Making Grass Silage

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Fermentation analysis profile

	Legume Silage	Grass Silage	Corn Silage
Moisture:	65%+	<65%	60-65%
pH	4.0-4.3	4.3-4.7	3.8-4.2
Lactic Acid	6.0-8.0	6.0-10.0	5.0-10.0
Acetic Acid	1.0-3.0	1.0-3.0	1.0-3.0
Ethanol (% of DM)	<1.0	<1.0	<3.0
Ammonia-N (% of CP)	<15.0	<12.0	<8.0
Lactic: Acetic ratio	2+	2+	3+
Lactic (% of total acids)	60+	60+	70+

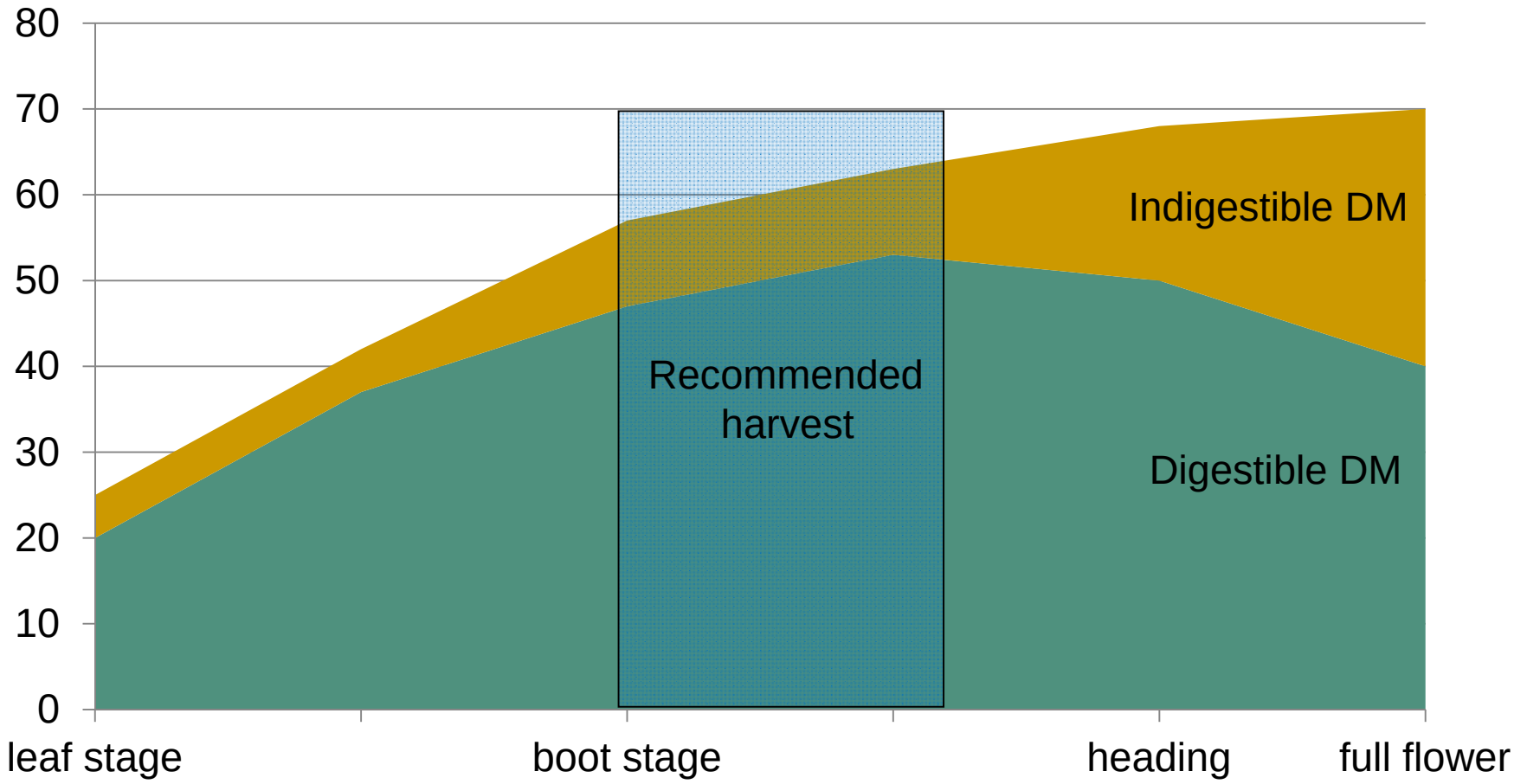
High quality grass silage results from:

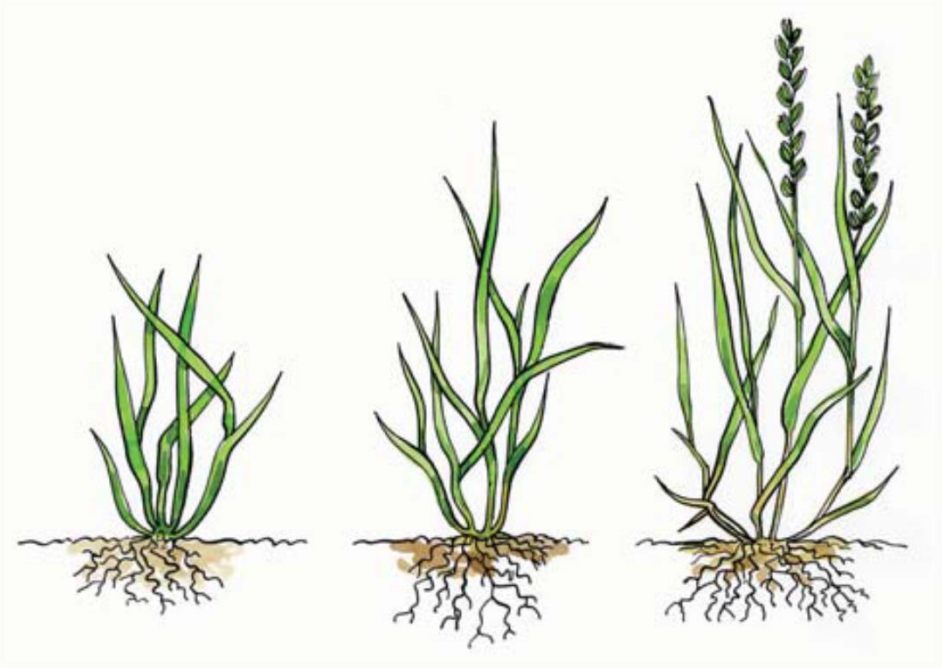
1. Harvesting high quality forage
2. Inoculation
3. Proper packing
4. Covering

Making Good Grass Silage

- Want 10–15% WSC (sugars) in the dry matter
  - Young, leafy grass that has been well fertilized, grass/clover mixtures and autumn cuts tend to have low sugar levels
- Buffering capacity is directly related to how much sugar it takes to lower silage pH.
  - Grass typically has a low buffering capacity and an adequate supply of sugars
  - High rates of N increase buffering capacity.

Grass Dry Matter Digestibility





Cool Season Grasses Head only on first Cutting

Harvest 1st cutting at boot stage

2nd and later cuttings are primarily leaves

Mowing, Conditioning

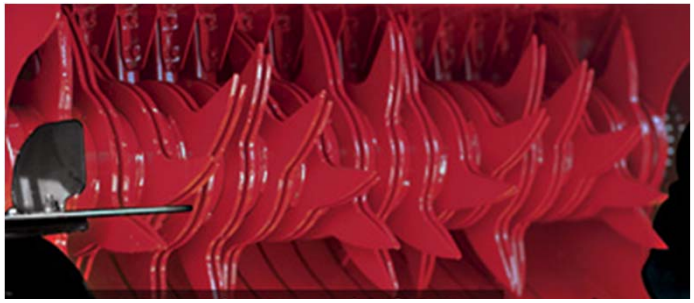
- Mowing height - 3.5 to 4 inches
  - Promotes rapid grass regrowth
  - Reduces dirt contamination
- Condition with flail conditioner
- Make wide swath
- Tedding may be necessary
- Rake/merge

Chopping

- Chop at 60 to 65% moisture
- Cut length ¾ to 1 inches
  - Longer makes compaction more difficult
    - Good compaction - Faster acid fermentation
    - Good compaction - Less spoilage on feedout
  - Improved feed uptake
- Apply inoculant

Precutting forage before baling

- Cutting forage for hay/haylage - bales that break apart easily for feeding
  - Bale is more dense
  - Bales break apart easier for use in TMR
  - Higher feeding efficiency
  - Improved stocker cattle gain



Different Types of Inoculants

- Traditional homofermentative types:
  - *Lactobacillus plantarum*, *L. casei*, *Pediococcus* species, *Enterococcus faecium*
- *Lactobacillus buchneri*, a heterofermenter
- Combination of homofermenters with *L. buchneri*

Homofermenter vs. Heterofermenter

- Homofermenter *(L planatarium)*

  1 6-C Sugar $\rightarrow$ 2 Lactic Acid

- Heterofermenter *(L buchneri)*

  1 6-C Sugar $\rightarrow$ 1 Lactic Acid + 1 Acetic Acid + CO_2

  1 6-C Sugar $\rightarrow$ 1 Lactic Acid + 1 Ethanol + CO_2

  1 Lactic Acid $\rightarrow$ 1 Acetic Acid + CO_2 (*L. buchneri*, not all heteros)

End Product Comparison

- **Lactic acid** - strong acid; weak spoilage inhibitor; fermented in rumen
- **Acetic acid** - weak acid; good spoilage inhibitor; not fermented in rumen
- **Ethanol** - neutral; poor spoilage inhibitor; partially fermented in rumen
- **Carbon dioxide** - lost dry matter

So…

- If you want to preserve crop quality:
  - Lactic acid
- If you want a silage that doesn't heat:
  - Acetic acid
- In any case, you want to minimize ethanol & CO_2

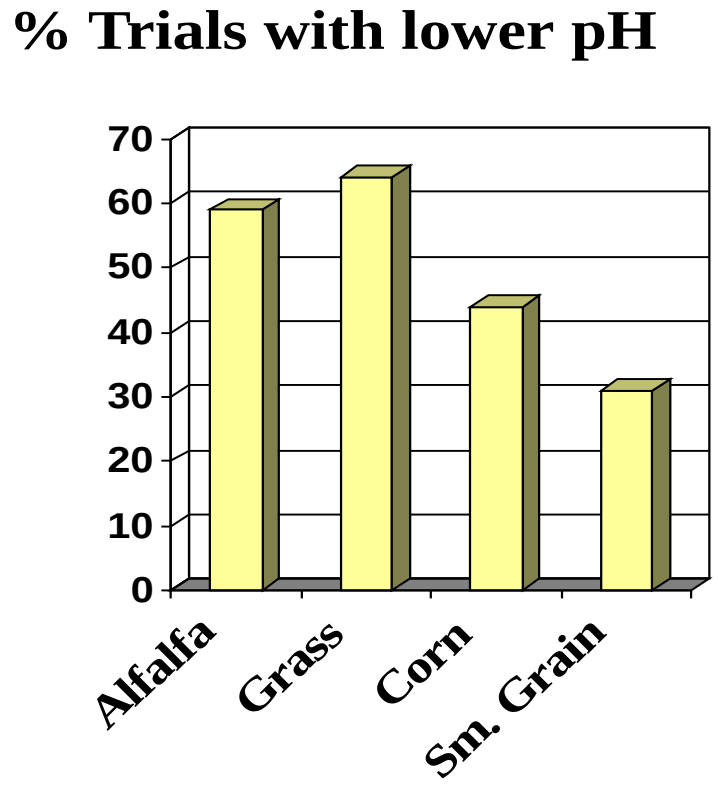
Homofermentative Inoculants - *Expectations*

- High lactic acid content, low other products
- Low pH
- Improved DM recovery
- Slightly better animal performance

Homofermentative Inoculants - Results

pH

- Lower but not all the time
- Works more often in hay crop than whole-grain silages



(Muck and Kung, 1997)

Aerobic Stability Problems

- Is the problem a management problem that can be solved without an additive?
  - 55% to 70% moisture, stability problems are almost always related to management issues
  - Below 55% moisture, you have a number of options:
    - Feed out in winter
    - Homofermentative inoculants for sporadic warm weather issues should make small improvements in stability
    - *L. buchneri* or combination of products for more consistent warm weather issues.

Issues with *L. buchneri*

- Slower growth than *L. plantarum*, takes 45 to 60 days storage time before having much effect
- Will not reduce heating with immature silage; propionic acid is the best solution.
- Results in dry matter loss

L buchneri inoculants - Expectations

- Higher acetic acid content
- Better bunk stability
- Slightly elevated pH
- Improved DM recovery from less spoilage offsetting more fermentation losses
- Animal performance - ??
  - Keeping silage cool benefits intake
  - High acetic acid may reduce intake?

Rapidly Fill and Cover

- Fill bunker silos in 1 or, possibly 2 days
- Wrap bales within 3 to 4 hours

Pack Silage Well

Silage Pile Height to Top of Slope (feet) =		10		August 23, 2007
Horizontal Portion of Side Slope (ie 3 for 3:1) =		3.0		
Top Width (feet) [can be zero]=		100		Values in yellow cells are user changeable
Silage Delivery Rate to Pile (T AF/Hr) =		120		Typical values 15-200 T AF/hr
Silage Dry Matter Content (decimal ie 0.35) =		0.34		Recommended range of DM content = 0.3-0.4
Silage Packing Layer Thickness (inches) =		6		Recommended value is 6 inches or less
Packing Tractor - Each Tractor	Tractor Weight (lbs)			Tractor Packing Time (% of Filling Time)
Tractor # 1	Typical tractor weight is 10,000-60,000 lbs	40,000		100
Tractor # 2	Typical tractor weight is 10,000-60,000 lbs	40,000		100
Tractor # 3	Typical tractor weight is 10,000-60,000 lbs	0		0
Tractor # 4	Typical tractor weight is 10,000-60,000 lbs	0		0
Proportioned Total Tractor Weight (lbs) =		80,000		
Average Silage Height (feet) =		8.1		Green cells are intermediate calculated values
Packing Factor =		501.8		Values in pink cells are results of calculations
Est. Average Wet Density = Bulk Density (lbs AF/cu ft) =		44.5		Wet Density greater than 44 lbs AF/cu ft is recomm
Maximum Achievable Bulk Density (lbs AF/cu ft)=		73.0		Wet Density greater than Max. Wet Density is unrea
Gas Filled Porosity =		0.39		Gas Filled Porosity less than 0.40 is recommended
Est. Average Dry Matter Density (lbs DM/cu ft) =		15.1		Density greater than 15 lbs DM/cu ft is recommende
Maximum Achievable DM Density (lbs DM/cu ft)=		24.8		DM Density greater than Max. Achievable is unrealis

Cover bunker or pile