



Priorities for Enhancing Fermentation & Bunk Life (Not in Order of Operation)

1. Cut the crop at the right moisture
2. Pack the silage tight and minimize pore space
3. **Enclose it in a sealed environment (plastic).**

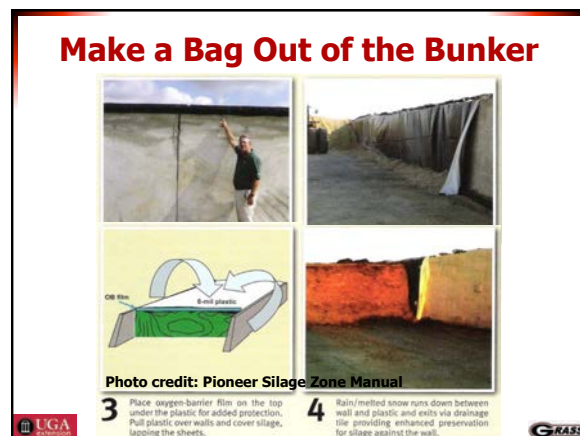
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Covers Vary in O₂ Permeability

Cover	Thickness (mil)	O ₂ Trans. Rate (100% O ₂ cm ³ /m ² /24 h)
Cover A	5.0	1,811
Cover B	7.0	710
Cover C	1.6	5,293
Cover D	1.6	5,982
Cover E	1.8	30
Baleage wrap	0.5-0.7	~10,000

Data from Michigan State Univ., School of Packaging

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**Cover it well, TUCK IT IN,
and weigh it down.**

Side wall plastic prev
O₂ from creeping down
top along the wall

UGA Photo credit: Hoards.com

Apply enough plastic but no more.

Remember - The plastic is not
impermeable to oxygen.

Application Amount – Inline Wrapper

- Eight+ layers (+ double on joints)
 - 12.5 – 16.7% overlap
 - two rolls rotating around bales
- Pre-stretched to 50-70%
- Tacky side towards the bale
- 60-80+ bales per hour

Application Amount – Ind. Wrapper

- Six+ layers (2 + 2 + 2 system)
 - 50% overlap
 - Three full bale rotations
 - If short term, 4-layers may be ok
- 15-40 bales per hour

- Minimize handling after wrapping
- Don't spear bales. Use squeeze carriers if they must be handled.
- Patch holes with greenhouse or silage tape.

- Duct tape has no UV inhibitor and will break down quickly in the sun.
- Obtain forage samples about 30 d before feeding, and immediately patch hole.

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1. Cut the crop at the right moisture
2. Pack the silage tight and minimize pore space
3. Cover it well, tuck it in, and weigh it down.
4. Save face in the feedout race
- 5. Inoculate the silage**





Can Inoculation Help?

Inoculation is the process of adding specific bacteria so that strain of bacteria will be predominant.

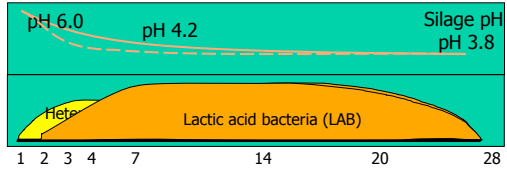

Types:

- Homolactic (*L. plantarum* or *Pediococcus*)
- Heterolactic (*L. buchneri*)
 - May also include fiber degrading esterase enzymes
- Combo (both species)

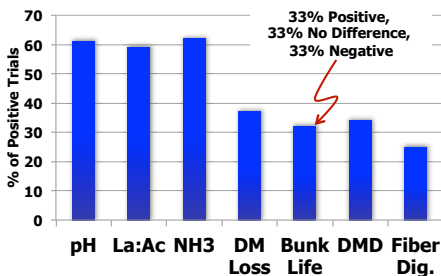



Homolactic Inoculants (*L. plantarum* or *Pediococcus*)


- Improve silage fermentation
- May not improve bunk life/silage stability
- Inc. rate of lactic acid formation = more rapid pH drop
- Minimizes losses of DM as CO₂

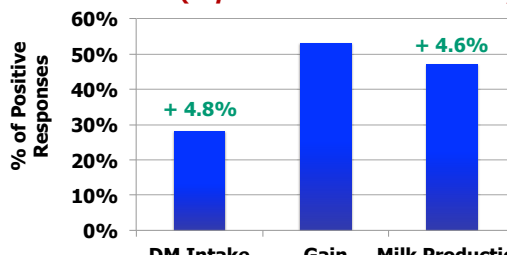
Effectiveness of Homolactic Inoculants (*L. plantarum* or *Pediococcus*)




Adapted from Muck & Kung, 1997



Effectiveness of Homolactic Inoculants (*L. plantarum* or *Pediococcus*)




Adapted from review by Muck & Kung (1997) of research trials conducted between 1990 and 1995. Data in GREEN = average response found in summary by Owen and Moran (1993).



Homolactic Inoculants (*L. plantarum* or *Pediococcus*)

Take Home Summary:

- Improves silage fermentation
- Usually improves DMI and milk production.
- Minimizes losses of DM as CO₂
- Likely won't improve bunk life/silage stability
- Use when:
 - High buffering capacity
 - High moisture
 - High nitrates
 - WSC are medium to low
 - Late winter annual forages
- Most estimate these are cost-effective when costs are **\$0.50-\$2.00/ton**



Heterolactic Inoculants (*L. buchneri*)

- May not improve silage fermentation, can inc. DM loss
- Improve bunk life/silage stability
- Dec. [lactate] & inc. [acetate], no pH improvement
- Acetic acid suppresses yeasts & molds, inc. bunk life

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Effectiveness of Heterolactic Inoculants (*L. buchneri*)

Characteristic	Control	LB-Low	LB-High
pH			
La:Ac			
DM Recovery, %			
Yeasts, log cfu/g			
Aerobic stability, h			

Adapted from a meta-analysis by Kleinschmit & Kung, 2006 summarizing 43 experiments.

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Effectiveness of Heterolactic Inoculants (*L. buchneri*)

Characteristic	Control	LB-Low	LB-High
pH	3.70	3.75	3.88
La:Ac	3.02	2.23	1.23
DM Recovery, %	95.5	95.5	94.5
Yeasts, log cfu/g	4.18	3.1	1.88
Aerobic stability, h	25	35	503

Adapted from a meta-analysis by Kleinschmit & Kung, 2006 summarizing 43 experiments.

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Effectiveness of Heterolactic Inoculants (*L. buchneri*)

From Ranjit & Kung, 2000.

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Combination Inoculants (*L. plantarum* or *Pediococcus* + *L. buchneri*)

- May improve silage fermentation and bunk life
- Can inc. DM loss
- Acetic acid suppresses yeasts & molds, inc. bunk life

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Combination Inoculants (*L. plantarum* or *Pediococcus* + *L. buchneri*)

	Control	Combo	P Value
pH			
La:Ac			
Yeast & Mold Count (log cfu/g)			
Aerobic stability (h)			
Silo Face Temp. (°F)			
Spoiled Silage (% of 45-ton bag)			

Reduce loss by 4.4%
\$118 per 45-ton bag

Adapted from Queiroz et al., 2012.

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Combination Inoculants

(L. plantarum or Pediococcus + L. buchneri)

	Control	Combo	P Value
pH	3.99	3.91	0.01
La:Ac	2.53	1.58	0.08
Yeast & Mold Count (log cfu/g)	4.62	2.59	0.01
Aerobic stability (h)	9.5	14.7	0.71
Silo Face Temp. (°F)	97.2	94.6	0.42
Spoiled Silage (% of 45-ton bag)	7.83	3.39	<0.01

Reduce loss by 4.4%
\$118 per 45-ton bag

UGA Adapted from Queiroz et al., 2012. GRASS

Silage after 5 d aerobic exposure

(Filya, 2003)

Forage	Treatment	pH	CO ₂ Production % of DM	Yeast Count log cfu/g DM	Mold Count
Corn	Untreated	6.1	2.55	6.5	3.3
	<i>L. plantarum</i>	5.8	4.76	7.7	2.8
	<i>L. buchneri</i>	4.2	0.41	<2.0	<2.0
	Both	4.8	0.70	2.0	<2.0

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Silage after 5 d aerobic exposure

(Filya, 2003)

Forage	Treatment	pH	CO ₂ Production % of DM	Yeast Count log cfu/g DM	Mold Count
Corn	Untreated	6.1	2.55	6.5	3.3
	<i>L. plantarum</i>	5.8	4.76	7.7	2.8
	<i>L. buchneri</i>	4.2	0.41	<2.0	<2.0
	Both	4.8	0.70	2.0	<2.0
Wheat	Untreated	4.9	2.94	6.8	3.5
	<i>L. plantarum</i>	5.3	3.73	8.1	3.1
	<i>L. buchneri</i>	3.9	0.46	<2.0	<2.0
	Both	4.1	0.68	2.2	<2.0
Sorghum	Untreated	6.4	3.16	7.6	3.7
	<i>L. plantarum</i>	6.4	4.53	8.4	3
	<i>L. buchneri</i>	4.3	0.54	<2.0	<2.0
	Both	4.6	0.88	2.6	<2.0

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Heterolactic & Combination Inoculants

(L. buchneri or combos)

Take Home Summary:

- Improves bunk life/silage stability
- Use when:
 - For summer feeding
 - Diseased
 - WSC are high
 - Drought-stressed
 - Winter annual forages
 - Wide face, slow feedouts
- May not increase performance, but should reduce spoilage and therefore maintain performance
- Most estimate these are cost-effective when costs are **\$0.50-\$2.00/ton** if heterolactic (*L. buchneri*) only
- <\$3/ton** for combo products

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Inoculants May Reduce Mold Risks

Untreated Homofermentative Inoculant Homofermentative and Heterofermentative Inoculant

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Four Bad Ideas for Application!!

Slide credit: Bolsen, 2012

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Selecting and Using Inoculants

- Use an inoculant labeled for your crop (strain specific)
- Apply at least 100,000 cfu/g
- Wet or dry? Either can work
 - Wet products are easier to deal with
 - Wet more effective if dealing with crop that is on the dry side
- Avoid chlorine when mixing
 - Sensitive at 1 ppm Cl⁻
- Keep inoculant < 100 °F
- Follow the directions



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Associated forage-based livestock systems have a farm gate value of over \$14 billion

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Questions?

