

18th ISC

Effects of dry matter, silage additive and bagging technology on fungal counts and aerobic stability of pressed sugar beet pulp silage (PSBP)

M. Schneider, **H. Auerbach**, M. Eklund, G. Rössl and
H. Spiekers

Joint project between research and industry partners



LfL

ISC

INTERNATIONAL SILAGE CONSULTANCY



Facts about pressed sugar beet pulp (silage)

- normally 22-28% DM, but new technological developments to increase DM concentration to about 45% DM
- storage in bunker silos and to increasing extent in bags using rotor-press technology but truck-bagging also available now
- challenge regarding aerobic stability during feed-out, especially in summer and at low feed-out rates
- survey on German farms carried out by Kalzendorf (2007):
 - yeasts ($>1,000,000$ fu/g): 75%
 - lactate-assimilating yeasts ($>100,000$ cfu/g): 75%
- *P. roqueforti*-group most frequently found in PSBP silage, mycotoxins incl. mycophenolic acid detected



Facts about pressed sugar beet pulp (silage)

- normally 22-28% DM, but new technological developments to increase DM concentration to about 45% DM
- storage in bunker silos and to increasing extent in bags using rotor-press technology but truck-bagging also available now
- challenge regarding aerobic stability during feed-out, especially in summer and at low feed-out rates
- survey on German farms carried out by Kalzendorf (2007):
 - yeasts ($>1,000,000$ fu/g): 75%
 - lactate-assimilating yeasts ($>100,000$ cfu/g): 75%



Aim of the study

Testing the effects of higher DM concentration, new bagging technology and additive use on fungal counts and aerobic stability of PSBP silage stored in bags

References: Nout et al., 1993; Weber et al., 2006a, 2006b; Scholz et al., 2014; Boudra et al., 2015; Potthast et al., 2016; Auerbach et al., 2016

Material and methods

- PSBP produced in 2015 and 2016 by a sugar factory of Südzucker AG, transported by truck to trial location
- 20-25 t of fresh PSBP per treatment, packed into **one bag per treatment**
- storage min. 6 months outside until June/July of the following year
- Treatments:

Bagging technology	DM	Additive	Year	
			2015	2016
Rotor	28%	-	X	X
		+	X	X
	45%	-	X	X
		+	X	X
		++		X
Truck	45%	-	X	X
		+	X	X

+1.5 L/t, ++2.0 L/t

Bagging technologies

Rotor bagger

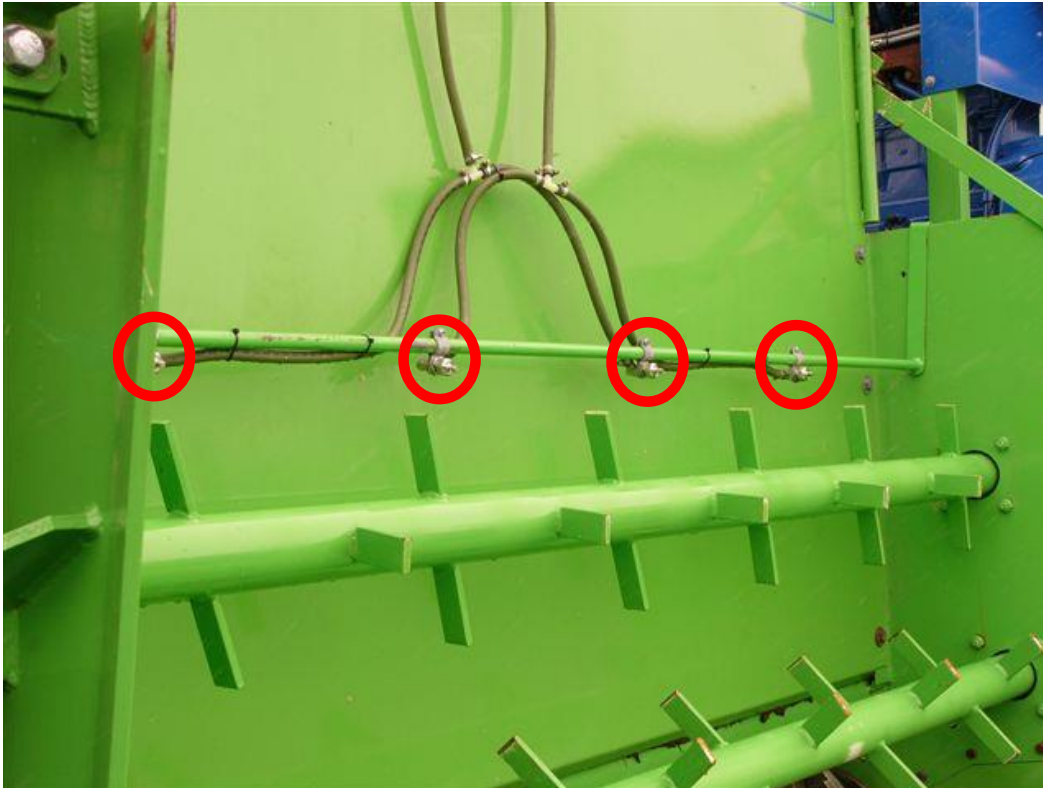


Truck bagger



Silage additive application

Rotor bagger



○ nozzles

Truck bagger



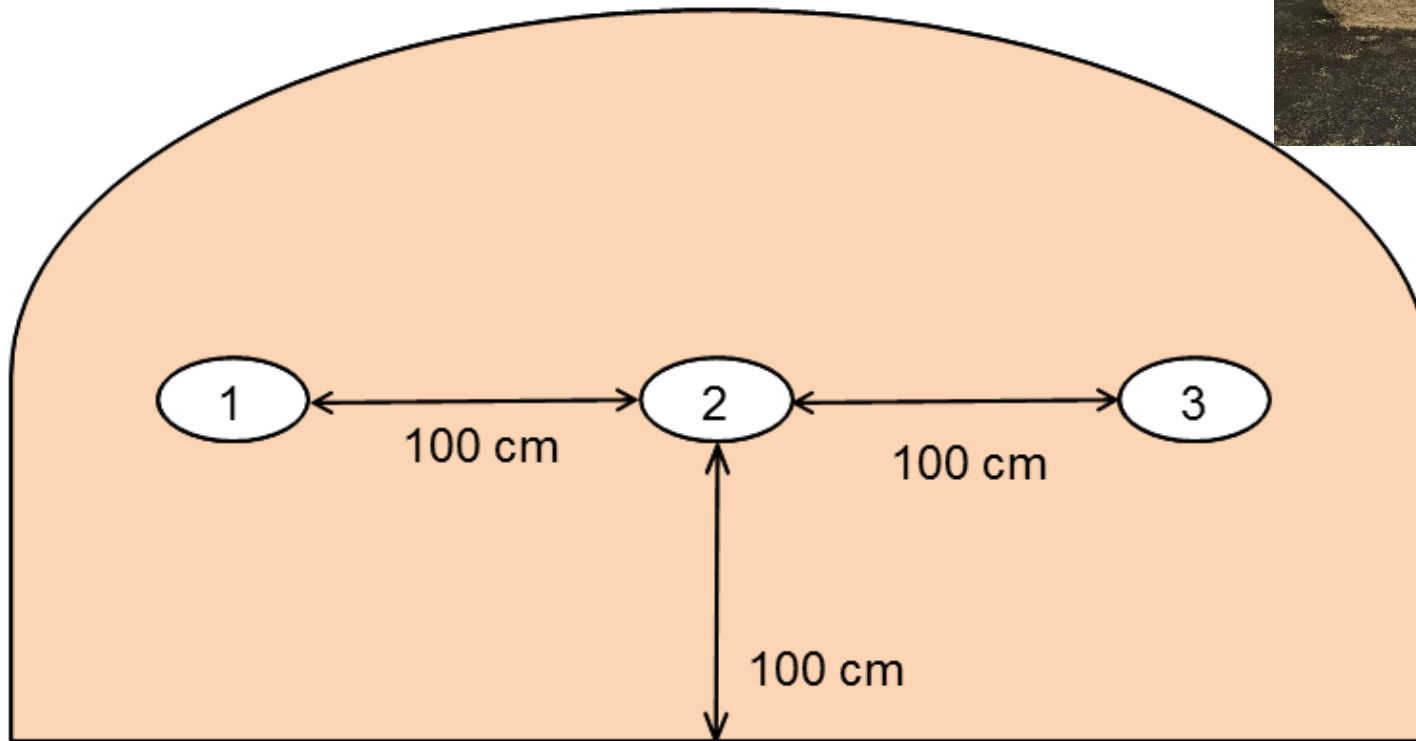
Additive composition:

Sodium benzoate:	257 g L ⁻¹
Potassium sorbate:	154 g L ⁻¹
Ammonium propionate:	57 g L ⁻¹

Material and methods

Sampling points

samples taken by hollow drill
diameter: 13 cm, length: 25 cm,
volume: 3.32 L

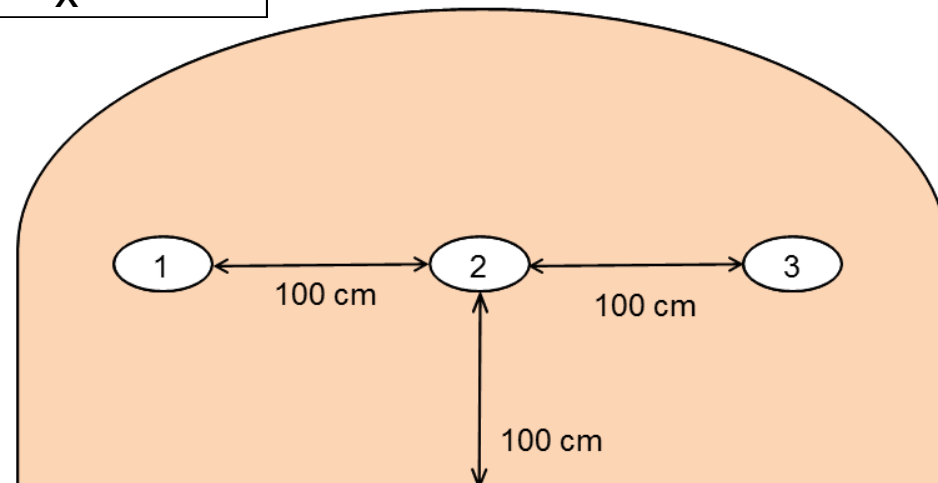


Material and methods

Sampling times

Sampling time	fresh	old*
1 (bag opening)	x	
2	x	x
3	x	x
4		x

* bag face exposed to air for 7 days



Analysed parameters

- DM
- packing density (kg DM m⁻³)
- pH
- fermentation pattern (acids/alcohols)
- fungal counts (yeasts and moulds)
- aerobic stability (ASTA) by temperature measurement (difference to ambient: 3 °C)
- statistical analyses by SAS, 9.4, procedures **MIXED** packing density or **ANOVAF** (non-parametric test) for fungal counts and ASTA



Approach 1: **DM, aeration, silage additive** (1.5 L/t)

Year	Bagging technology	Air exposure	DM (%)					
			28			45		
			Silage additive application rate (L/t)					
			0	1.5	2.0	0	1.5	2.0
2015	rotor	fresh	s3 x t3	s3 x t3		s3 x t3	s3 x t3	
		old	s3 x t3	s3 x t3		s3 x t3	s3 x t3	
2016	rotor	fresh	s3 x t3	s3 x t3		s3 x t3	s3 x t3	
		old	s3 x t3	s3 x t3		s3 x t3	s3 x t3	

only rotor-bagged material

Approach 2: **bagging technology, aeration, additive** (1.5 L/t)

Year	Bagging technology	Air exposure	DM (%)					
			28			45		
			Silage additive application rate (L/t)					
			0	1.5	2.0	0	1.5	2.0
2015	rotor	fresh				s3 x t3	s3 x t3	
		old				s3 x t3	s3 x t3	
	truck	fresh				s3 x t3	s3 x t3	
		old				s3 x t3	s3 x t3	
2016	rotor	fresh				s3 x t3	s3 x t3	
		old				s3 x t3	s3 x t3	
	truck	fresh				s3 x t3	s3 x t3	
		old				s3 x t3	s3 x t3	

only 45% DM material

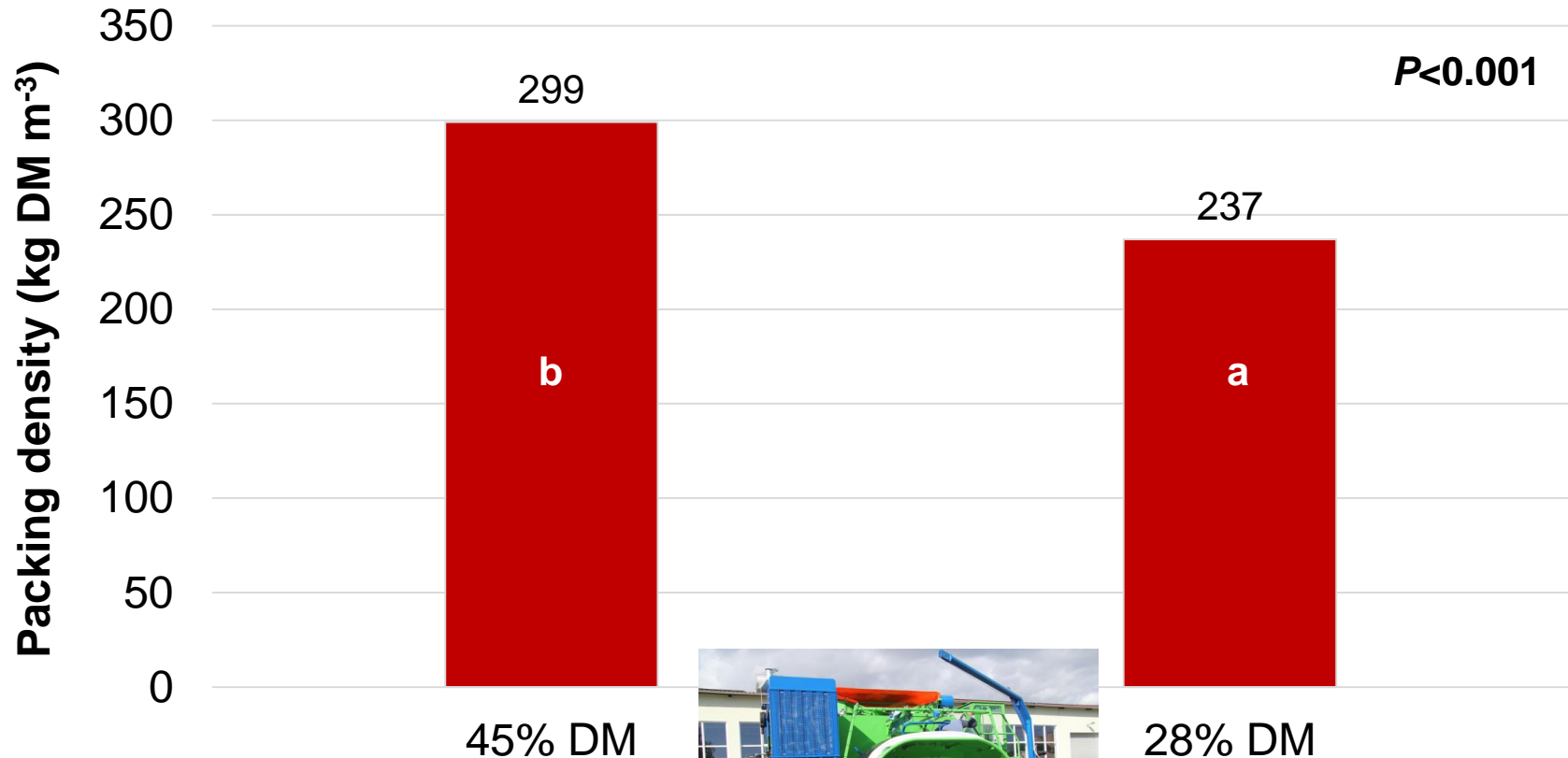
Approach 3: **aeration, additive, application rate**

Year	Bagging technology	Air exposure	DM (%)					
			28			45		
			Silage additive application rate (L/t)					
			0	1.5	2.0	0	1.5	2.0
2016	rotor	fresh				s3 x t3	s3 x t3	s3 x t3
		old				s3 x t3	s3 x t3	s3 x t3

only 45% DM material, rotor-bagged

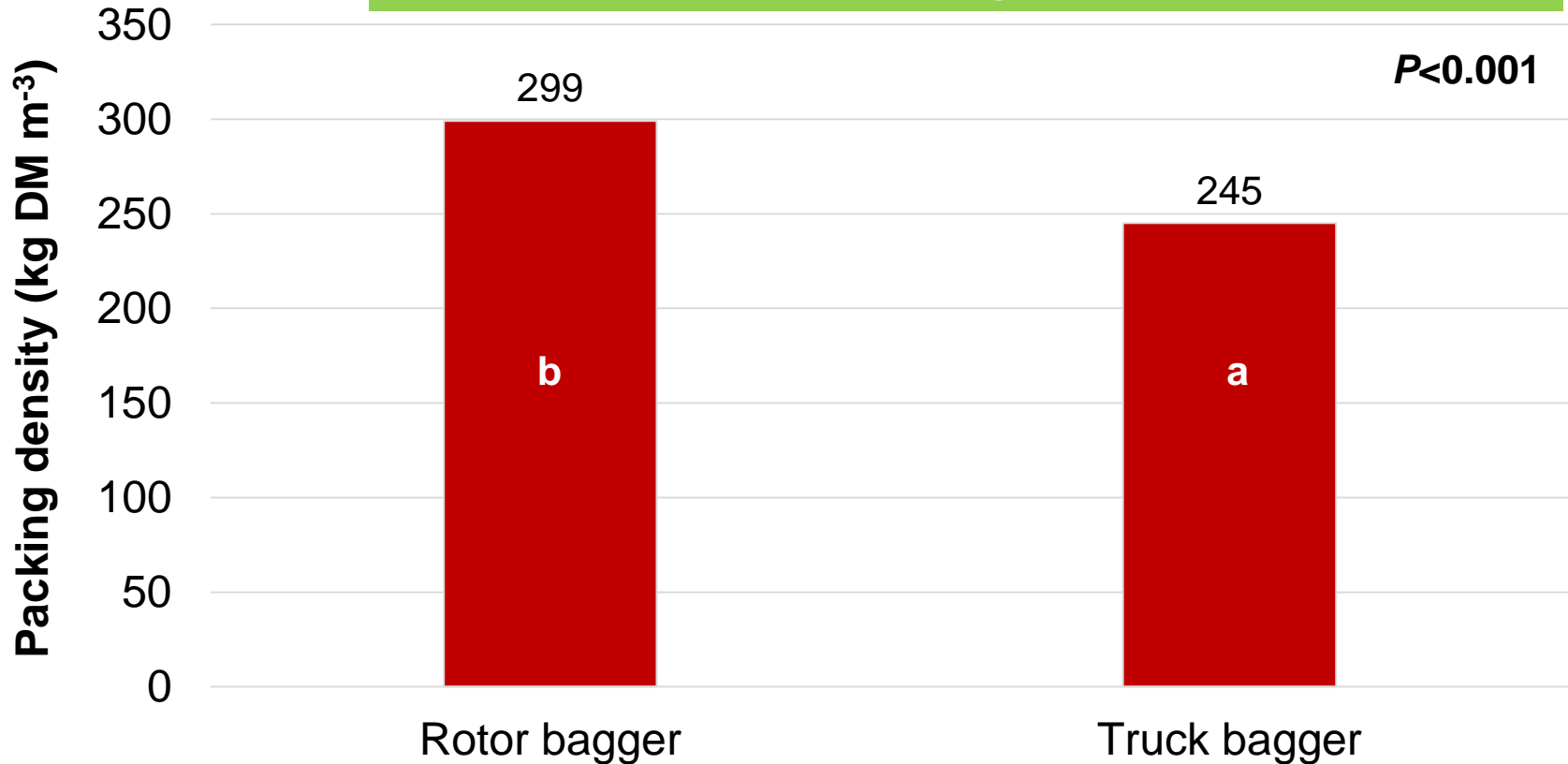
Results: Packing density in **rotor-bagged** material

Literature data on PSBP silage with 25-28% DM, rotor-bagged:
184 - 213 kg DM m⁻³



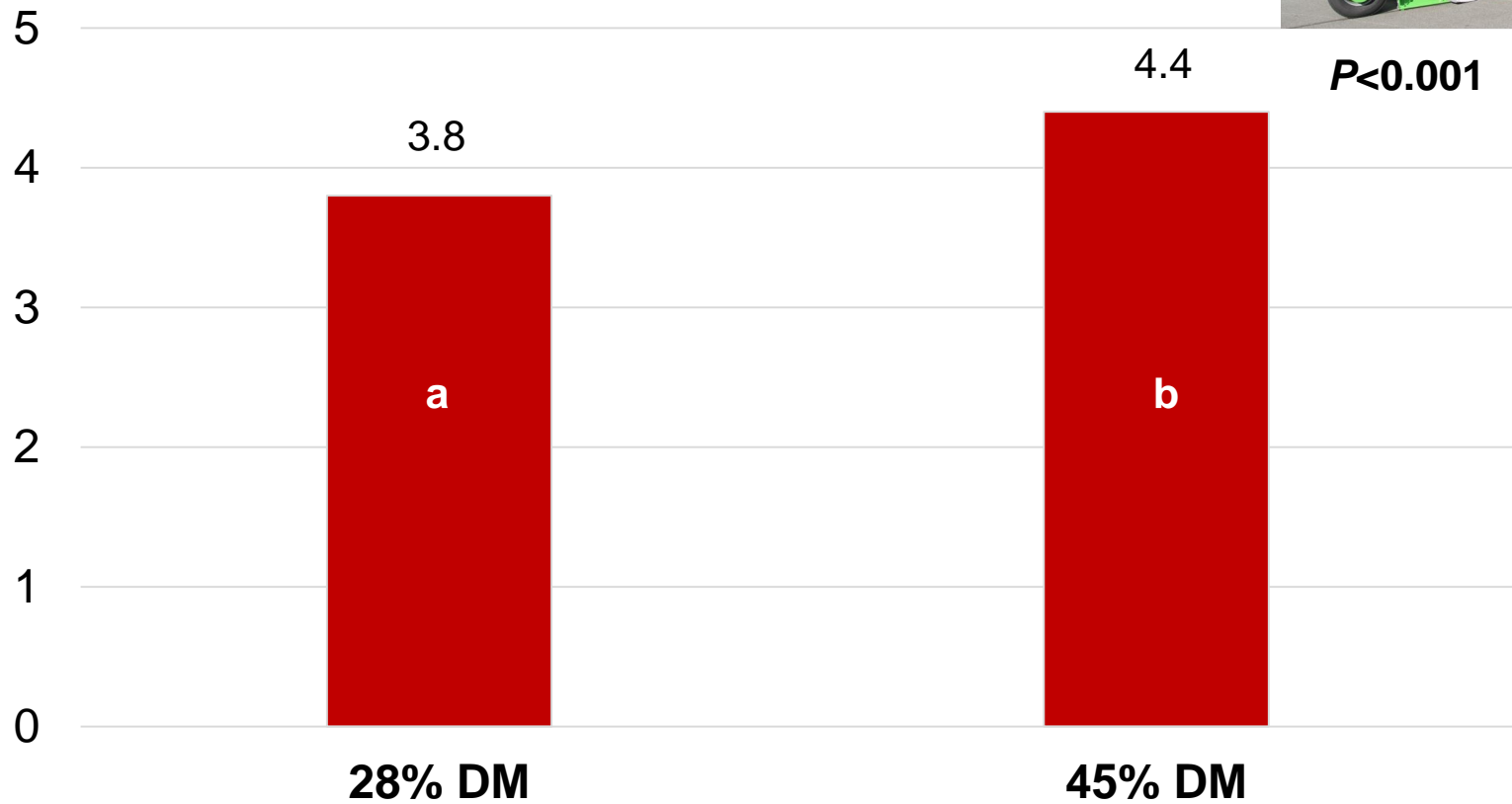
Results: Packing density of **45% DM PSBP** silage

higher than in „normal“ (up to 28%) DM PSBP silage:
max. 210 kg DM m⁻³



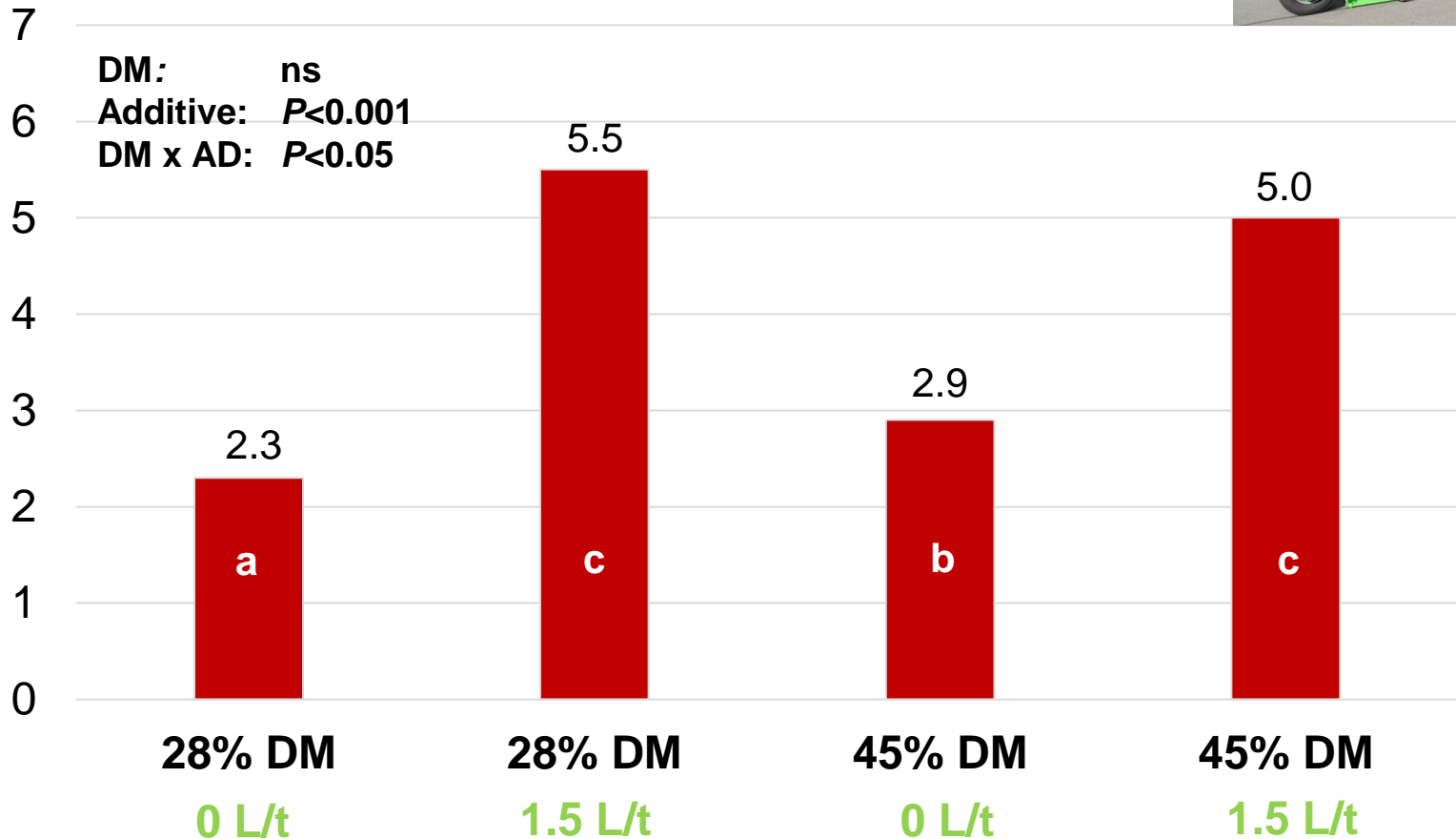
Results: **Yeast count** (approach 1: DM)

Yeast count (\log_{10} cfu g⁻¹)



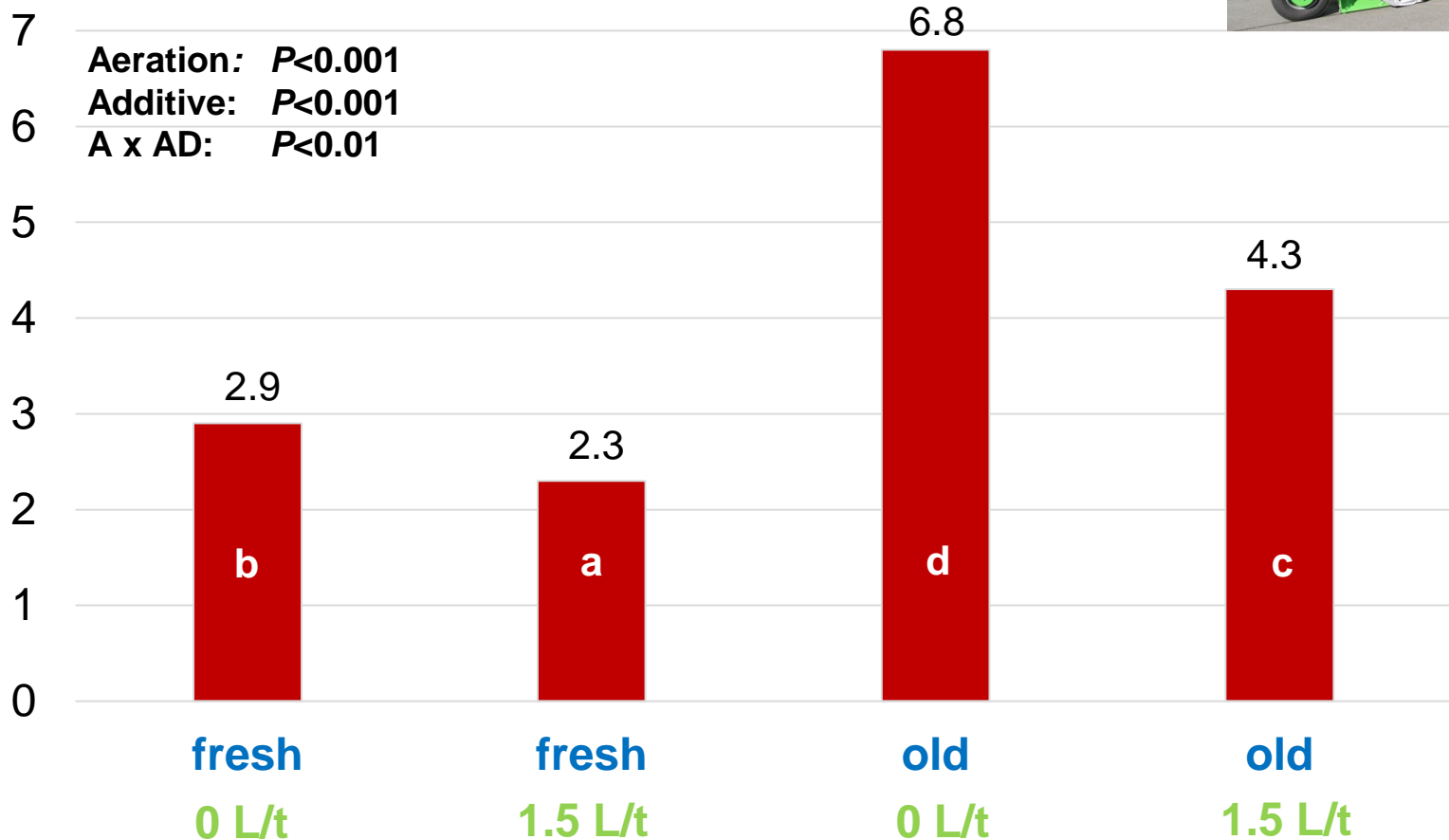
Results: **Aerobic stability** (approach 1: DM, **additive**)

Aerobic stability (days)



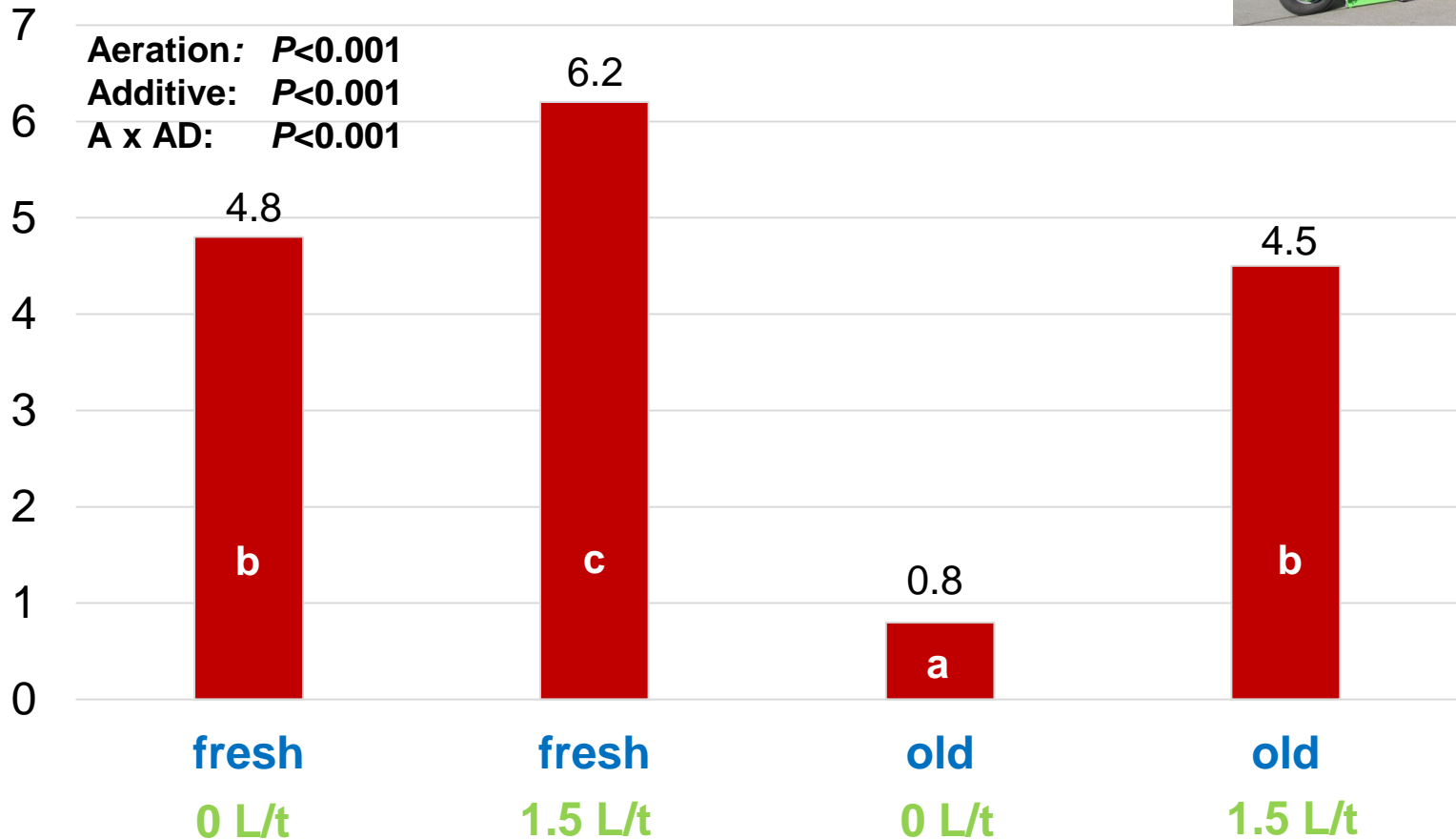
Results: **Yeast count** (approach 1: **aeration**, **additive**)

Yeast count (\log_{10} cfu g⁻¹)



Results: **Aerobic stability** (approach 1: **aeration**, **additive**)

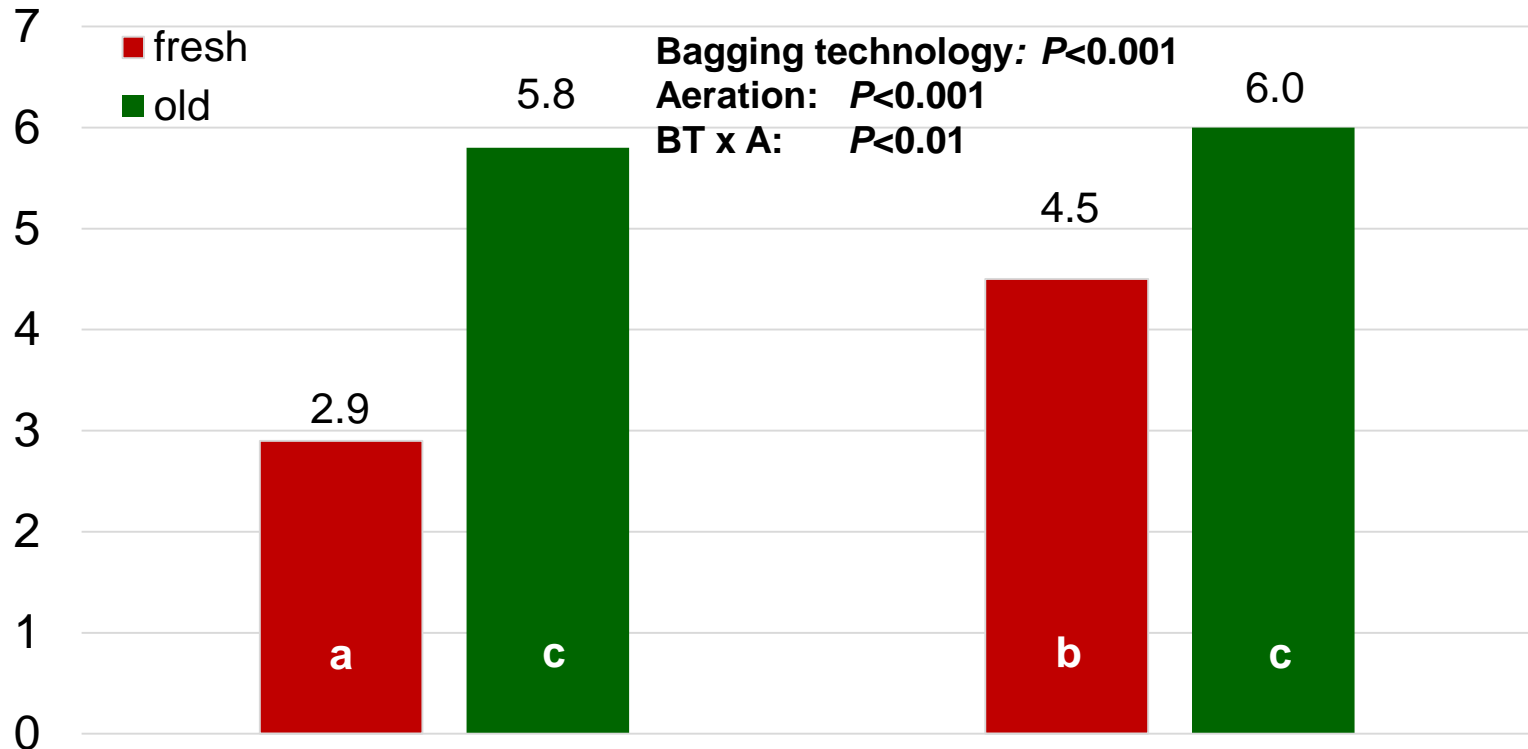
Aerobic stability (days)



Results: **Yeast count** (approach 2: **technology**, **aeration**)

PSBP with 45% DM

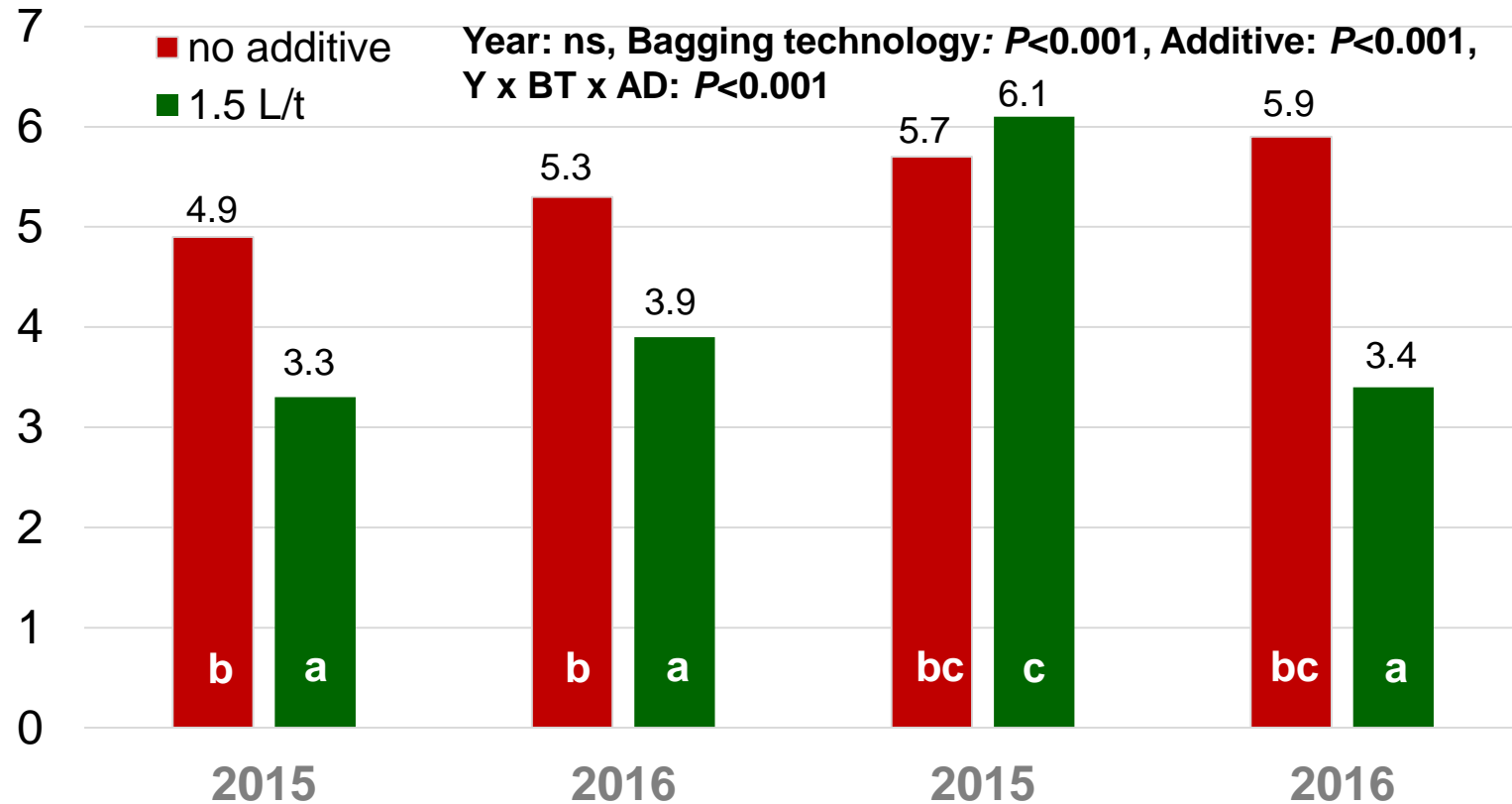
Yeast count (\log_{10} cfu g⁻¹)



Results: **Yeast count** (approach 2: year, technology, additive)

Yeast count (\log_{10} cfu g⁻¹)

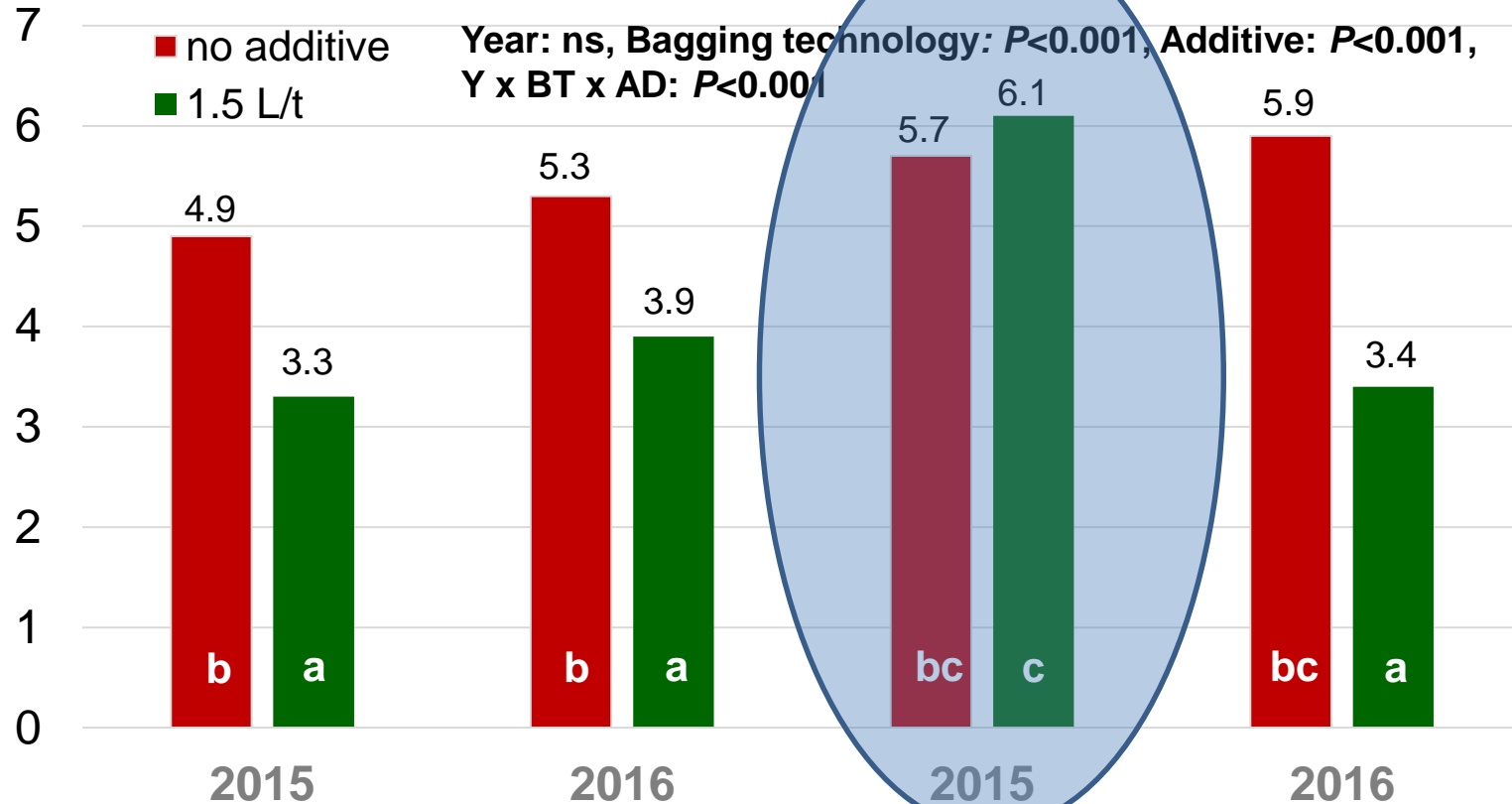
PSBP with 45% DM



Results: **Yeast count** (approach 2: year, technology, additive)

Yeast count (\log_{10} cfu g⁻¹)

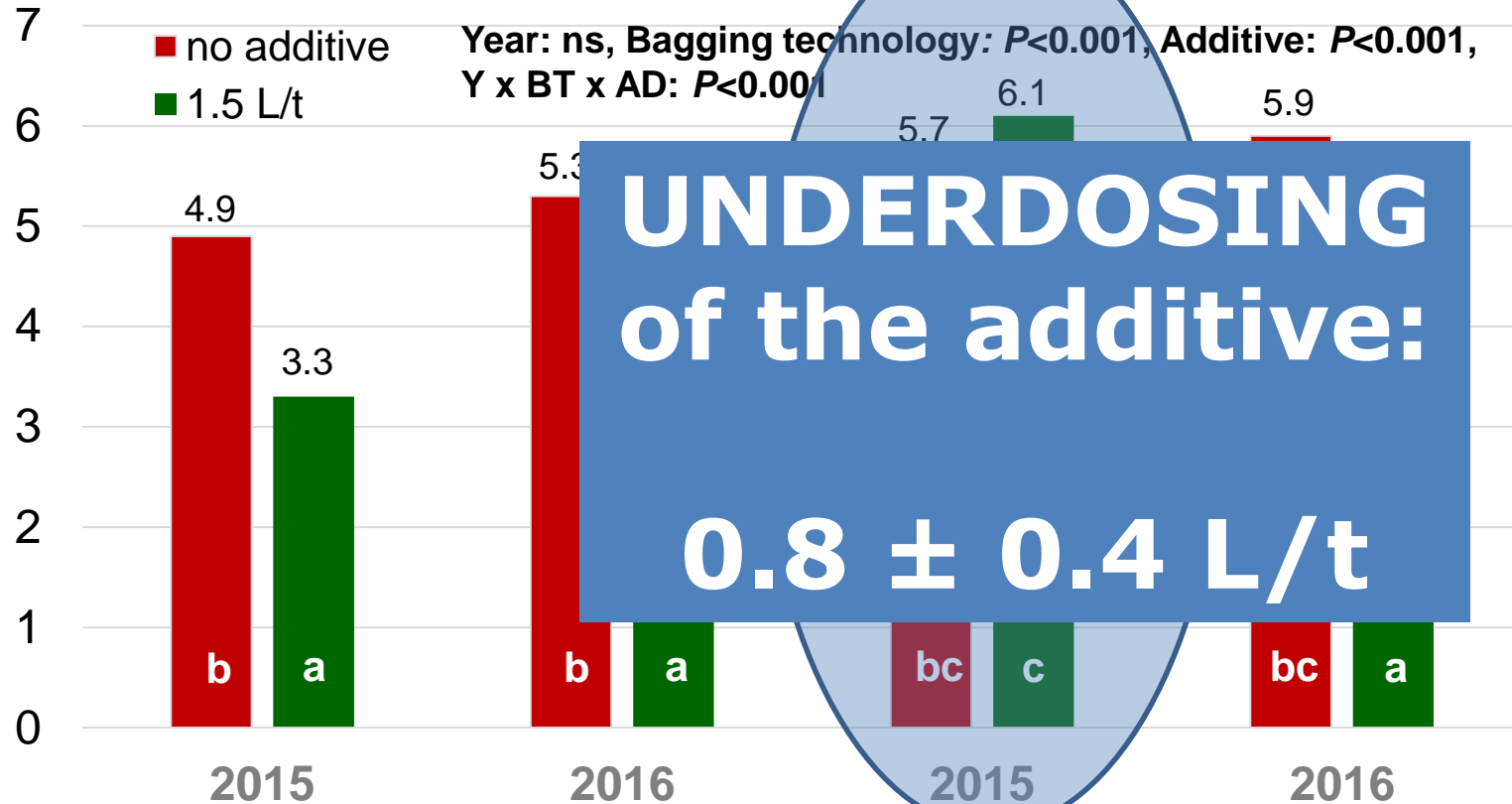
PSBP with 45% DM



Results: Yeast count (approach 2: year, technology, additive)

Yeast count (\log_{10} cfu g⁻¹)

PSBP with 45% DM

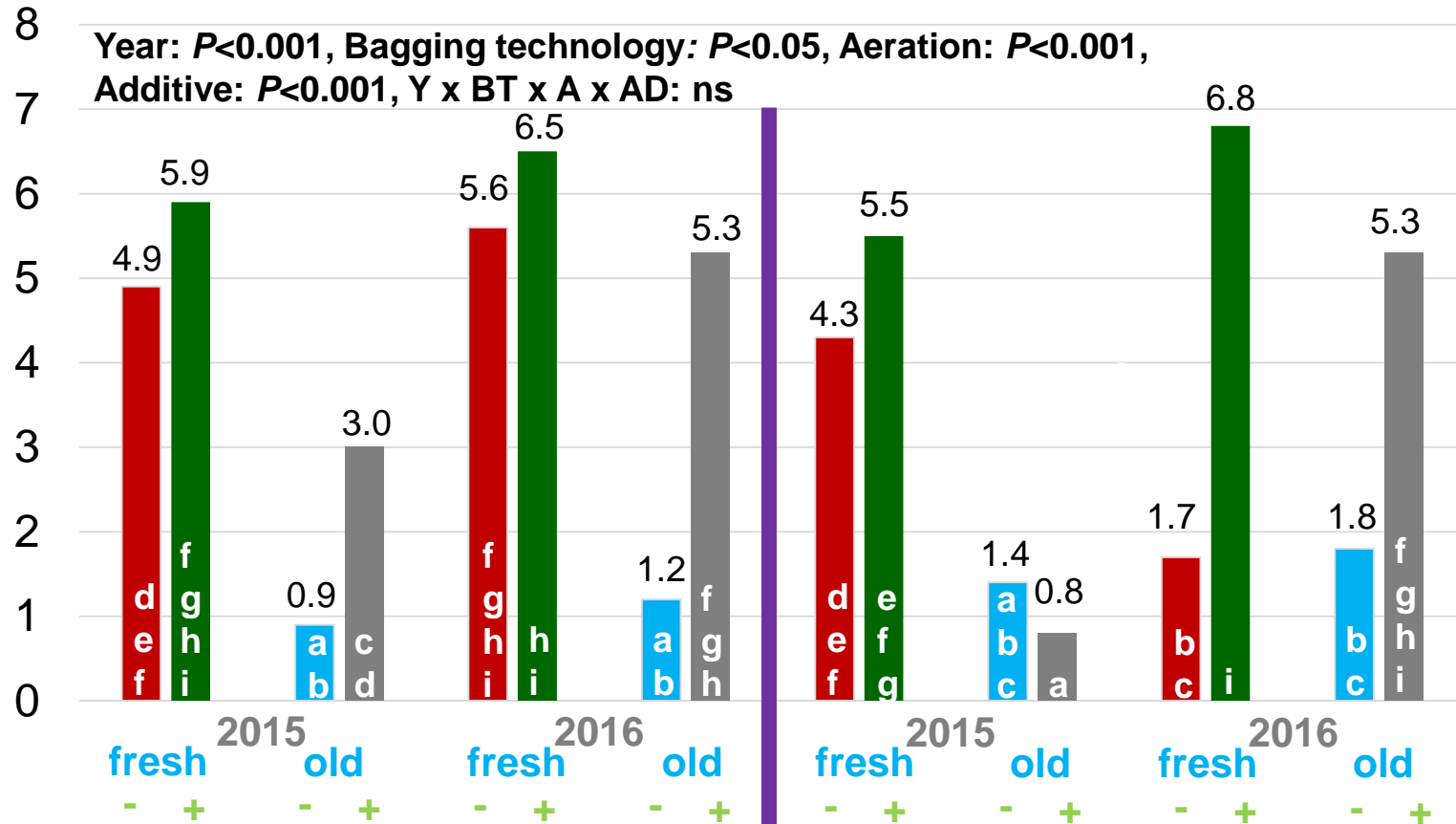


Results: **ASTA**

(approach 2: year, technology, aeration, additive)

Aerobic stability (days)

PSBP with 45% DM



Year
Aeration
Additive

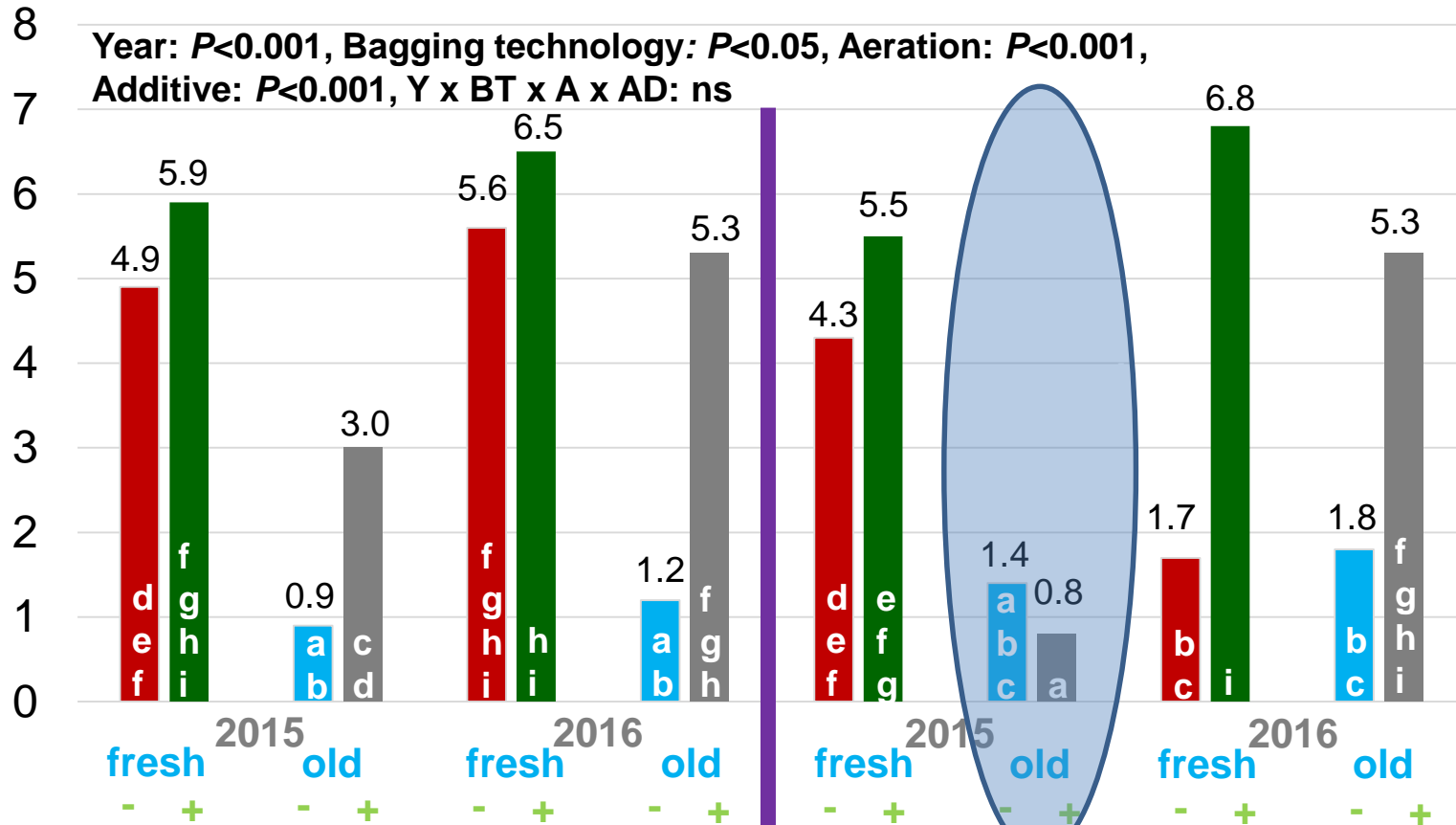


Results: **ASTA**

(approach 2: year, technology, aeration, additive)

Aerobic stability (days)

PSBP with 45% DM



Year
Aeration
Additive

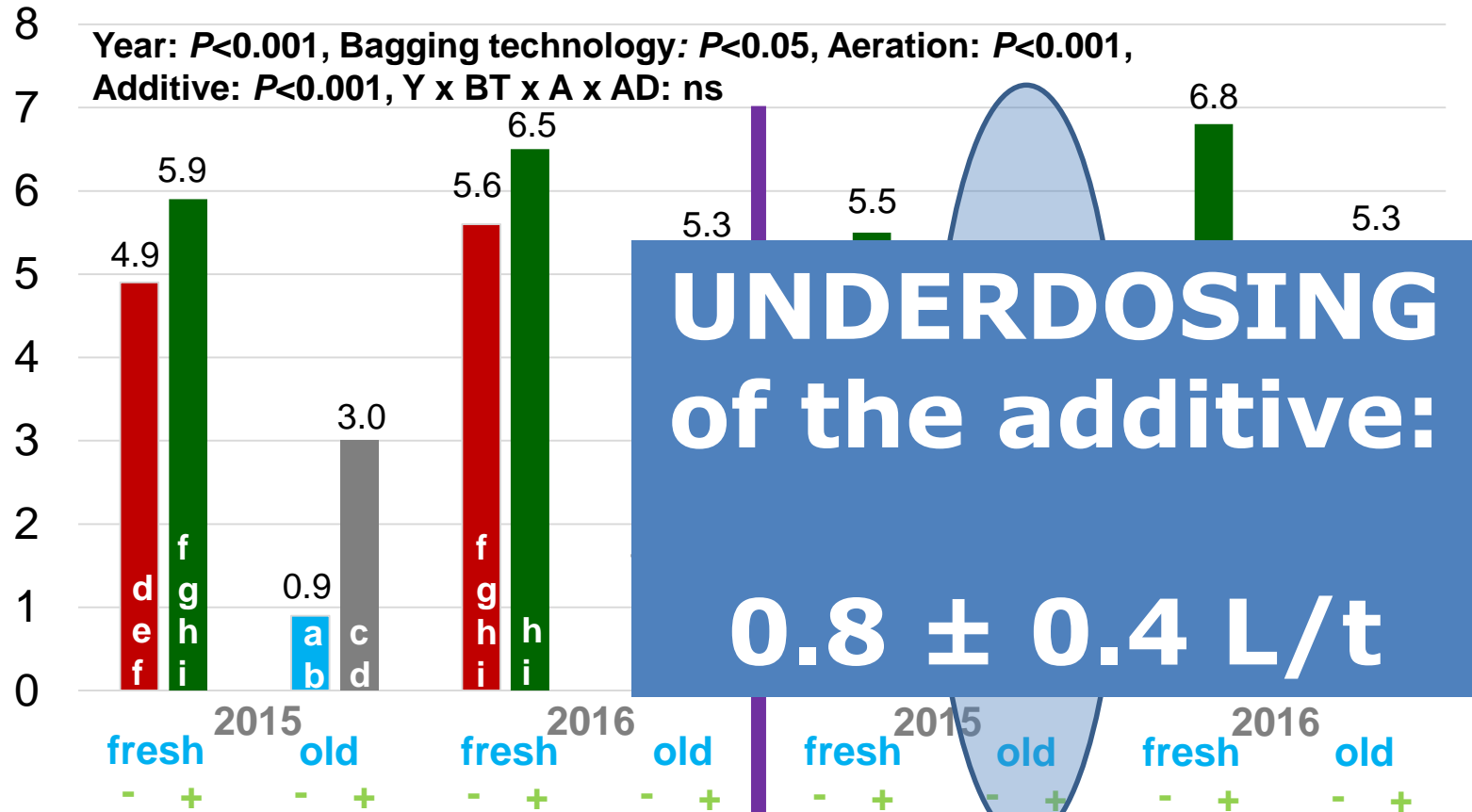


Results: **ASTA**

(approach 2: year, technology, aeration, additive)

Aerobic stability (days)

PSBP with 45% DM

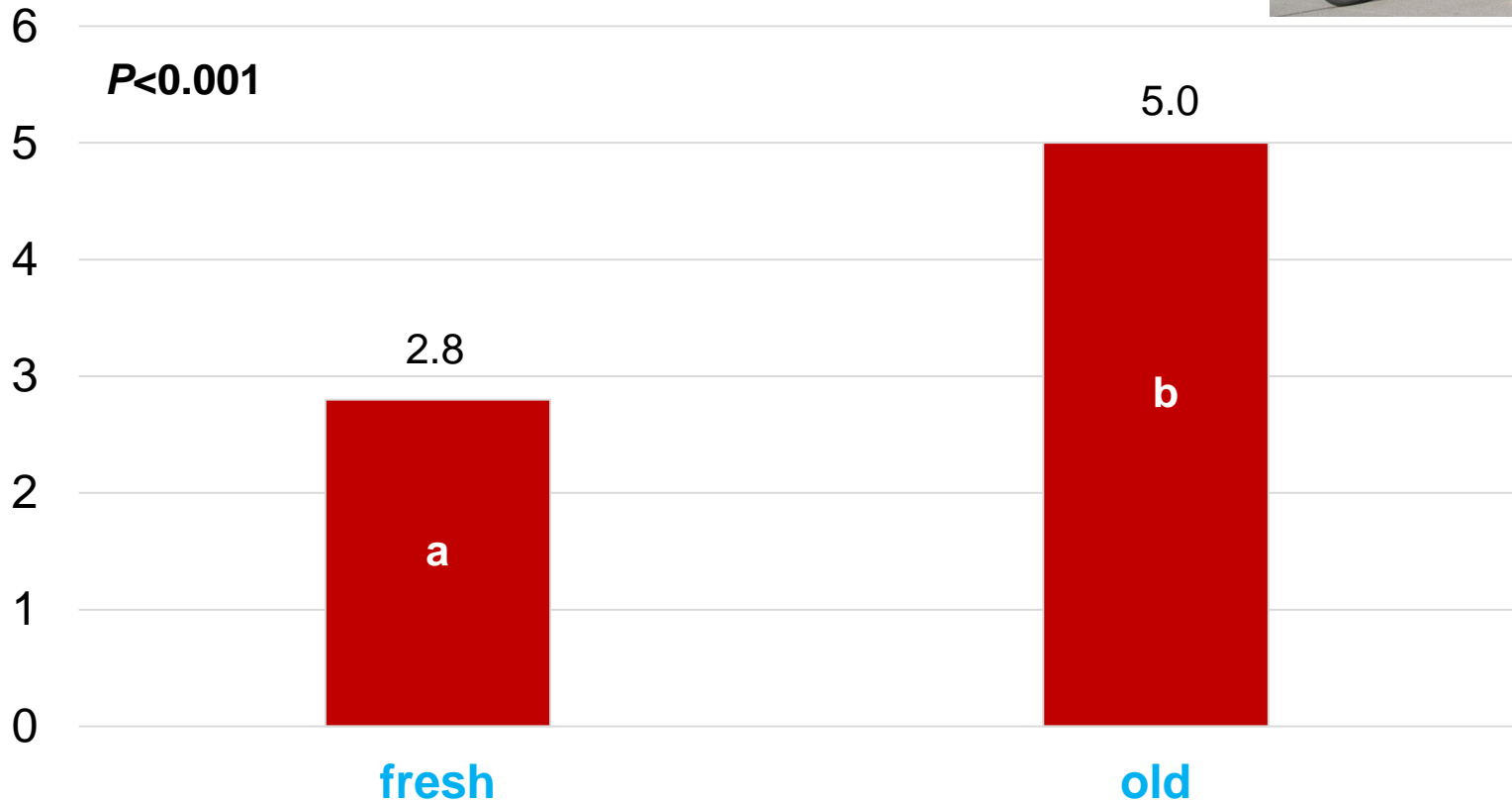


Year
Aeration
Additive



Results: Yeast count (approach 3: aeration)

Yeast count (\log_{10} cfu g⁻¹)



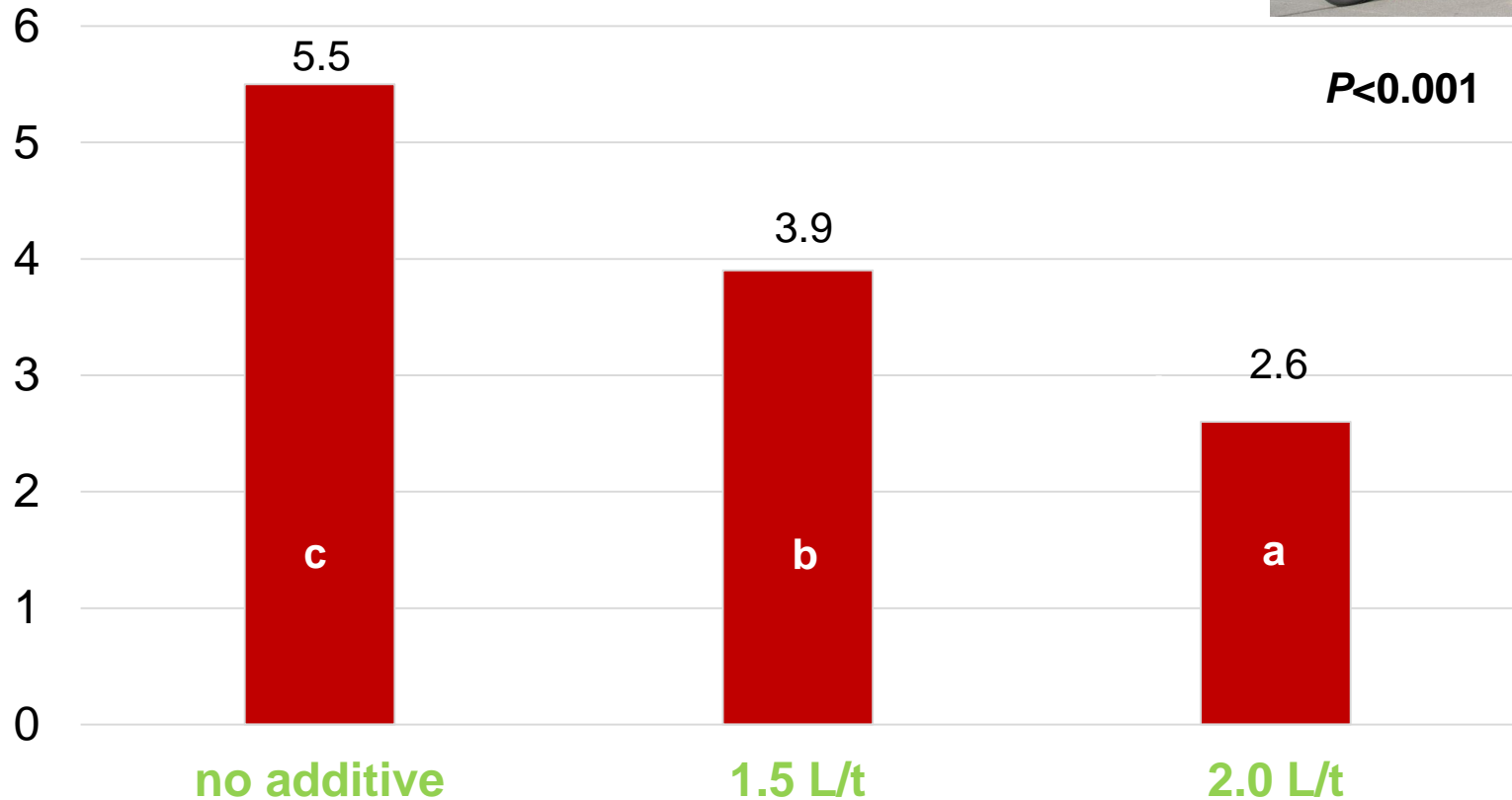
PSBP with 45% DM
2 application rates



Results: **Yeast count** (approach 3: **additive dosage**)

Yeast count (\log_{10} cfu g⁻¹)

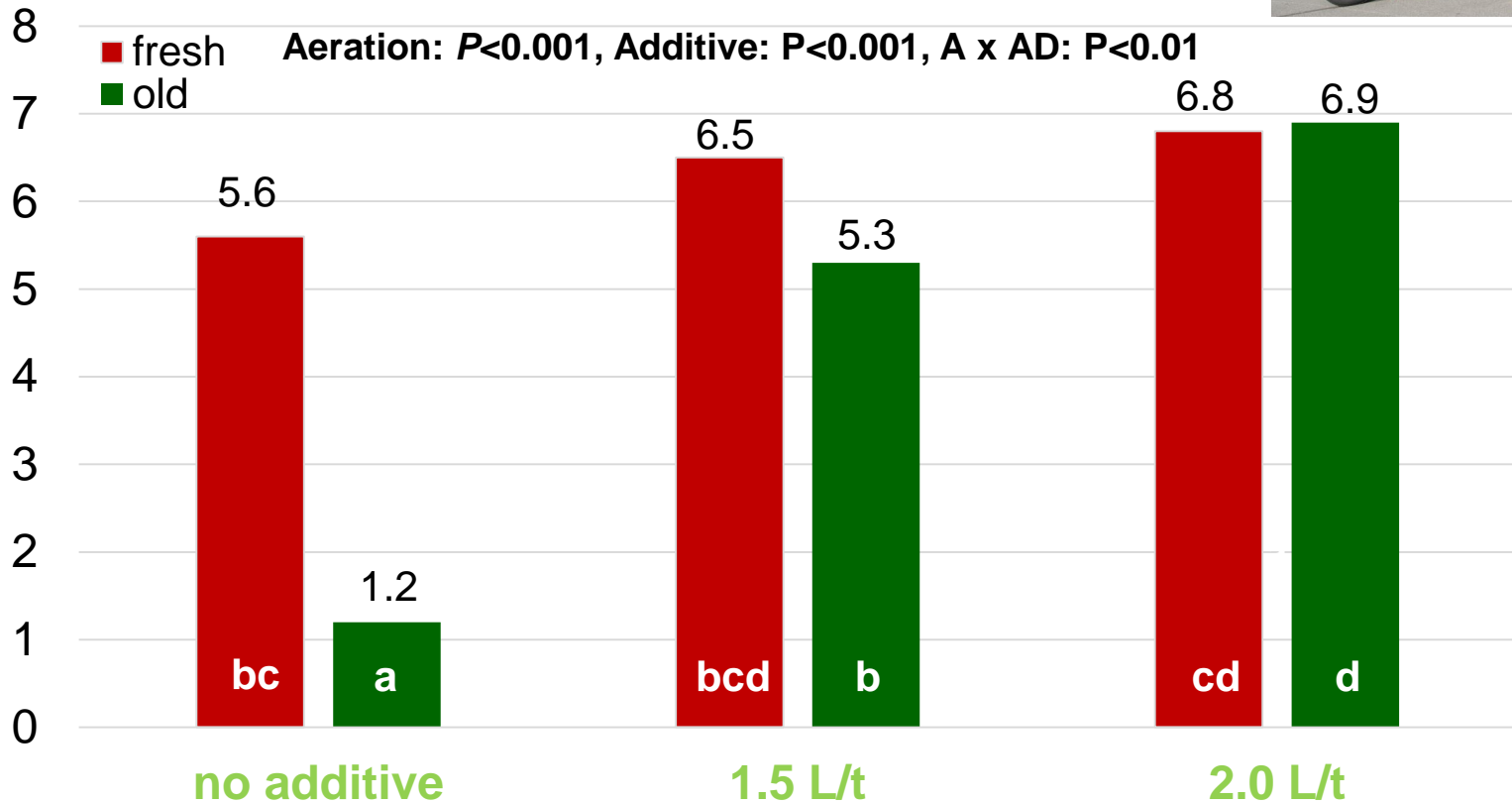
PSBP with 45% DM
2 application rates



Results: **Aerobic stability** (approach 3: **aeration**, **dosage**)

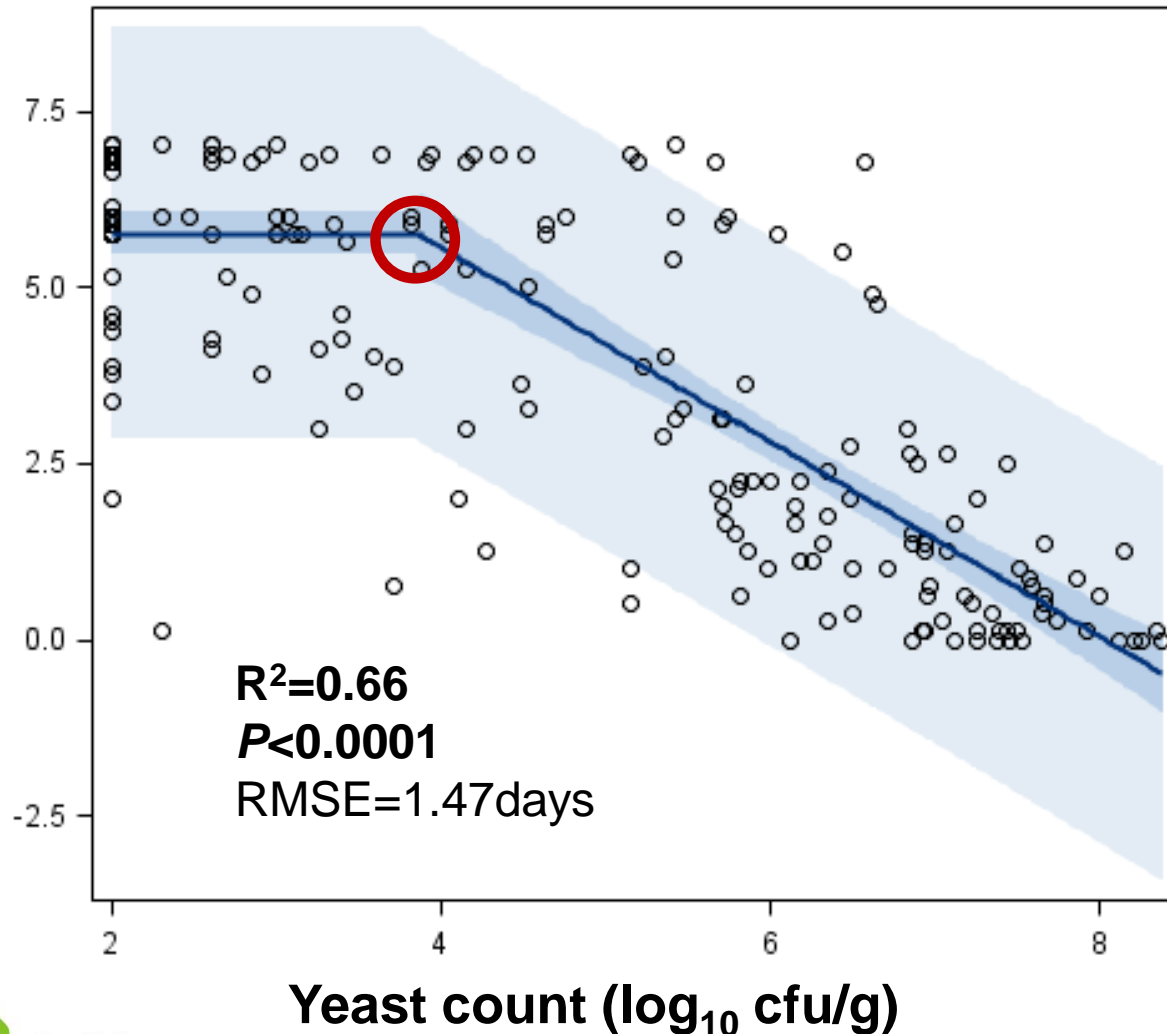
Aerobic stability (days)

PSBP with 45% DM
2 application rates



Relationship between yeast count and aerobic stability

Aerobic stability (days)



Fit plot (n=213) best described by

Broken-Line-Model

$$x \leq 3.89, y=5.77$$

$$x > 3.89, y=11.1-1.38x$$

Summary and Conclusions

- High packing densities can be achieved with both bagging systems.
- Additive reduced yeast count and increased ASTA given that application rate was sufficiently high. The additive effect was larger in material exposed to air.
- A strong dose-dependent effect of the additive on ASTA was observed in PSBP silage exposed to air.
- The strategic use of the chemical additive is strongly advised, especially in challenging conditions, e. g. during summer feeding and when feed-out rate is slow.

Thank you very much for your attention!

