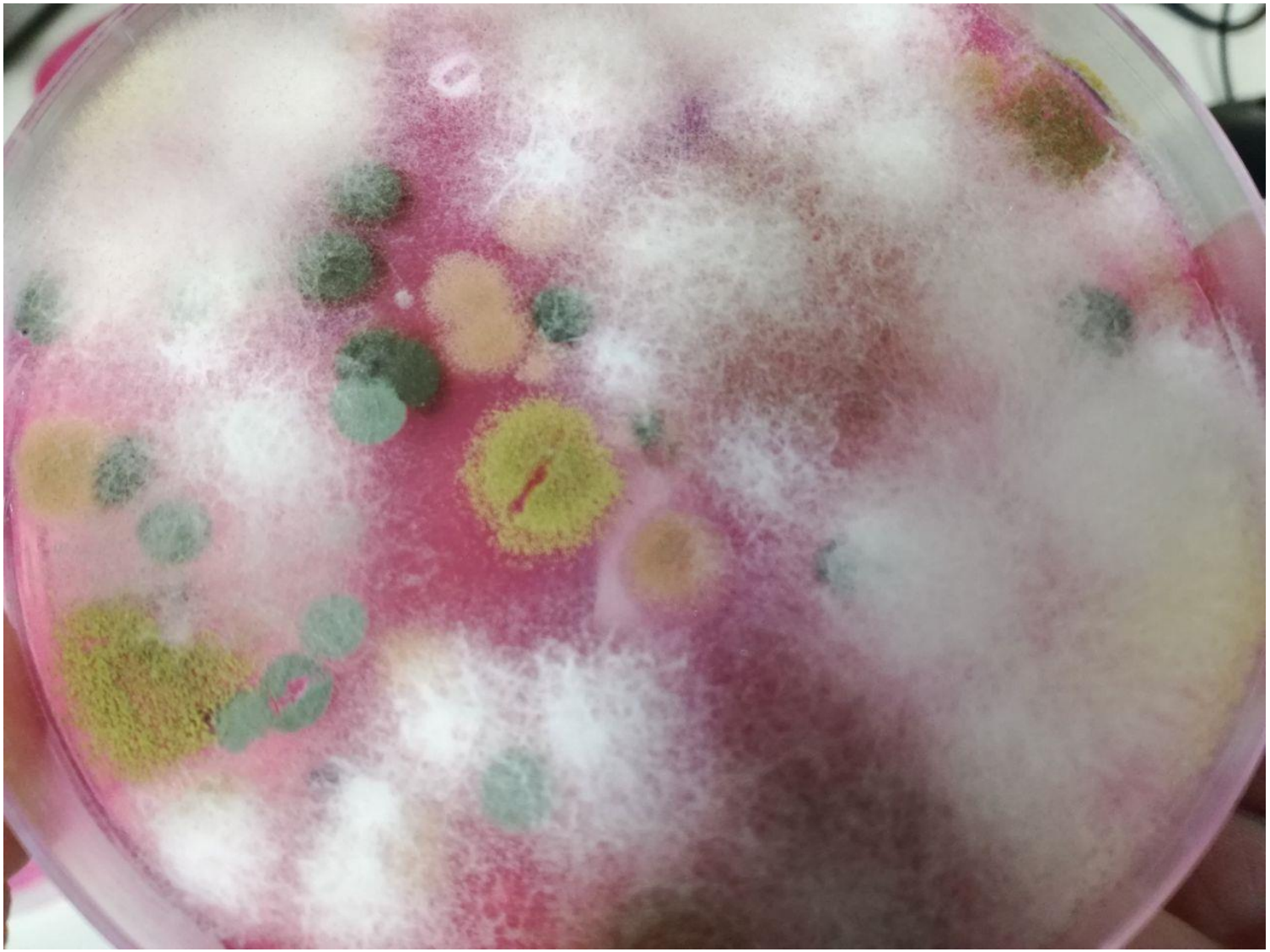
2.

Disadvantages:

1.

2.

Moulds



What are moulds and yeasts?

Characteristics	Moulds	Yeast
Fungi	Yes	Yes
Cell type	Multi-cellular	Single celled
Growth	Hyphae/ Conidia	Budding/ Mitosis
Photosynthesis	No	No
Produce mycotoxins	Yes	No
Visible	Large colonies – spores (coloured)	No
Requirements for growth	Moisture, oxygen	Moisture
Nutritional effect	Carbohydrates, vitamins & proteins	Simple sugars
Palatability	Dustiness (conidia)	Flavour

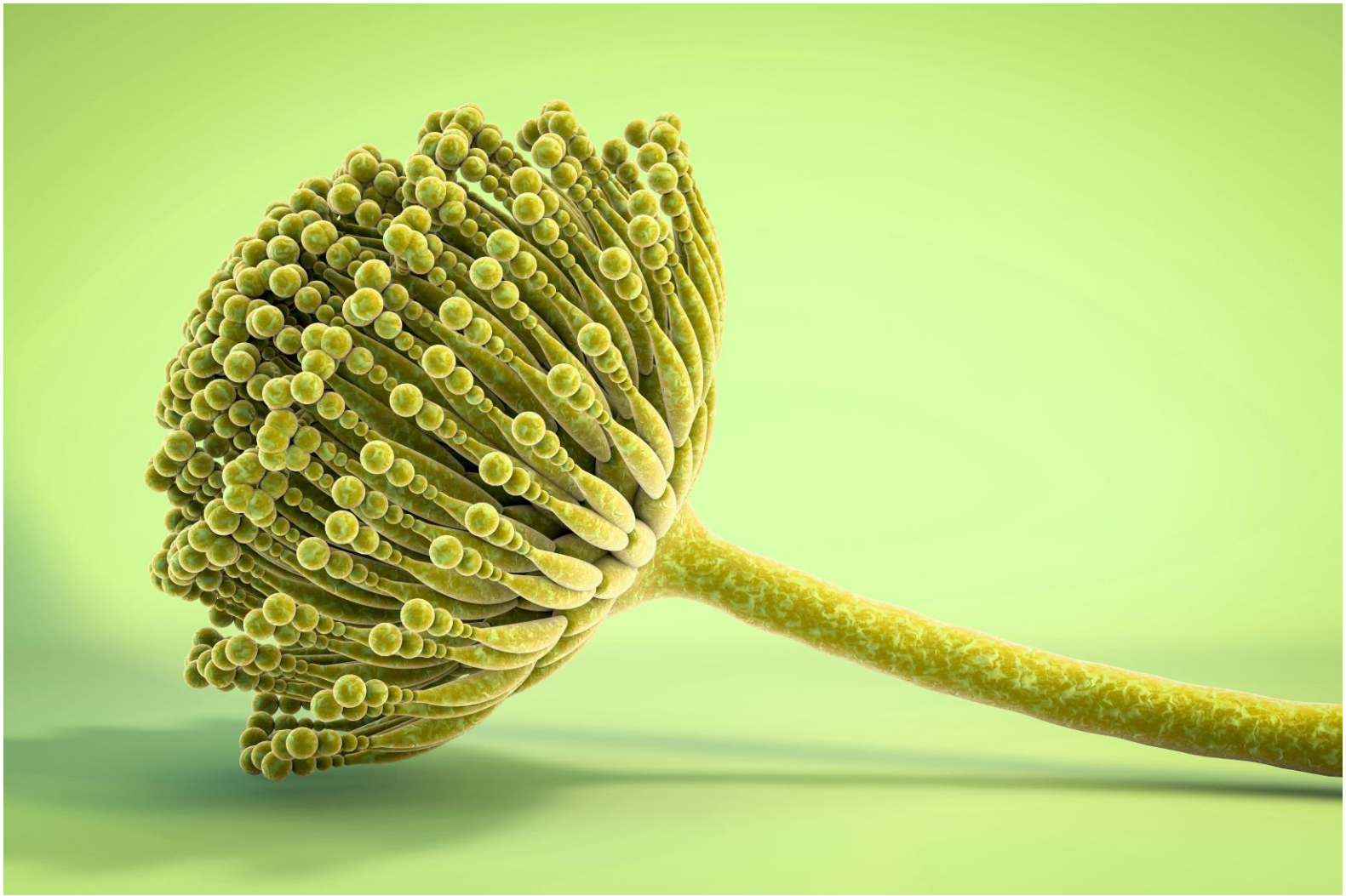
Moulds & Yeasts

Appearance	Name
• White mould	Fusarium, Aspergillus, Mucor
• Red mould	Fusarium, Monascus
• Black mould	Aspergillus, Fusarium
• Green mould	Penicillium, Aspergillus
• Bacteria	Clostridia, Salmonella, E. coli
• Yeast	Candida, Hansenula

Effects of mould on feed quality

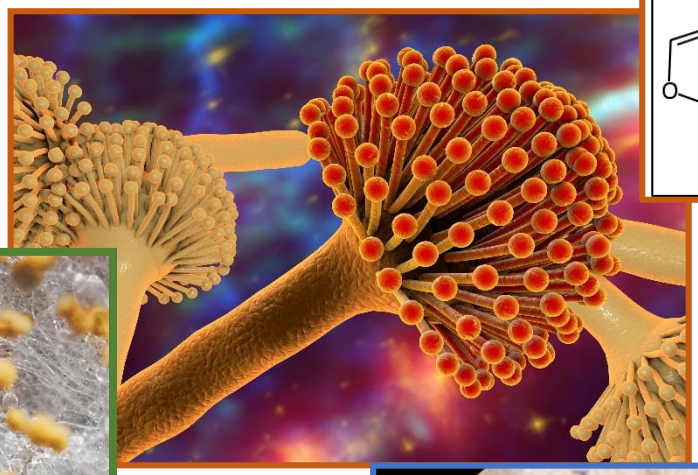
- Unpredictable vitamin stability
- Reduction in amino acid content
- Reduction in energy content
- **Synthesis of mycotoxins**

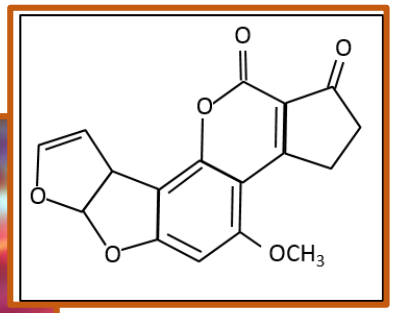
Mycotoxins



Moulds & Mycotoxins

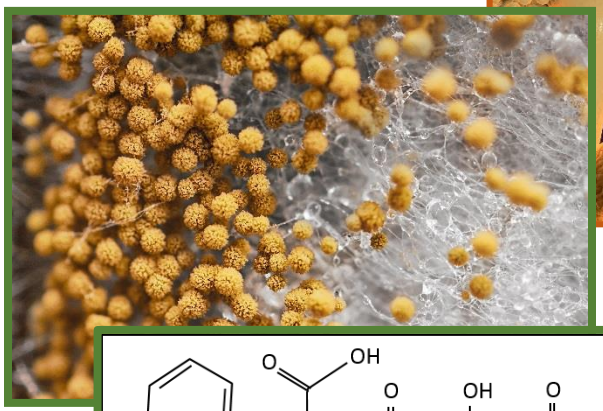
Aspergillus

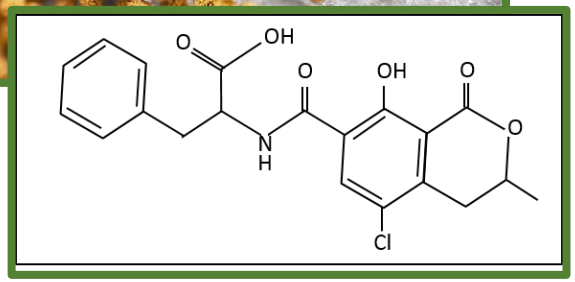




Aflatoxin B_1

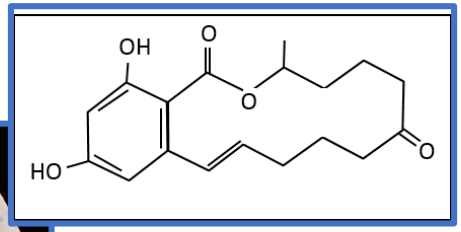
Penicillium

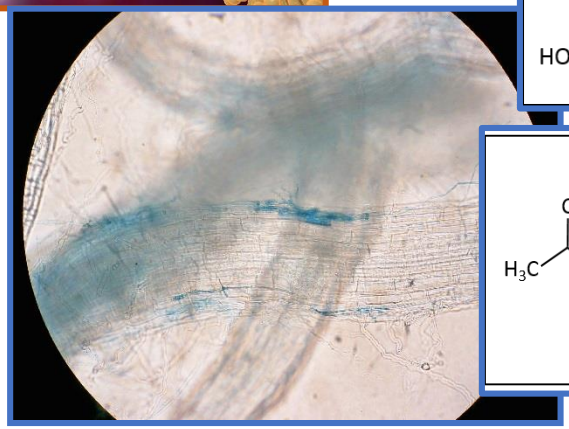




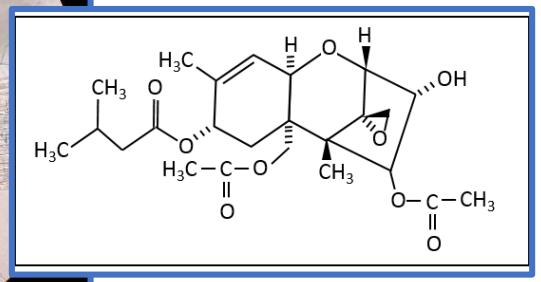
Ochratoxin A

Zearalenone





Fusarium



T2 Toxins
DON

What are mycotoxins?

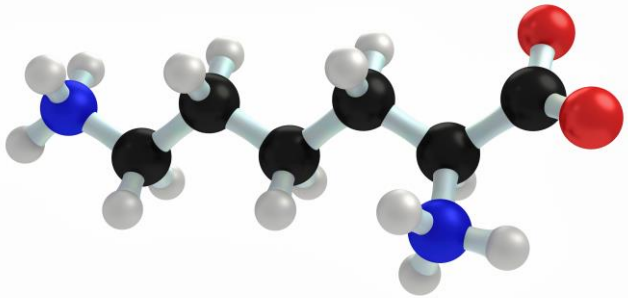
- Mycotoxins are secondary metabolites created by moulds that are toxic to organisms other than the mould itself.
- **Defensive chemical**

- **Things to keep in mind**
  - Little correlation between spore counts and the levels of toxins
  - Toxin combinations can be more toxic than just one toxin

Mycotoxin tests

6 major mycotoxin groups

1. Deoxynivalenol (DON)
2. Fumonisins (B1 & B2)
3. Aflatoxins (B1, B2, G1 & G2)
4. Ochratoxin
5. Zearalenone
6. T-Toxins (HT2 & T2)



Toxfin™ dry Reg#V20839 Act36/1947

Mycotoxin Development

Moulds

Field Mycotoxins

Fusarium

Fumonisins

Tricothecenes (DON, HT2, T2)

Zearalenone

Storage Mycotoxins

Aspergillus

Aflatoxin

Penicillium

Ochratoxin

Main effects in Animal (Organs Targeted)

System	Afla	DON	Fum	Ochra	T-2 Toxin	HT-2 Toxin	Zea
Liver	X	X	X	X	X	X	
Immune	X	X	X	X	X	X	X
Neural			X				
Kidney				X			
Brain			X				
Lipid Metabolism	X		X				
Protein synthesis		X			X	X	
Skin		X			X	X	
Digestive		X			X	X	X
Reproduction							X

Conclusion

- Making hay and silage is dependent on management and planning.
- The weather plays a big part in your planning.
- Think of solutions that will help you reach your goal of making high quality feed for you animals when you plan your production season.
- Small solutions to problems can save you money and give you options.

Thank You

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