Harvesting and Preserving More Nutrients from Your Forages

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Corn Silage and Conserved Forage Field Day, Tifton, GA, June, 2013

Outline

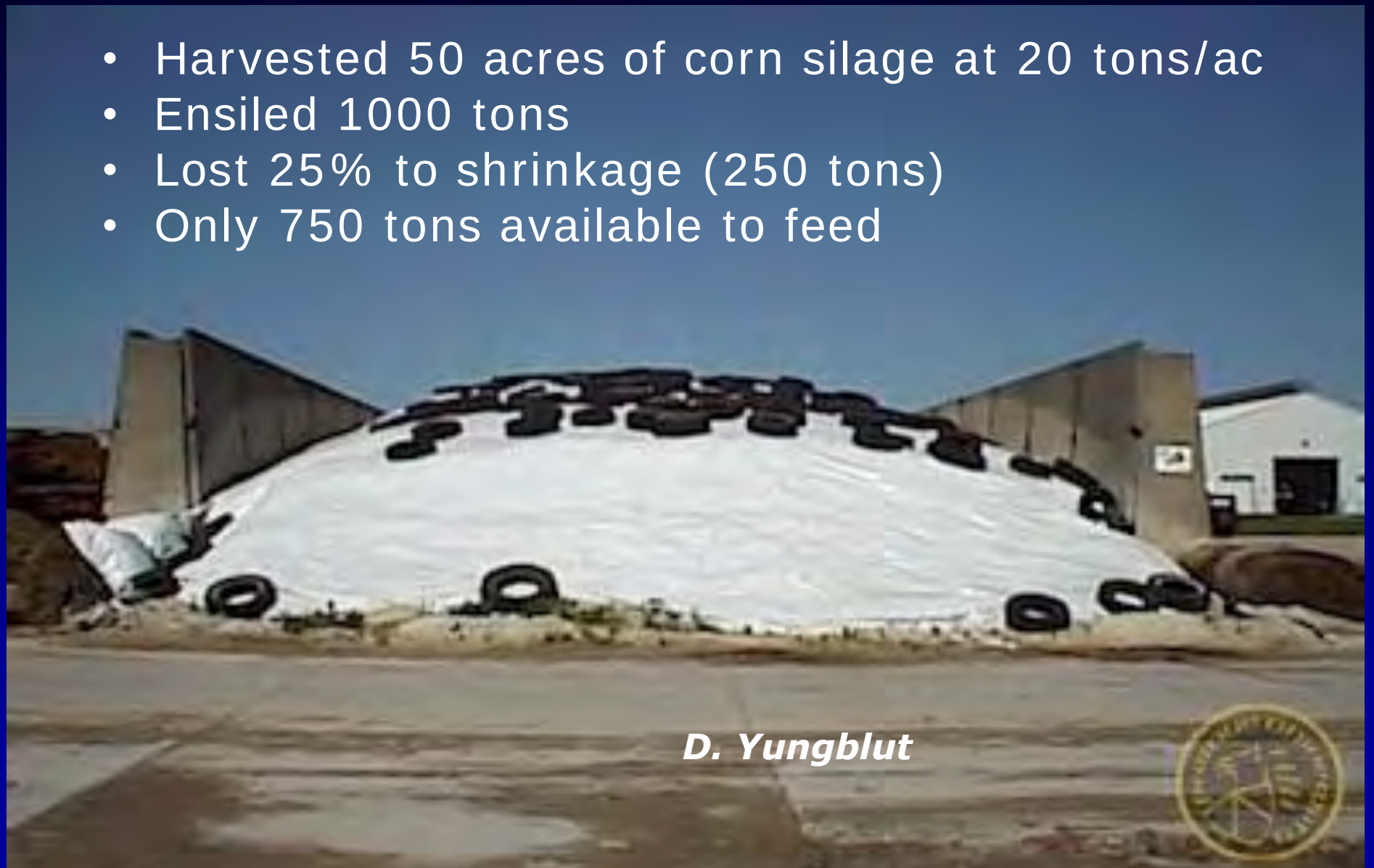
- Main causes of nutrient losses from silage
  - Shrinkage
  - Spoilage
- Unique challenges of southeastern silages
- Strategies for maximizing harvesting and preservation of silage nutrients
  - Management
  - Additives

Main causes of ensiling nutrient losses

1. Shrinkage (DM losses)
2. Heating (aerobic spoilage)

DM losses (shrink)

- Harvested 50 acres of corn silage at 20 tons/ac
- Ensiled 1000 tons
- Lost 25% to shrinkage (250 tons)
- Only 750 tons available to feed



Dry matter losses with good and poor silo management.

		Management	
Source		**Good**	**Poor**
Respiration	Keep below 10%	0-4%	10-15%
Fermentation		4-6%	10-15%
Seepage		0-2%	5-15%
Storage (aerobic)		5-7%	10-20%
Total		9-17%	20-40%

(Adapted from Rankin, UW)

DM losses, a billion dollar problem

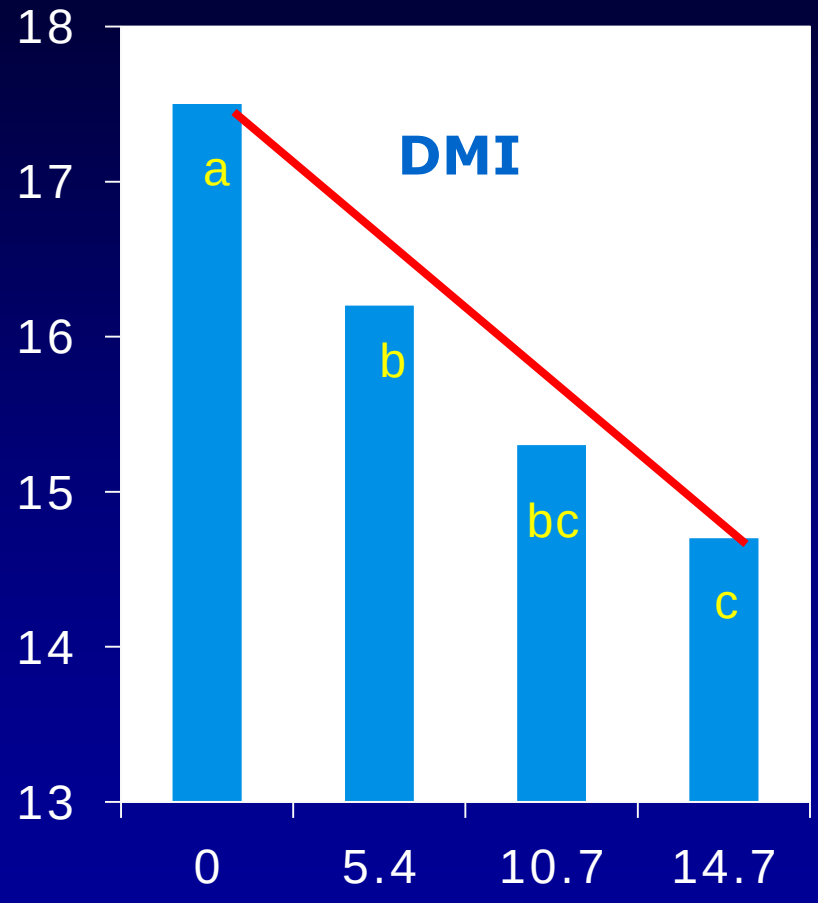
- US silage tonnage = 109 million tons (NASS, 2011)
- Value = $ 5.5 billion @ $50/ton
- Cost of loosing 20 % of DM
  = $1.2 billion

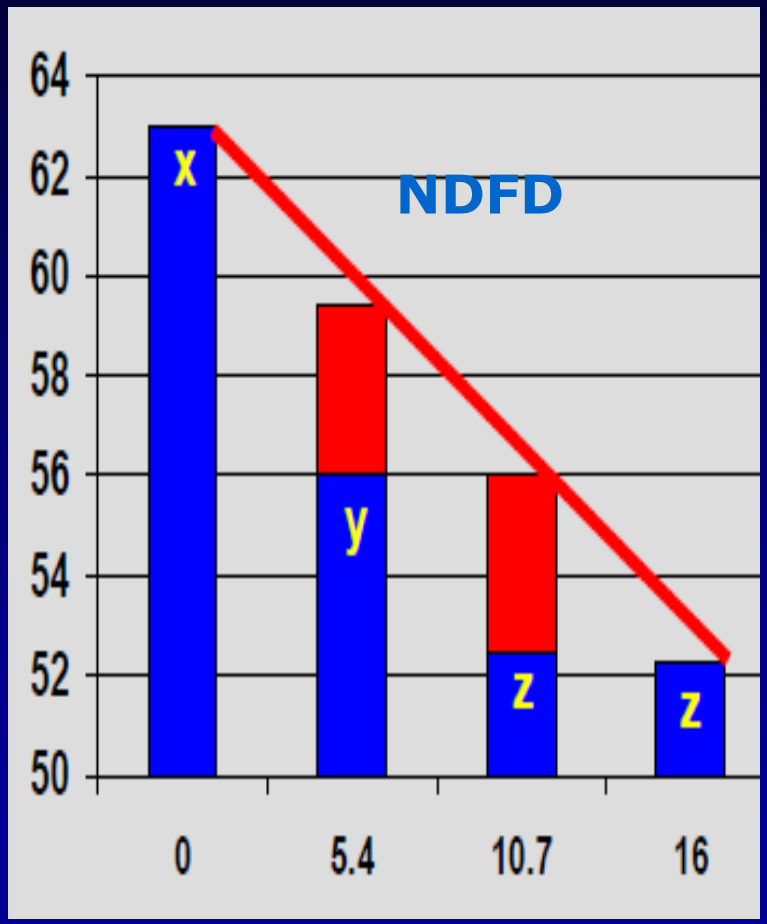
Questions for you

What are DM losses costing your operation ?

Aerobic spoilage/heating

Effect of feeding spoiled silage on DMI and NDF digestibility (Whitlock et al., 2000)





Cost = approx. $100 per cow per year if milk yield decreases by 2-3 lb/d; $80,000 on a 800-cow

Effects of aerobic spoilage

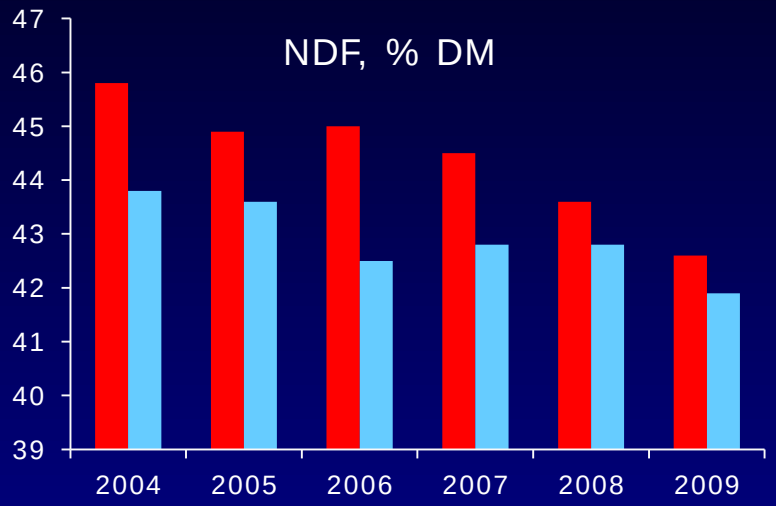
- Heating
- Losses of DM, energy and nutrients
- Mold growth & mycotoxin production
- Growth of pathogenic bacteria
- Diseases (bloody gut, aspergillosis)

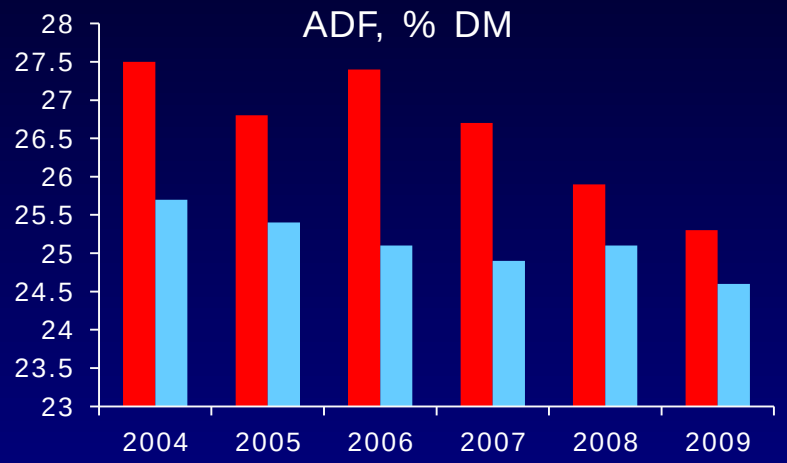
Invited talk title:
Why is SE silage quality poorer?

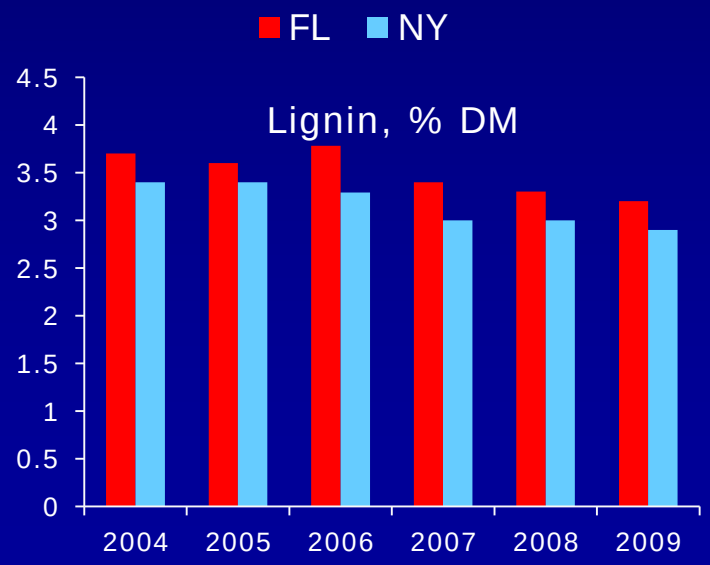
Is it true?

Is SE silage quality really poorer?

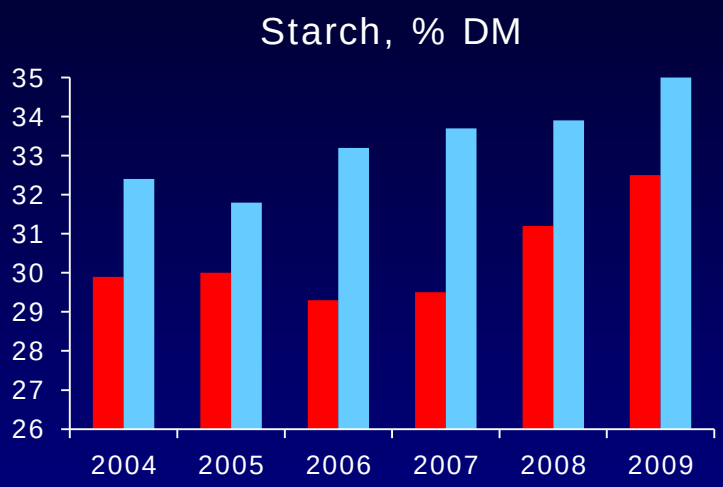
Cell wall composition of Florida (FL) and New York (NY) silages

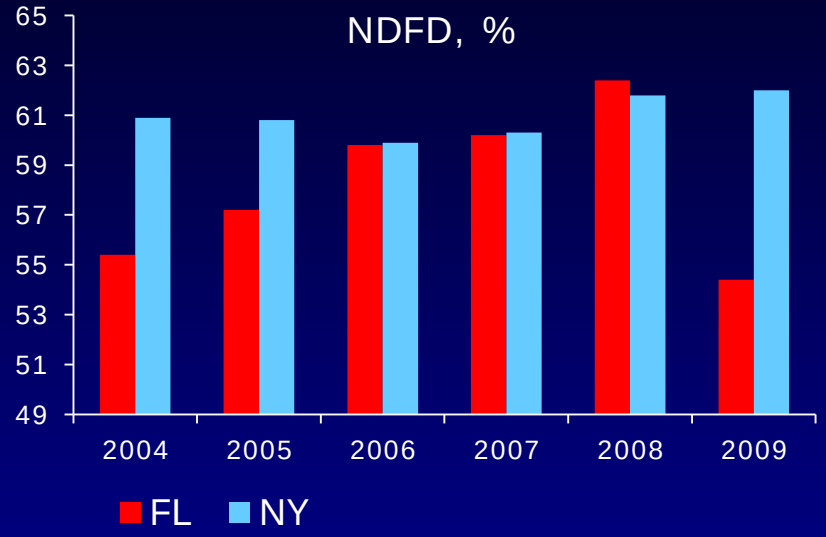






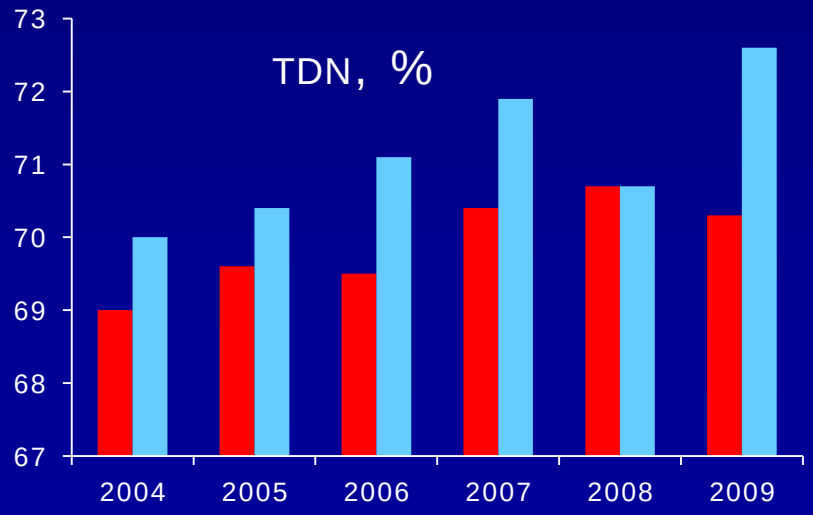
Energy measures of FL and NY silages





FL: n= 70 to 500/year

NY: n = 3000 to 7000/year



SE silage quality is poorer because high temperatures cause:

- Reduced starch synthesis and grain yield
- Flint kernels with vitreous endosperm
- Unique (C4) photosynthetic pathway (more lignified anatomical features)
- Increased fiber deposition
- Increased disease incidence
- Ideal conditions for molds and mycotoxins

How to maximize harvesting and preservation of nutrients in the SE

Assume the following are already optimized:

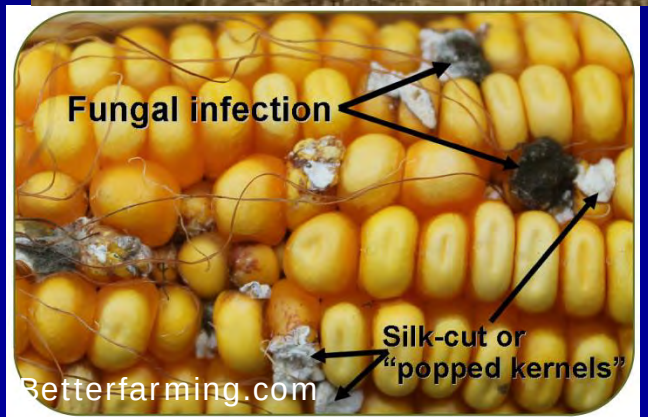
- Hybrid choice
- Plant spacing
- Fertilization
- Irrigation

Harvest at 35% DM (65% moisture)

Harvesting too early causes:

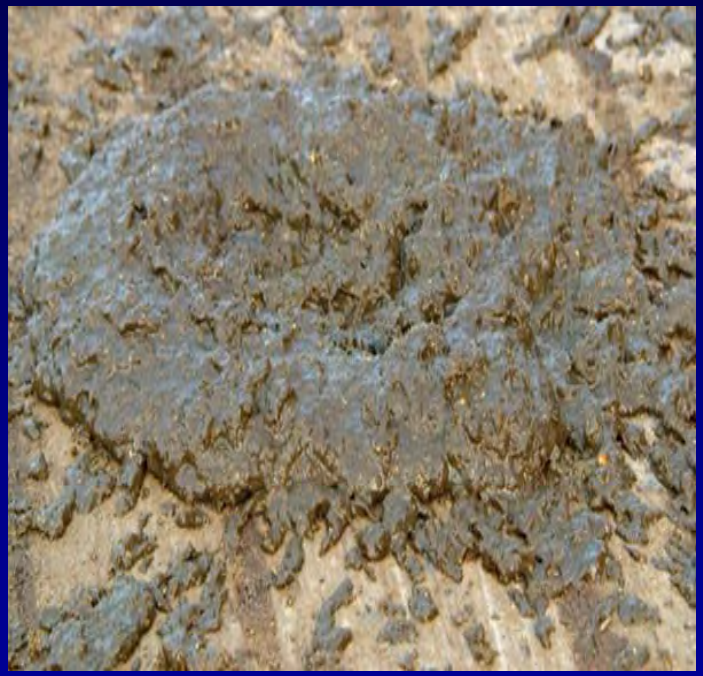
- Low yields,
- Seepage
- Butyric silage

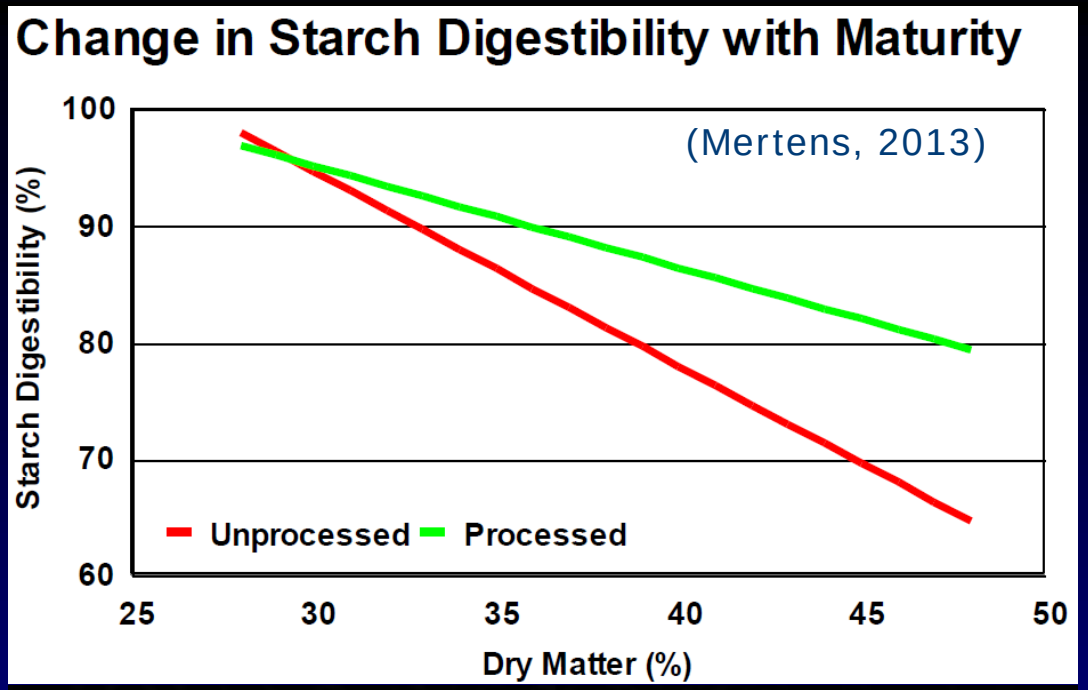
Harvesting too late causes

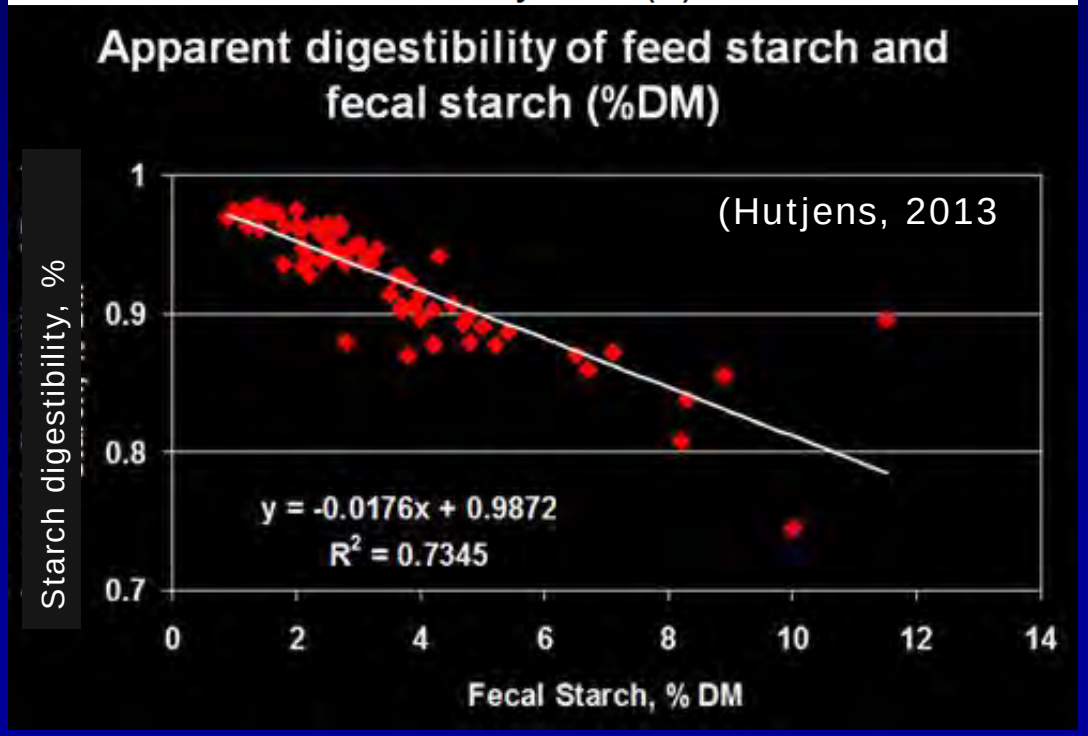


- Poor packing,
- More porosity,
- More yeasts and molds,
- More spoilage & DM losses,
- Short bunk life,
- Disease and mycotoxins,
- Lower starch and fiber digestibility

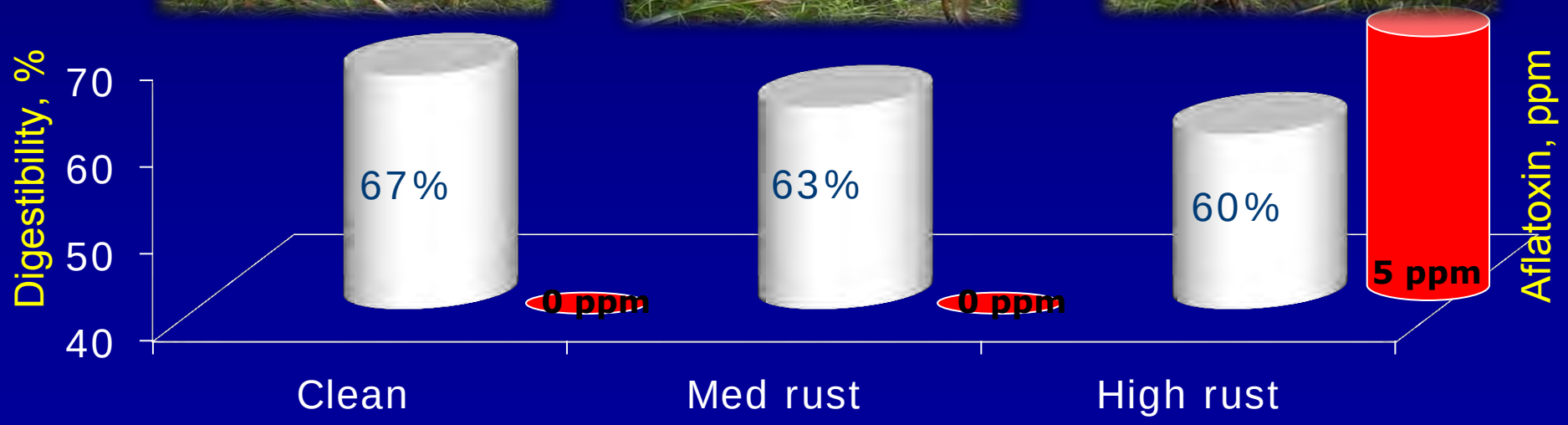
Harvesting late reduces starch digestibility







Rust effects on DM digestibility & aflatoxin level



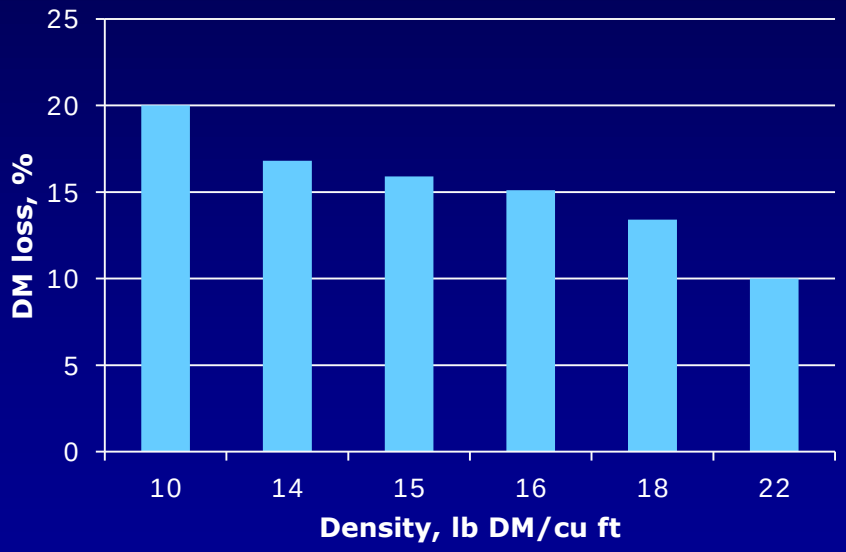
Chop properly and consider processing

- Sharpen blades, Aim for corn silage chop lengths of:
  - Unprocessed (1/4 –3/8 inch)
  - Processed (3/4 inch)

Effect of density on DM loss in alfalfa

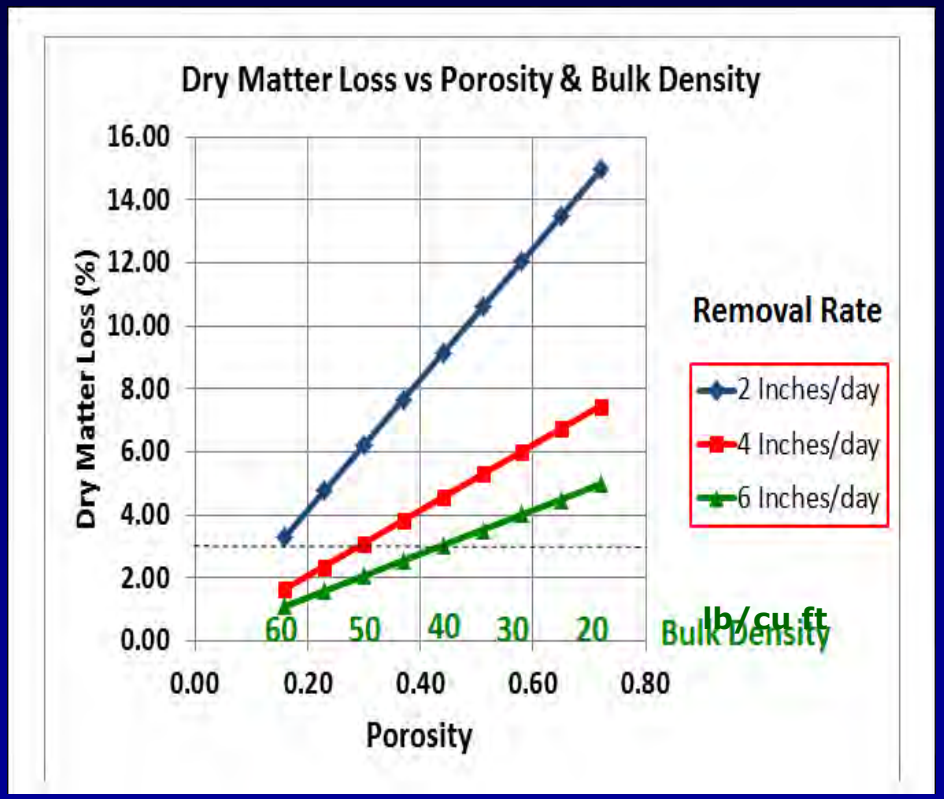
Old recommendation

Dry density effect on DM loss, % (Ruppel et al., 1995)



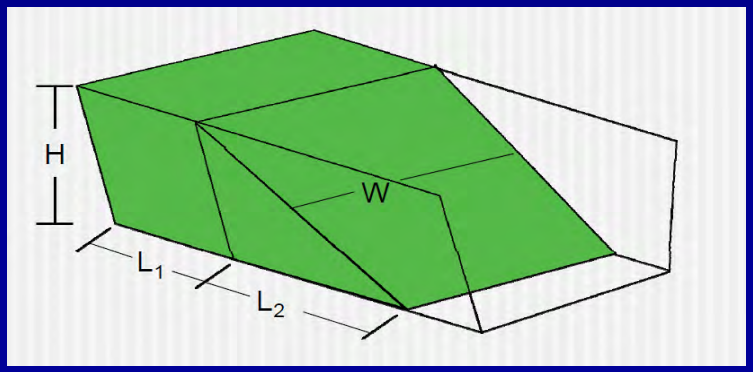
But dry density cannot be measured in the field and is affects porosity

New recommendation
(Holmes and Muck, 2012)



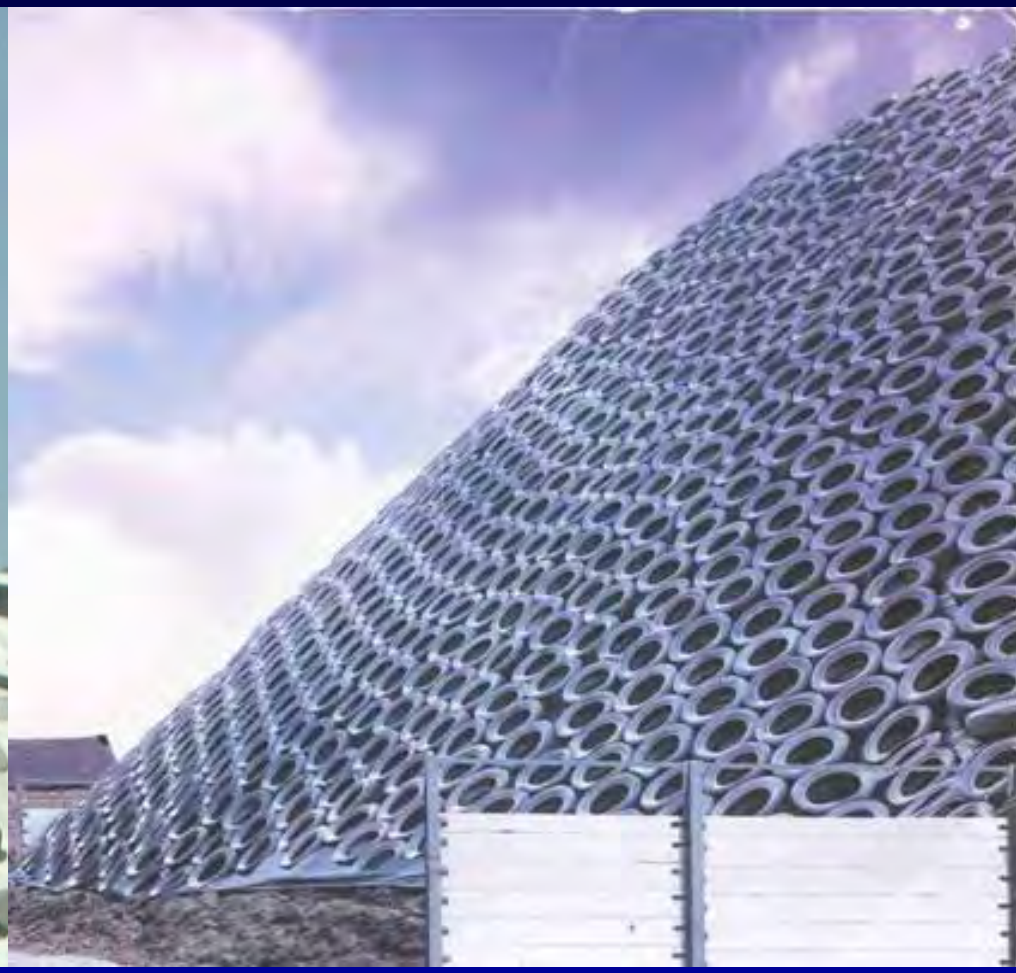
Use wet /bulk density (porosity) instead of dry density

Excel at packing (at least 40 lb/cu ft)



- Use heaviest tractor
- Divide tractor weight by 800 to get silage tons to pack per hour
- 40,000 lb tractor can pack 50 tons/hr.
- Spread to depth of 6” at a time
- Use dorset wedge packing method; 30=40% incline

Seal immediately & properly



Outside the box ‘forage harvesting’

Forage; Progressive Forage grower

Effect of delaying ensiling of 25-27% DM ryelage on fermentation quality

	No delay	12 h delay
pH	4.6	5.8-6.4
Ammonia, % DM	0.34	0.9-1.0
Butyric acid, % DM	0	0.1-0.2

“*Bottom line: Leave it overnight in the field and you will have wet, smelly slop. Ensile it the same day you mowed it, add the correct inoculant … and you can have very high quality, correctly fermented forage with even higher moisture levels in silage*”

Read the original report at:

http://whminer.org/Farm%20Report/2012_05.pdf

- Original report focus: increasing butyric acid in mini silos!
- Recommended delaying ensiling to increase butyric acid.
- Stick to recommended moistures at ensiling for forages
- Ensile on the day of harvest unless wilting is necessary to achieve recommended moisture for ensiling.
- For wet forages, a good homolactic inoculant may help; depends on forage moisture, sugar content, and buffering capacity

Plastic film

- Using better sealing strategies
- Silostop film with 1/40 oxygen permeability of normal plastic (very clingy)

Kung

- Virtual elimination of visible spoilage
  - Biggest difference at the shoulders (wall)

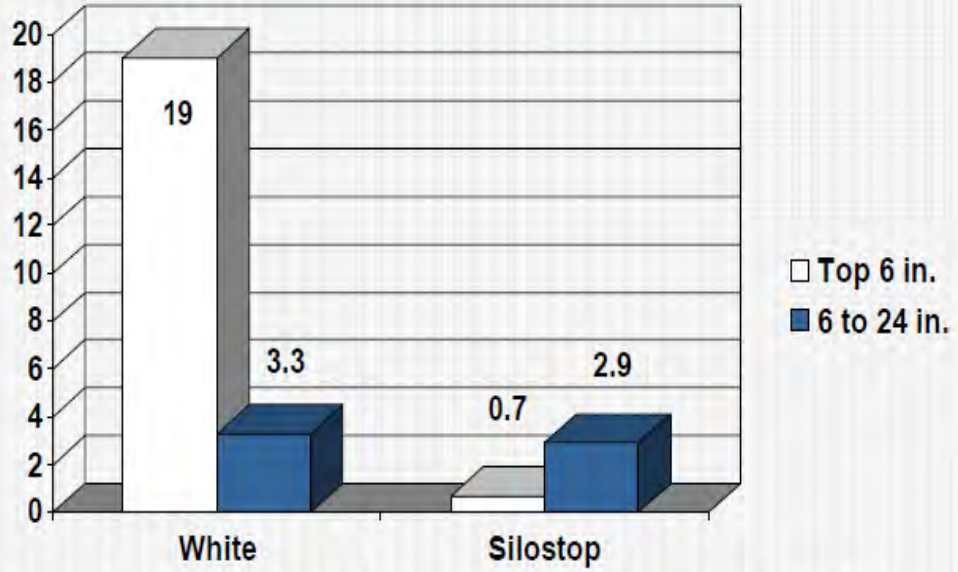
Muck, 2007

30 h NDF-D, %

	Top 6" Silage			
To Wall	4"	12"	20"	5'
Control	43	53	58	57
Silostop	57	58	58	60

McDonell and Kung, 2006

Estimated % DM Losses at the Wall - 2 Alfalfa Bunkers



Reduced spoilage near the wall in top 6 in. with Silostop.

Muck, 2007

Methods

3 replicate bunkers were used for each cover type

Control treatment,
all 3 silos looked bad

Side wall treatment,
all 3 silos looked bad

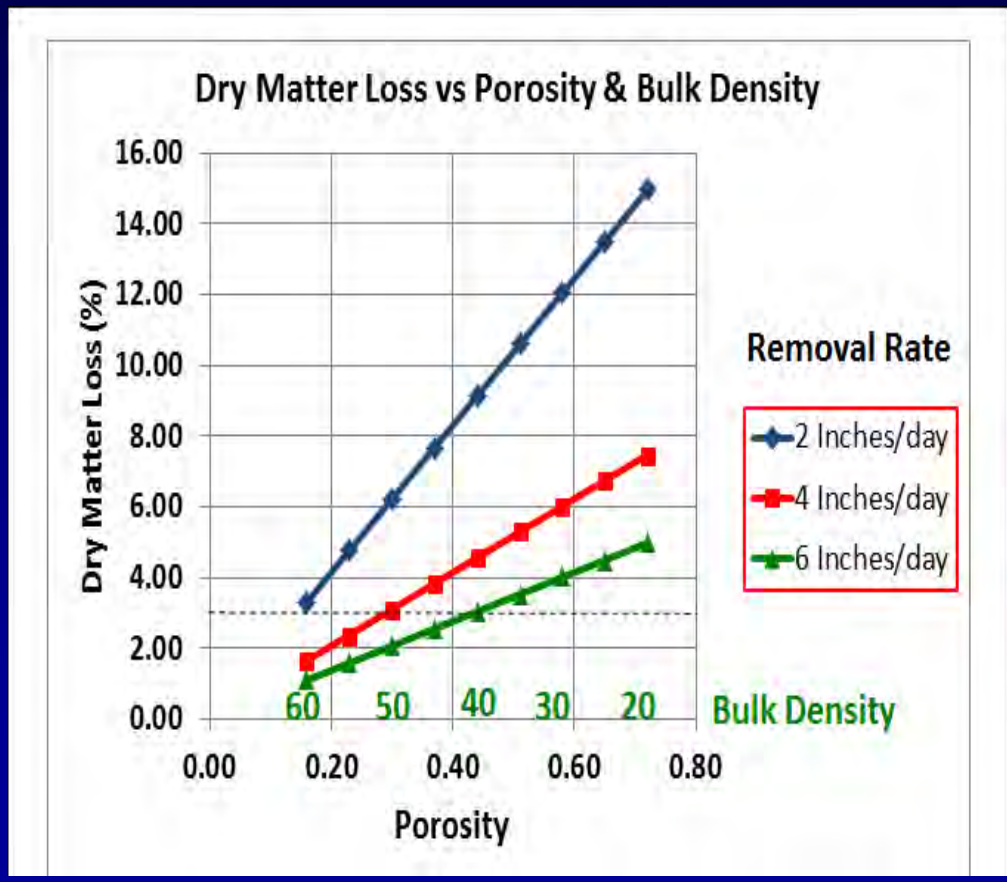
Silostop treatment,
1 silo looked excellent, 2 did

Consider silo size / dimensions

- Narrower is better
- Less oxygen infiltration and spoilage
- Avoid large exposed faces

Unload carefully & at a good pace

- Remove > 6″ per day in winter, 12″ in summer



Manage the silo face

- The narrower the bunker, the better
- Minimal disturbance is best
- Use shavers if affordable
- Heat loss = DM loss

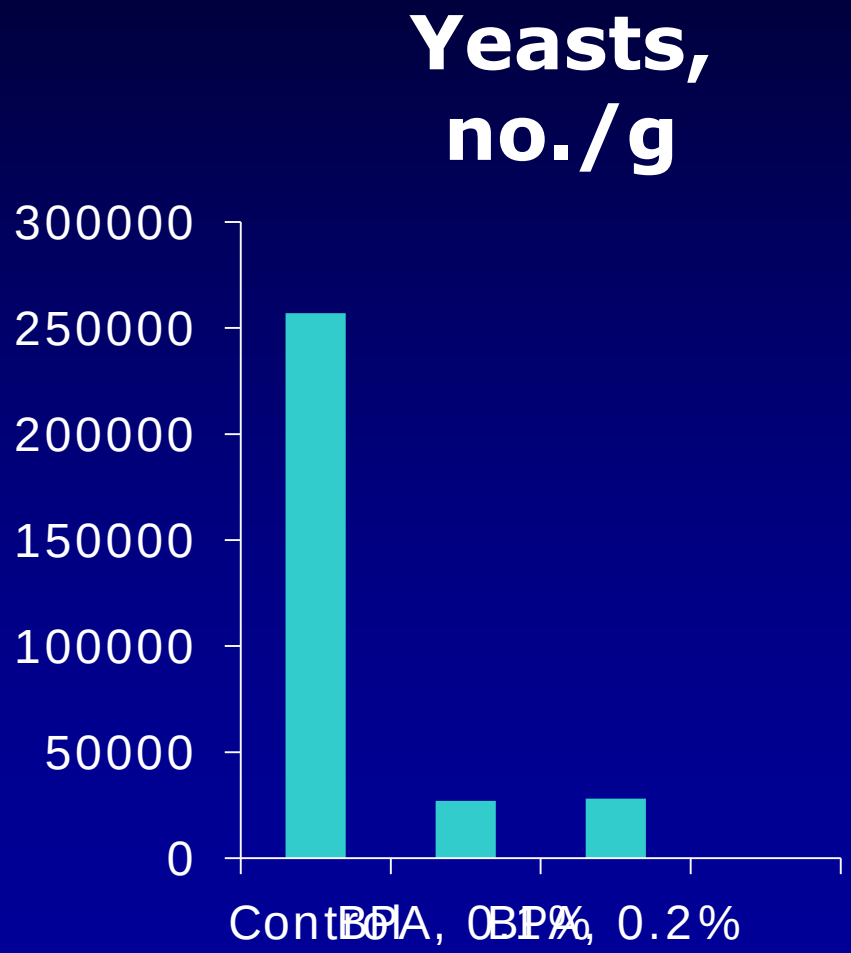

02 26 2013

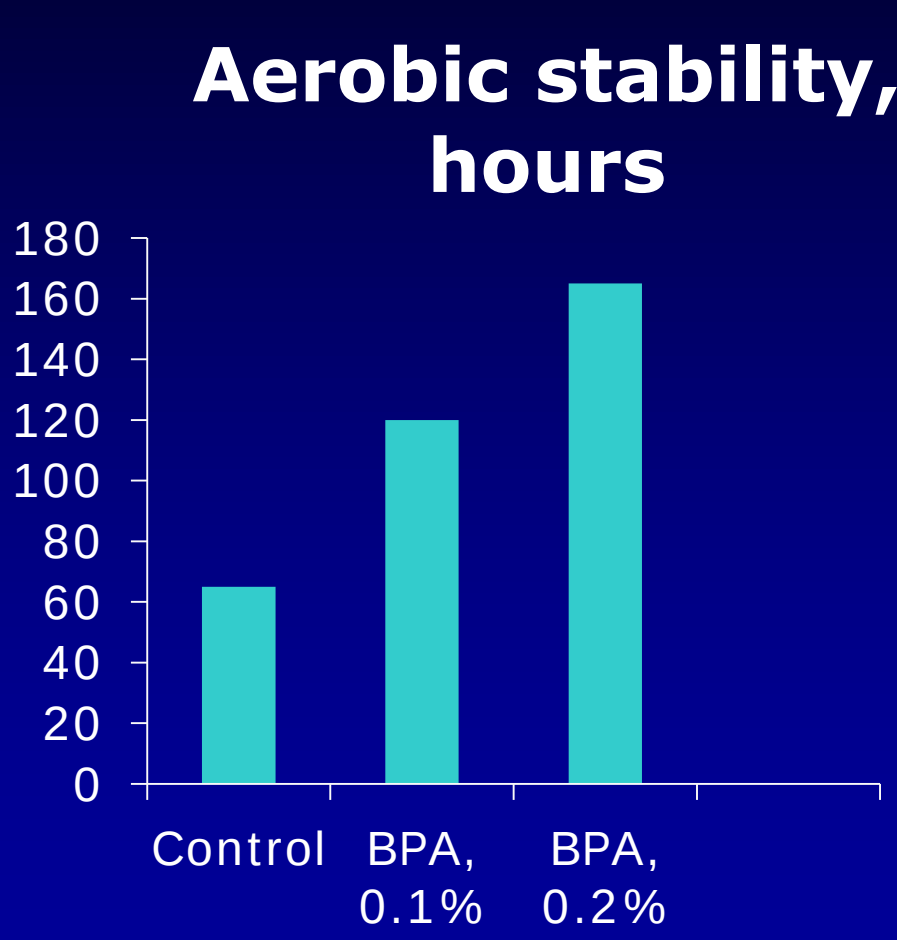
Additives

Organic acids

- E.g. Formic, propionic, benzoic, acetic, citric and sorbic acids
- Propionic acid – Highly antifungal; great spoilage inhibitor
- Apply at 0.1 to 0.3 % fresh forage
- Use buffered products to avoid corrosiveness (e.g. ammonium propionate)

Buffered propionic acid (BPA) effects on spoilage measures of corn silage





Kung, et al., 88

Inoculants

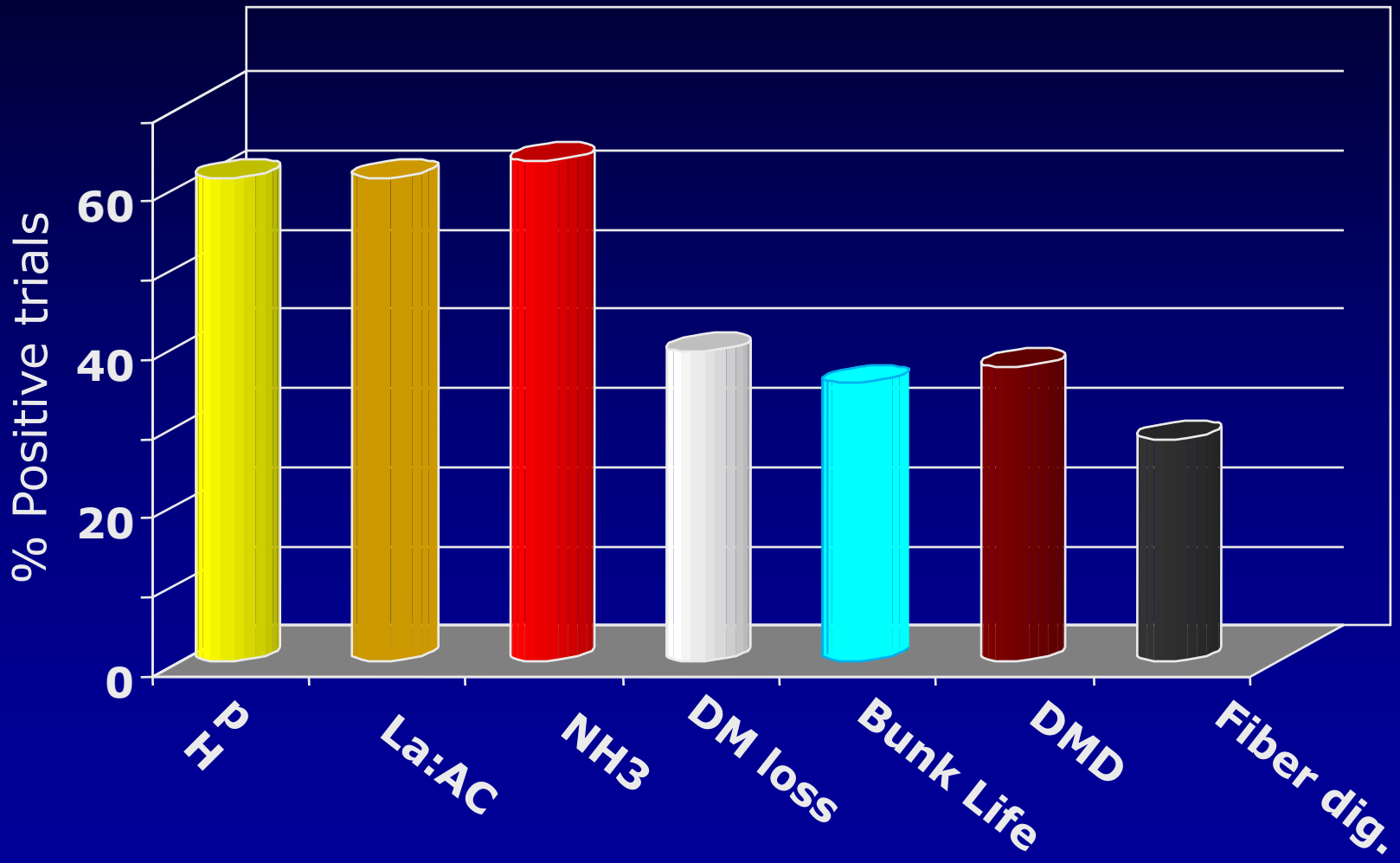
- Bacterial cultures used to dominate the natural plant (epiphytic) bacterial population
-

- Types
  1. Homofermentative
  2. Heterofermentative
  3. Combination (Combo)

1. Homolactic inoculants

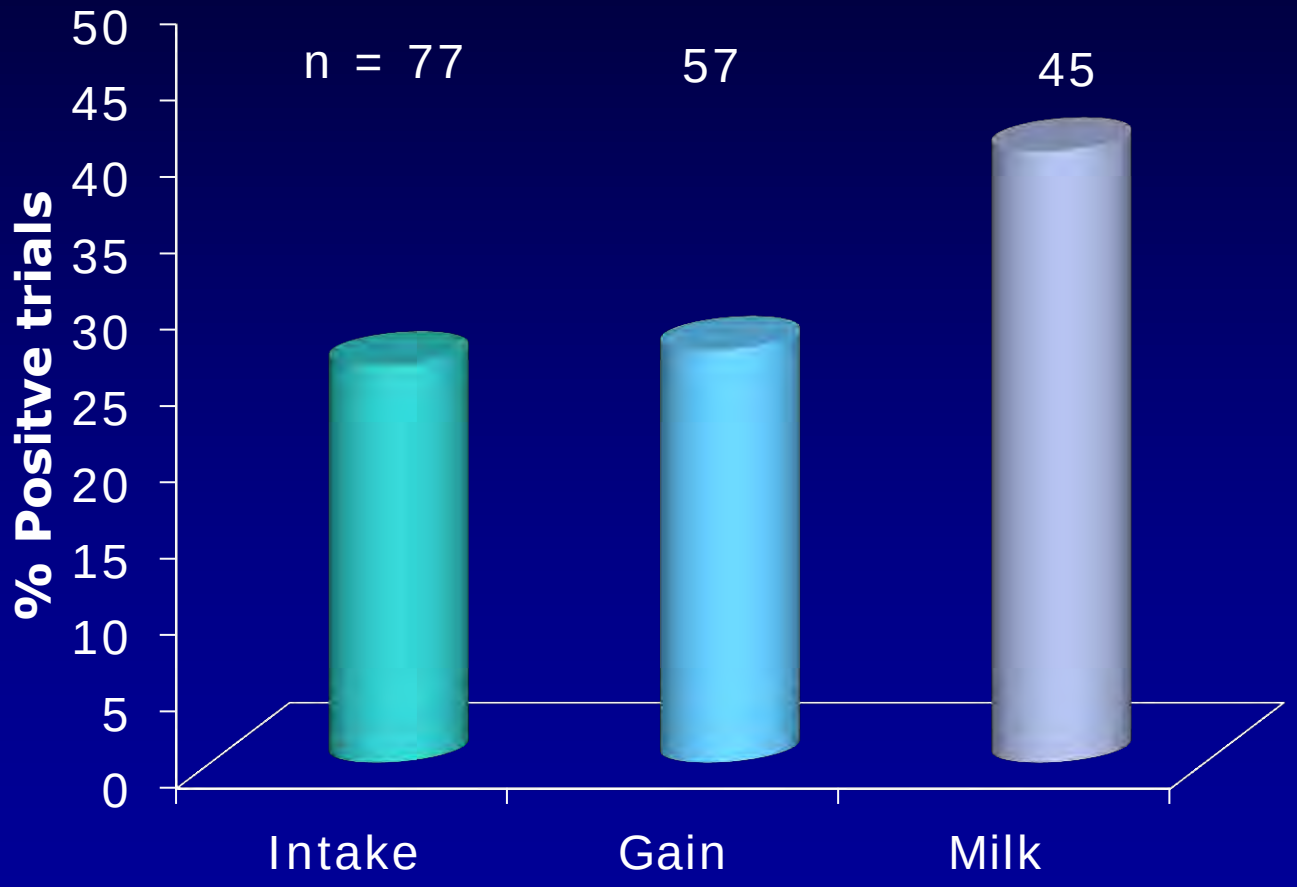
- Typically contain *Lactobacillus plantarum* *Pediococcus spp., Enterococcus spp.*
- Rapidly acidifies forage by fermenting sugars to lactic acid
- Minimize DM and nutrient losses

Effectiveness of (homolactic) inoculants on different silages in 39 studies



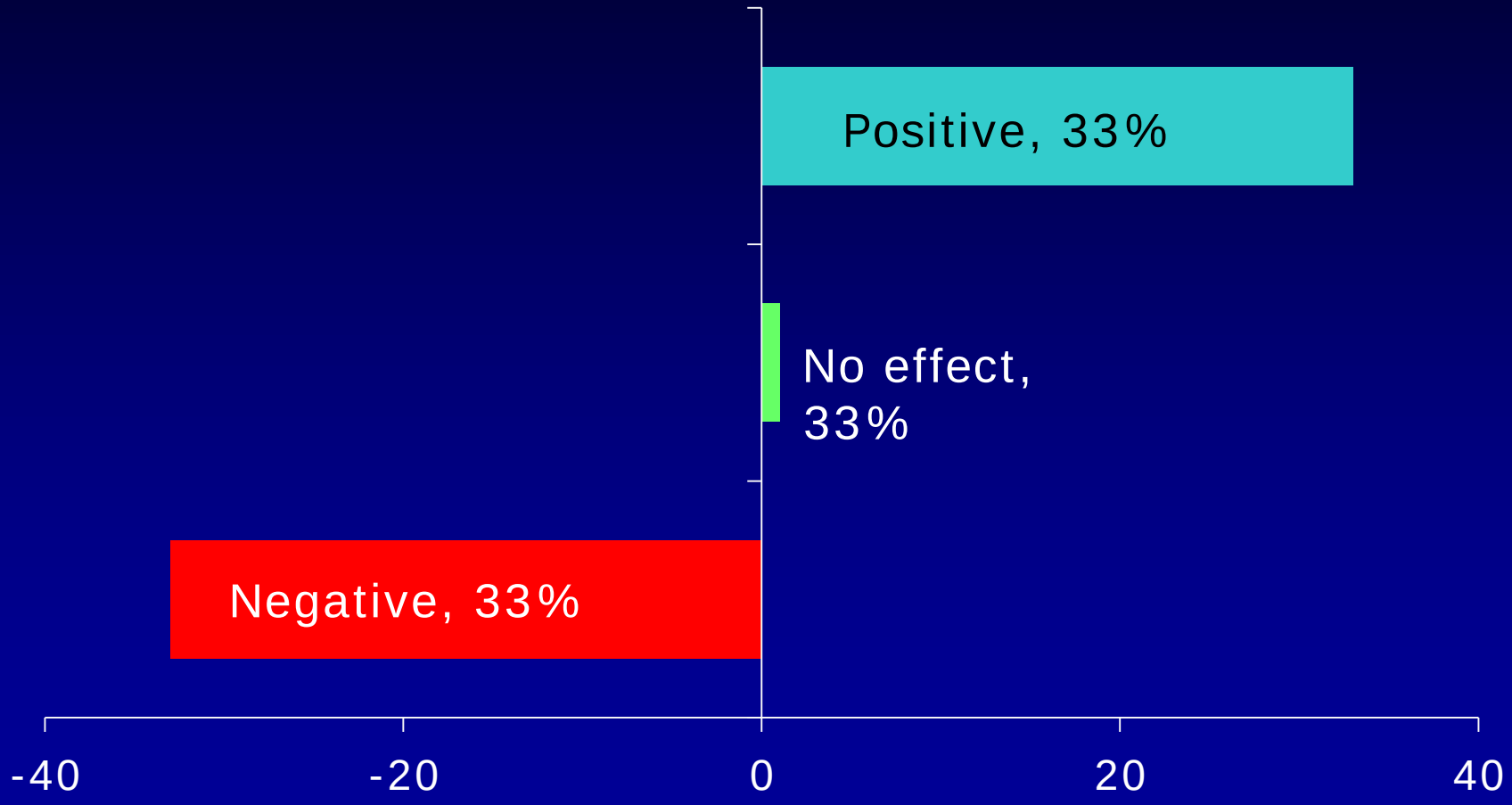
(Muck & Kung, 1997)

Effectiveness of (homolactic) inoculants on different studies



(Muck & Kung, 1997)

Effect of (homolactic) inoculant application on bunk life in 39 studies



(Muck & Kung, 1997)

Homolactic inoculant summary

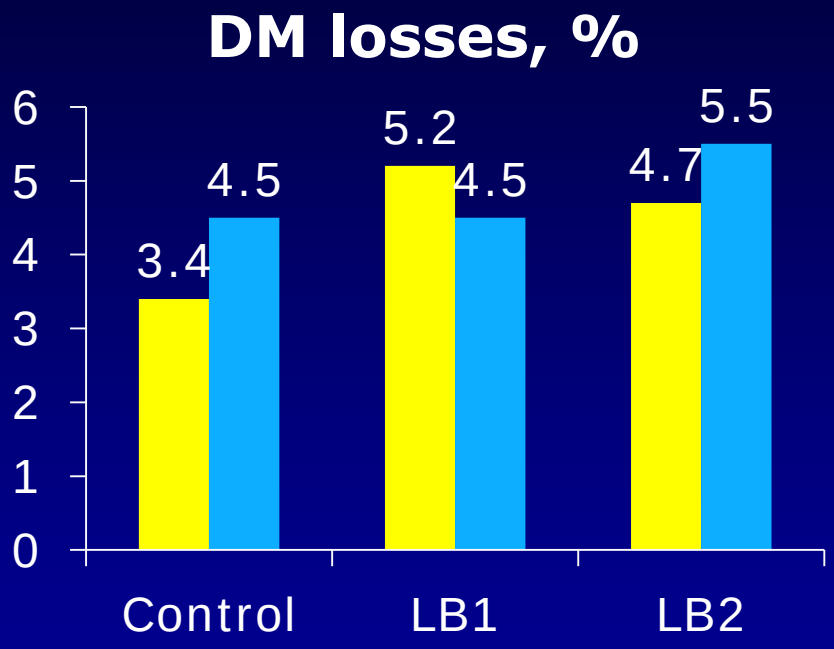
- Improve DM recovery and fermentation
- May improve digestibility and performance
- Inconsistent effects on bunk life

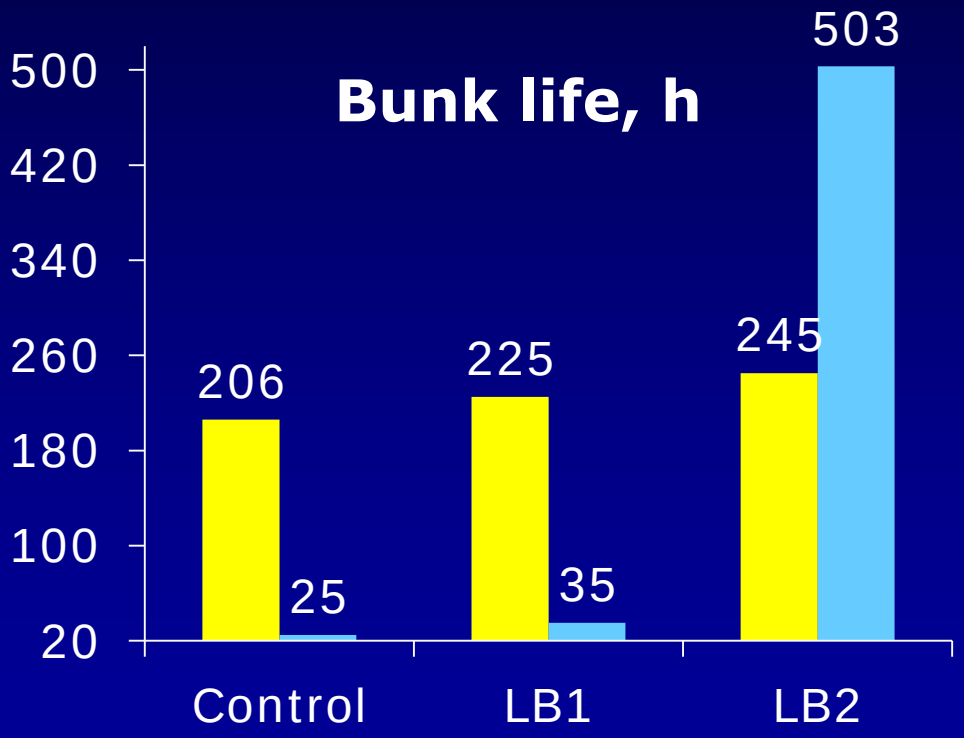
- Use on high moisture, high nitrate, med. - low sugar, high buffering capacity or winter forages
- Use with glass-lined, oxygen limiting, tower silos
- Cost-effective - $0.5 to 2/ton

2. Heterolactic inoculants

- Most of these contain *Lactobacillus buchneri*
- Ferments lactic acid to acetic acid
- Acetic acid inhibits spoilage yeasts and molds and increases bunk life
- May increase DM losses slightly
- Also sold as a Combo inoculant with homolactic bacteria to decrease DM losses

Effects of L. buchneri (LB) in 43 studies

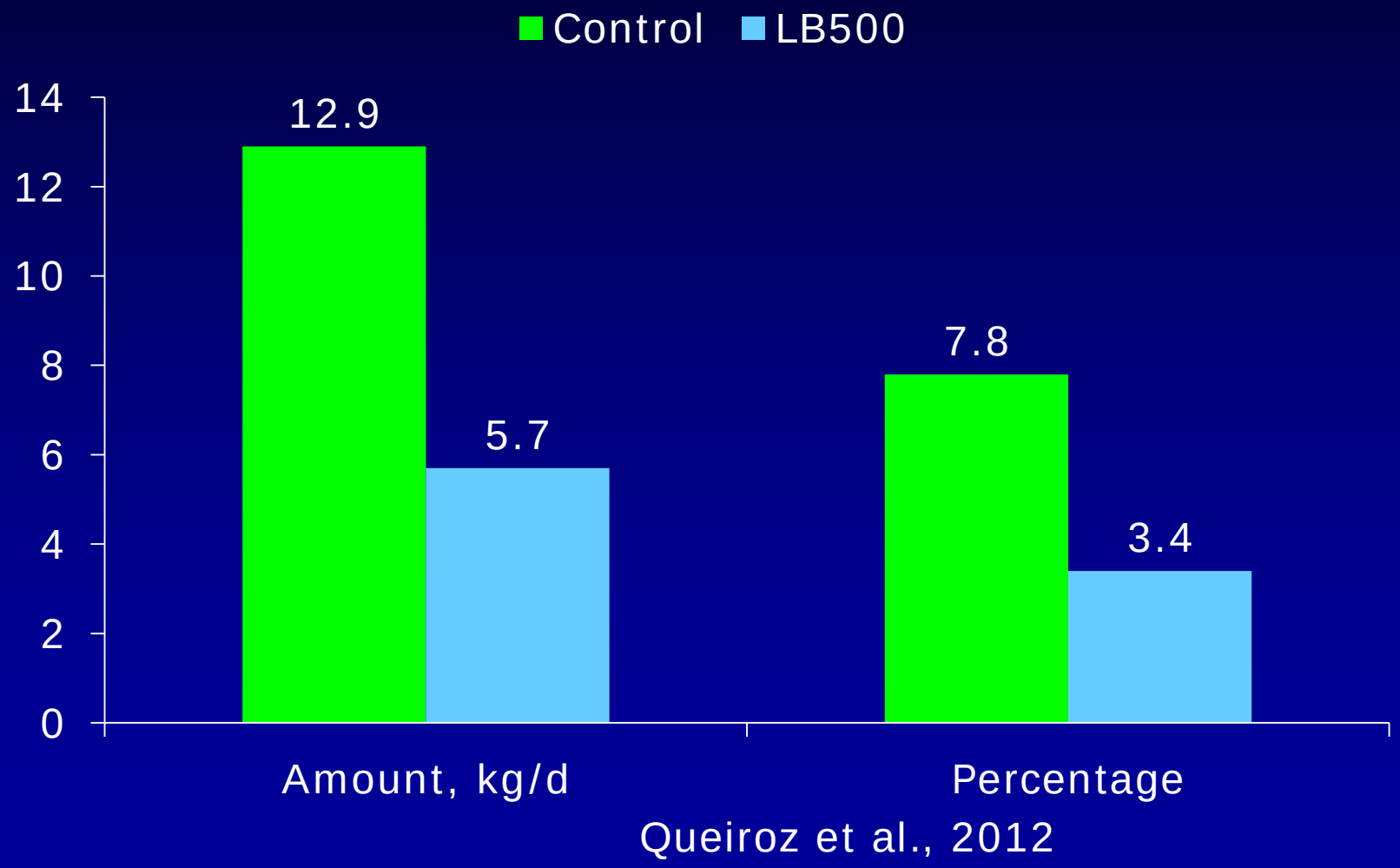




LB1 = <100,000 cfu/g
LB2 = >100,000 cfu.

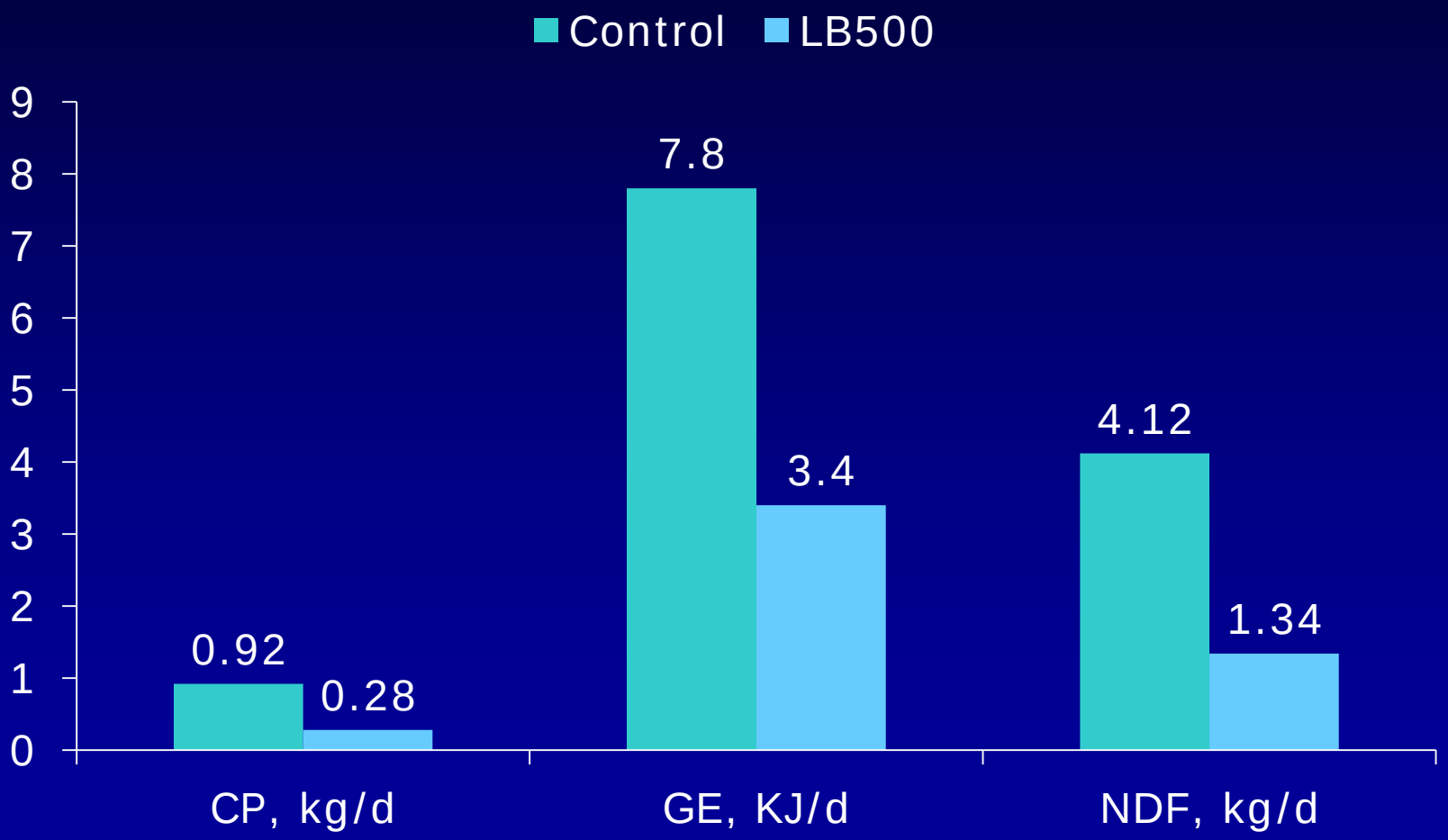
(Kleinschmit and Kung, 2007)

Effect of Buchneri combo inoculant on spoiled corn silage in 45-ton bags



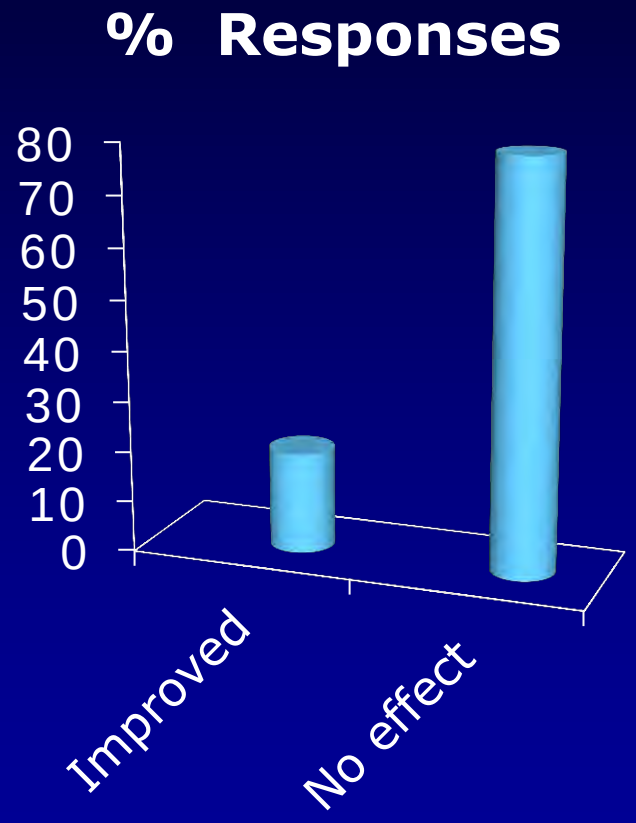
Queiroz et al., 2012

Effect of buchneri combo inoculant on nutrient losses from corn silage



Queiroz et al., 2012

Effects of L. buchneri inoculants on milk production in 5 experiments.



Summary on L. buchneri and buchneri combo inoculants

- Reduce heating, molds and mycotoxins
- Good for summer, mature, high sugar, high DM, diseased, drought-stressed silage
- Use with silage in bunkers, piles, (wide faces), slow feedout rates, transported silage

- Do not increase performance but by preventing heating, may maintain performance
- Cost effective – $1.5 to $2 for L. buchneri alone
- Up to $3/ton for combo buchneri inoculants

Four Bad Ideas for Application!!

(Bolsen , 2012)

Take home message:

To maximize silage nutrient preservation, every link in the silage-making 'chain' must excel

- Hybrid selection
- Growing the crop
- Predicting harvest dates
- Chopping
- Processing
- Packing and sealing
- Additives
- Feedout

Especially in the southeast


Thank you
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Happy 21st
RIGHT OF WAY IN THE SWAMP

Return on L. buchneri investment – aerobic stability

- If treated tonnage = 1 tonne
- Inoculant cost = $1.5 at $1.50/tonne
- If spoilage avoided = 4% (Florida example)
- Silage saved = 0.04 tons
- Value of DM saved = 0.04 x $50/ton = $2
- ROI = 1 to 1 on saved silage alone
- If milk loss due to spoilage is saved, ROI increases further