State University of Maringá

Production and utilization of silages in tropical areas

João Daniel

&

T. Bernardes, C. Jobim, P. Schmidt, L. Nussio

Scope of the presentation

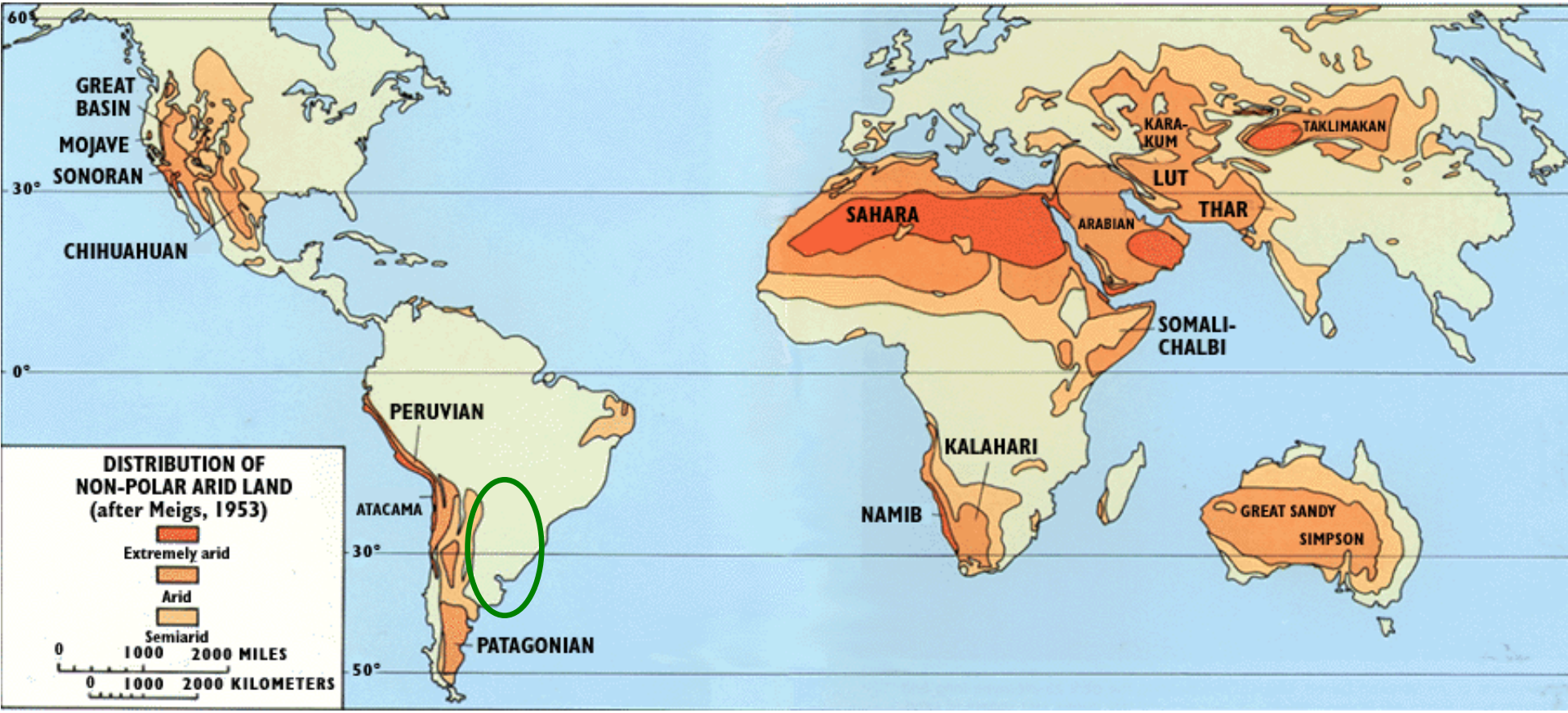
Particular reference to Brazil and South America

- Climate facts
- Aspects of silage production and utilization
- Final remarks

Central-southern: Major site of agriculture

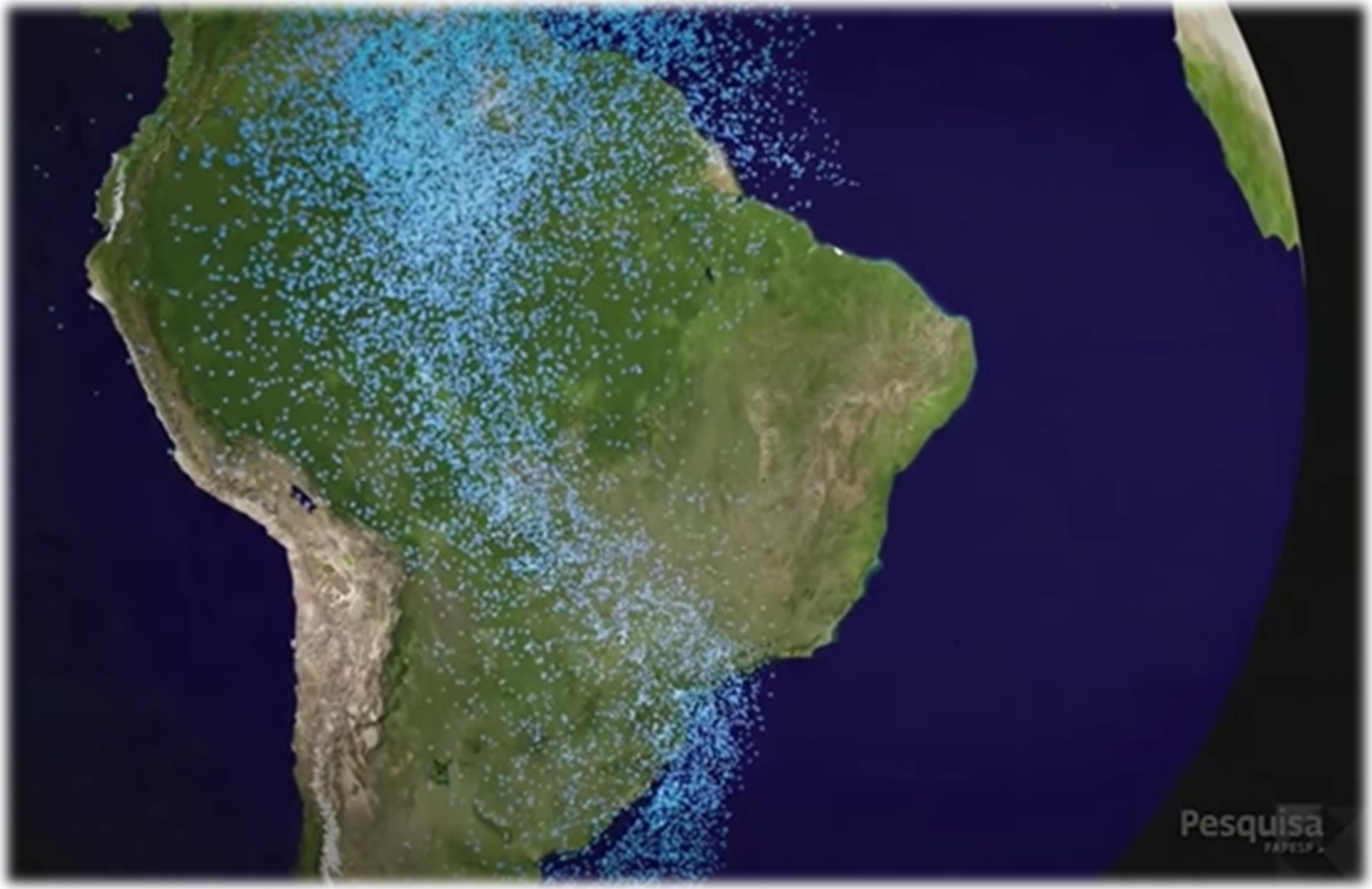
70% of GDP in South America

Dry regions are aligned to middle latitudes



Source: https://qjjb.weebly.com/map.html

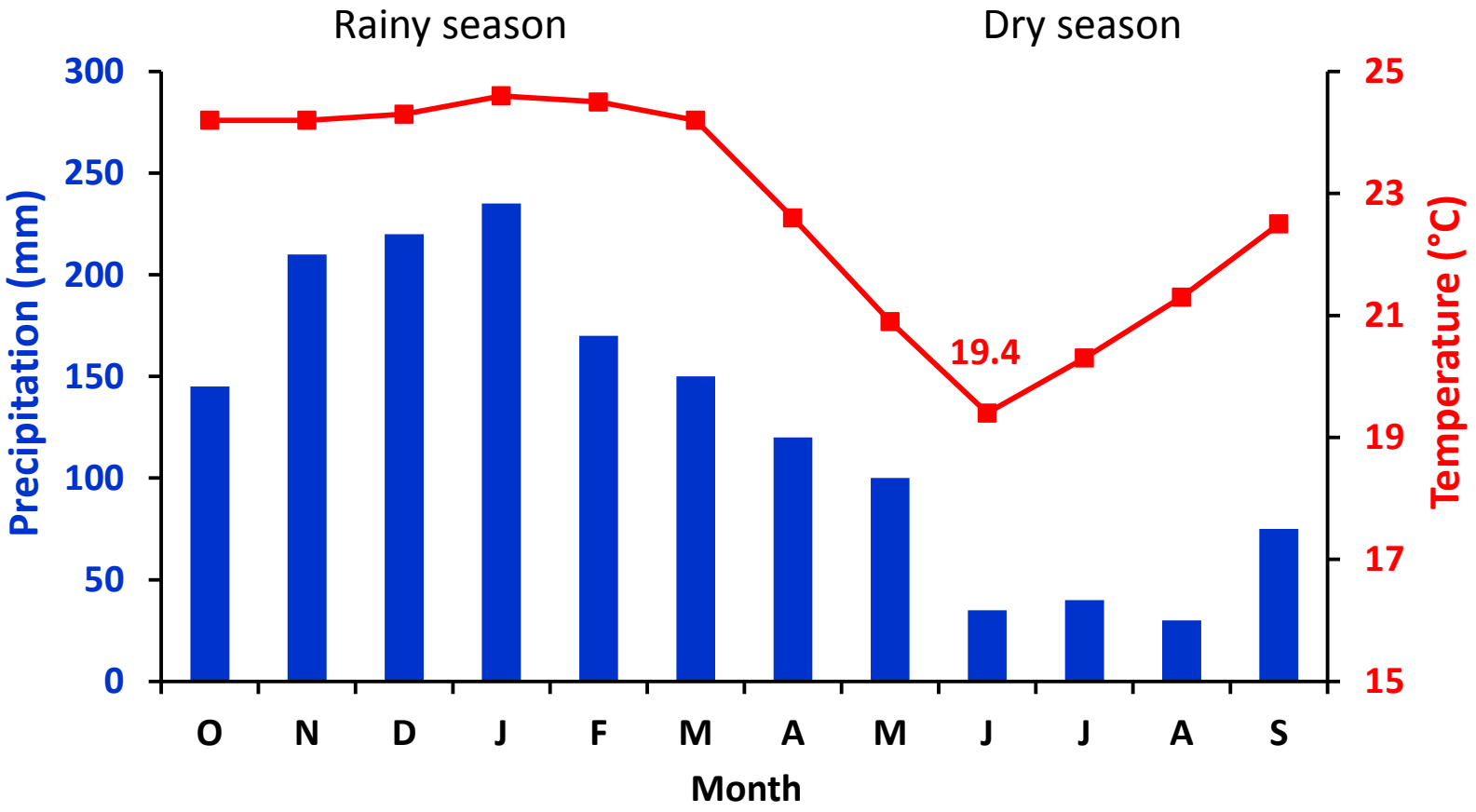
Amazon: **A rain factory**



Brazil is an important player to supply the global market

- Agriculture comprises the largest single sector of the economy (24% of GDP & 40% of exports)
  - 2nd largest cattle herd (~ 220 million head) and meat exporter
  - 4th largest milk producer
  - Large producer and exporter of soybeans, corn, sugar, ethanol, orange, coffee, cotton, poultry, etc.
- Big domestic market
- Still having ability to increase production efficiency and expand the planted area (8%) without deforestation (e.g. over degraded pasture areas)

Typical climate in Central-Southern of South America



Campo Grande (MS)

Average precipitation:
~ 1400 mm/year

Source: INPE / CPTEC

Forage sources in Brazilian **beef feedlots**

Source: Pinto and Millen (2016)

Ensiled forages in Brazilian **dairy farms**

~ 2.25 million ha of corn silage (source: CONAB)

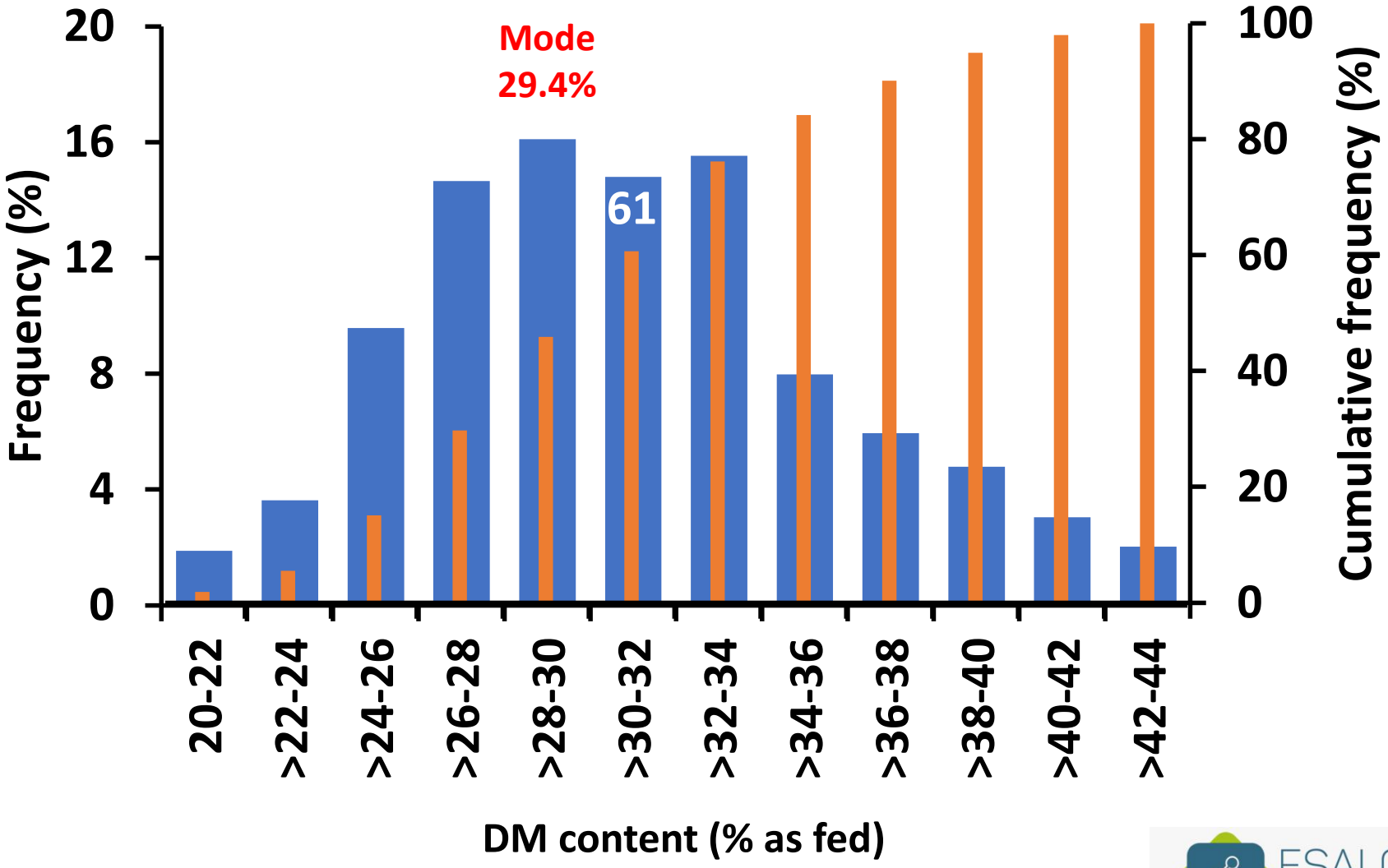
Source: Bernardes and do Rêgo (2014)

Corn silage composition (2017 data set)

Item	USA	Brazil	
Starch, % DM	33.8 ± 6.8	30.4 ± 6.6	-
In vitro starch digestibility-7 h, %	78.5 ± 10.3	75.7 ± 8.7	-
NDF, % DM	37.9 ± 6.0	42.8 ± 6.0	+
Total-tract NDF digestibility, %	43.0 ± 5.3	38.8 ± 5.4	-
pH	4.00 ± 0.23	3.93 ± 0.17	
Lactic acid, % DM	3.24 ± 1.76	3.62 ± 1.39	
Acetic acid, % DM	1.56 ± 1.03	2.26 ± 0.91	+
Lactic:Acetic ratio	2.08	1.60	

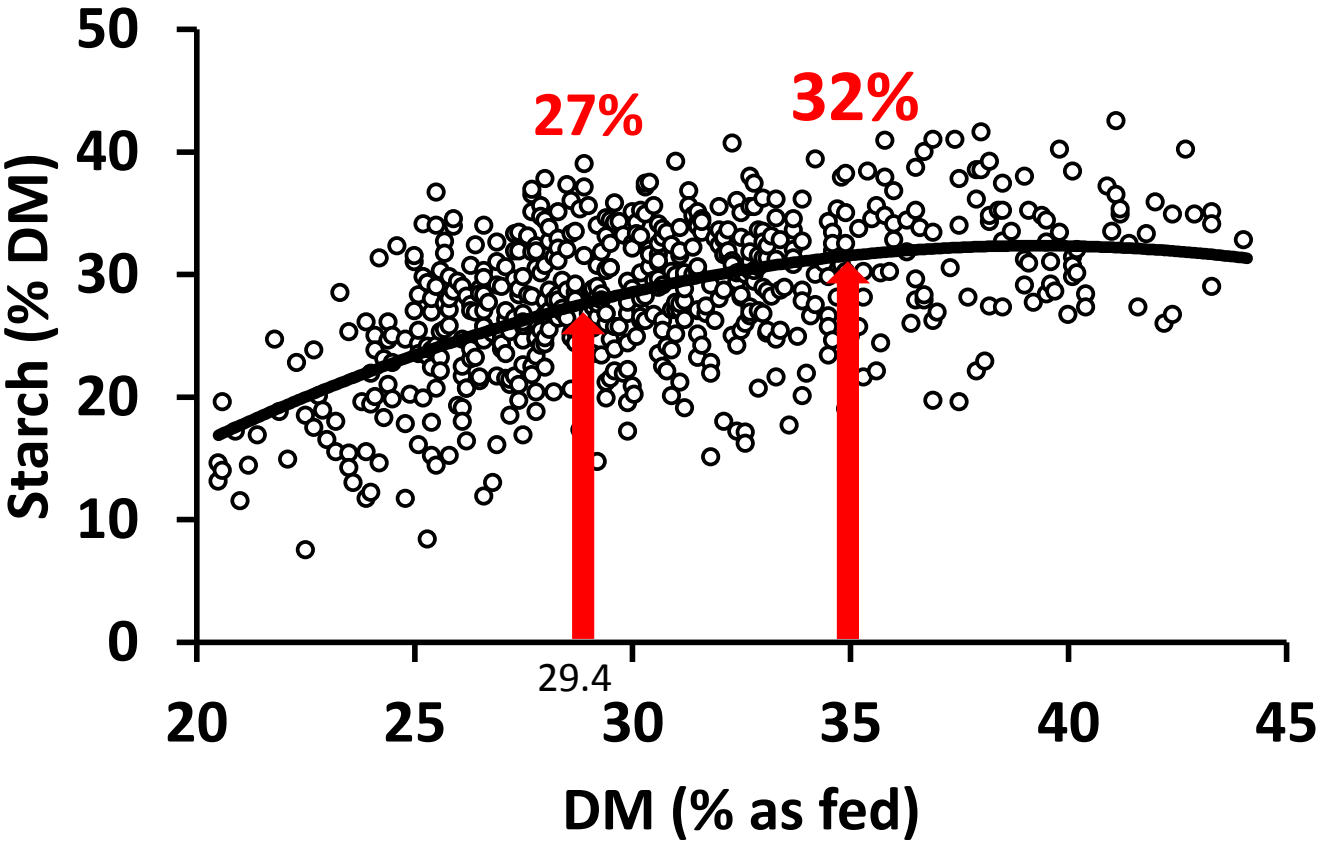
Source: 3rlab® / Rock River®

Many farmers are harvesting corn silage with low DM



Source: ESALQ LAB Zootecnia

…. and losing starch and DM yield



Assuming 11 kg DM of silage intake with +5%-units = 0.55 kg of starch

~ 1.2 kg/d of HMC

Source:

Pull-type represents ~90% of forage harvesters

Source: Bernardes and Do Rêgo (2014)

Dent corn

Flint corn

Vitreousness of Brazilian hybrids ~ 73%

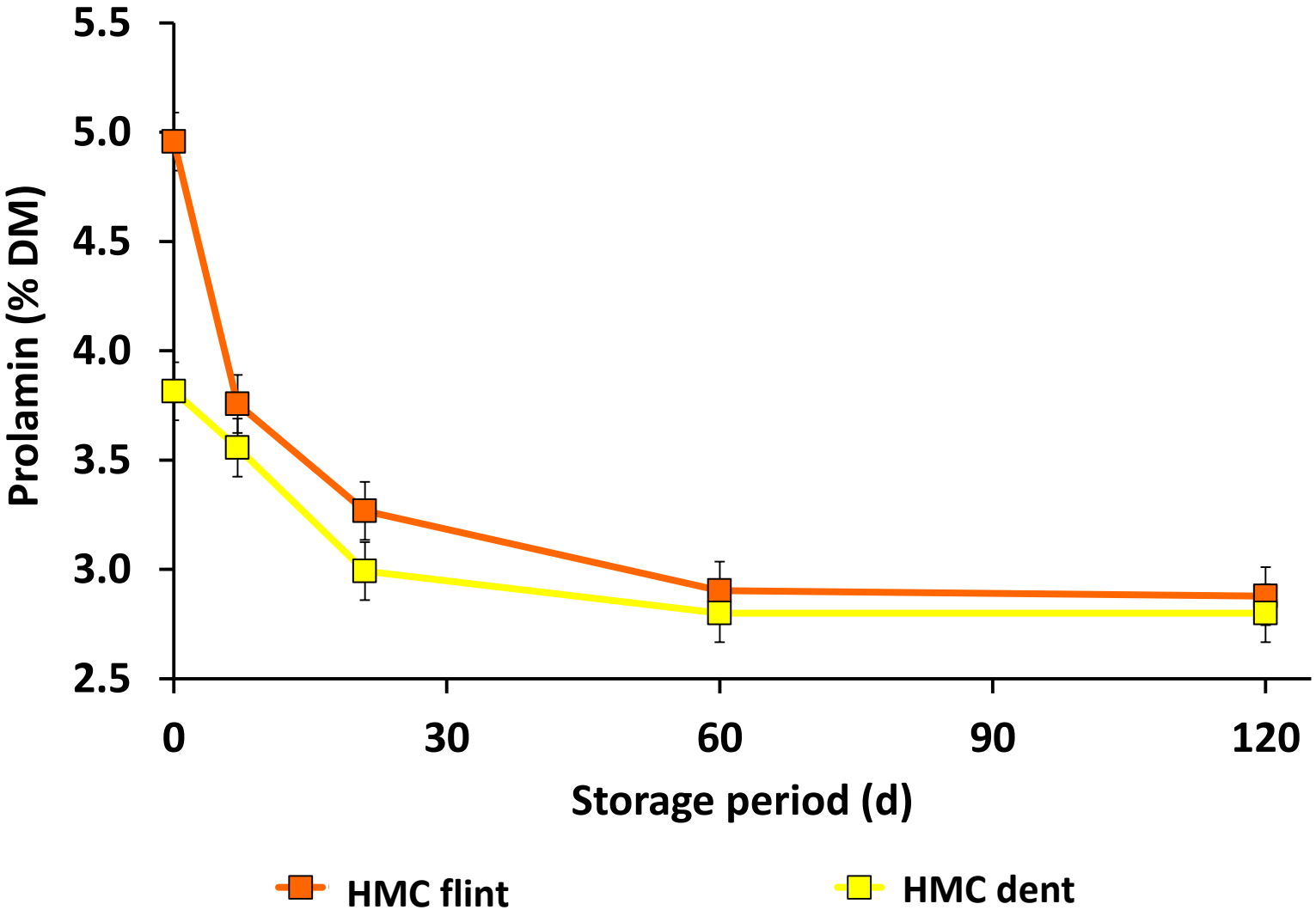
Source: Corrêa et al. (2002)

Impact of corn endosperm vitreousness on the nutritive value of whole-plant corn silage

Item	Dent	Flint	*P*-value
DM intake (kg/d)	23.0	23.2	0.82
Milk yield (kg/d)	34.2	34.6	0.82
Starch-D (%)	89.7	91.7	0.37

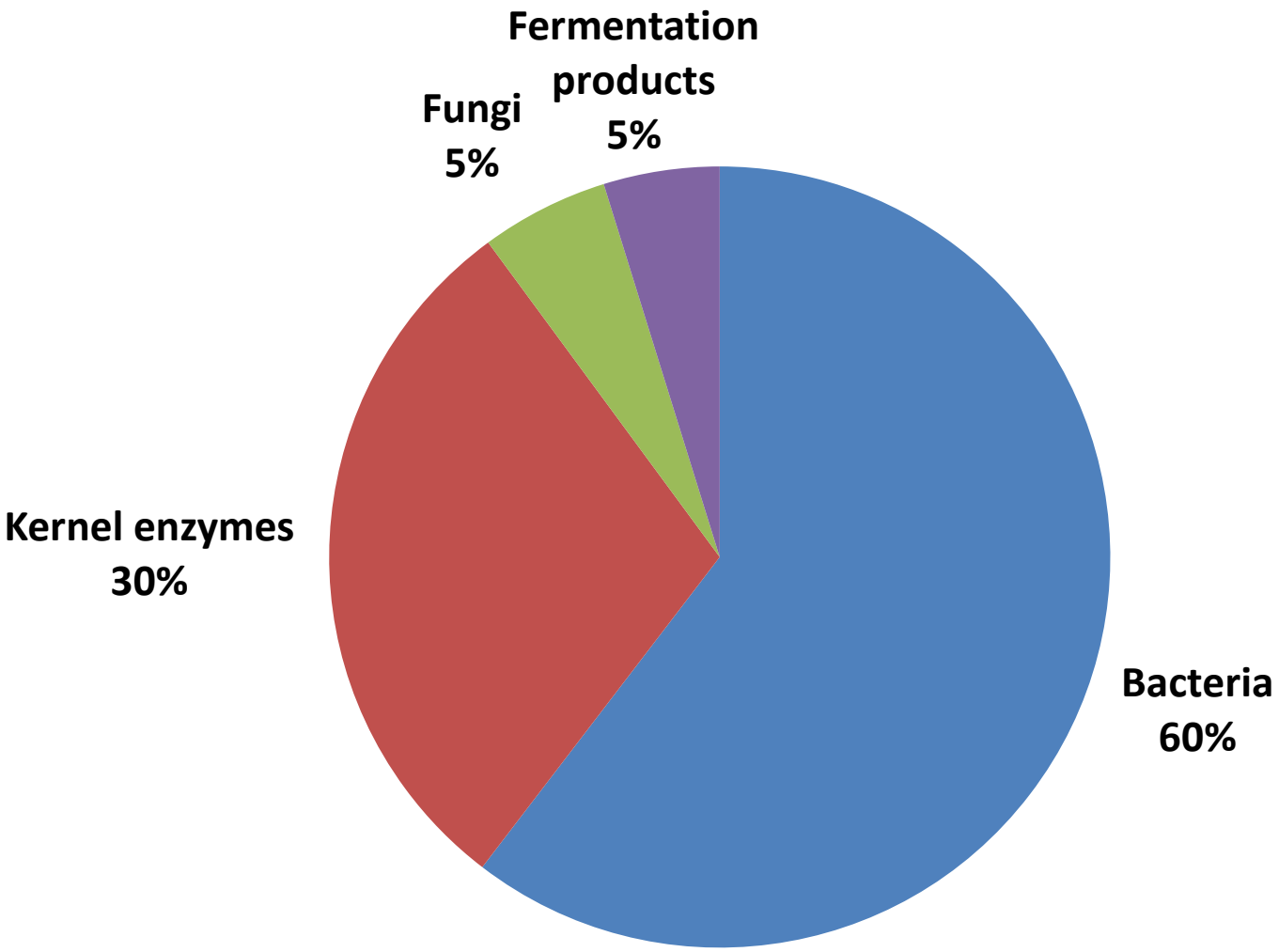
Source: Corrêa et al. (2003)

Prolamin decreases during fermentation of HMC



Source: Fernandes (2014)

Bacteria are the main contributor to proteolysis in corn grain silage



Source: Junges et al. (2017)

Use of grain silages in Brazilian **dairy farms**

Source: Bernardes et al. (2018)

Ensiling corn grain improves feed efficiency in beef cattle

Item	Dry	Ensiled		*P*-value
ADG (kg/d)	1.53	1.53		0.92
DM intake (kg/d)	11.6	10.5		<0.01
Feed efficiency (G:F)	0.129	0.150	**+16%**	<0.01
Fecal starch (% DM)	8.11	3.27		<0.01

Source: Da Silva and Jobim (2015)

Aerobic deterioration

… is an important but <u>not</u> a unique problem of hot areas

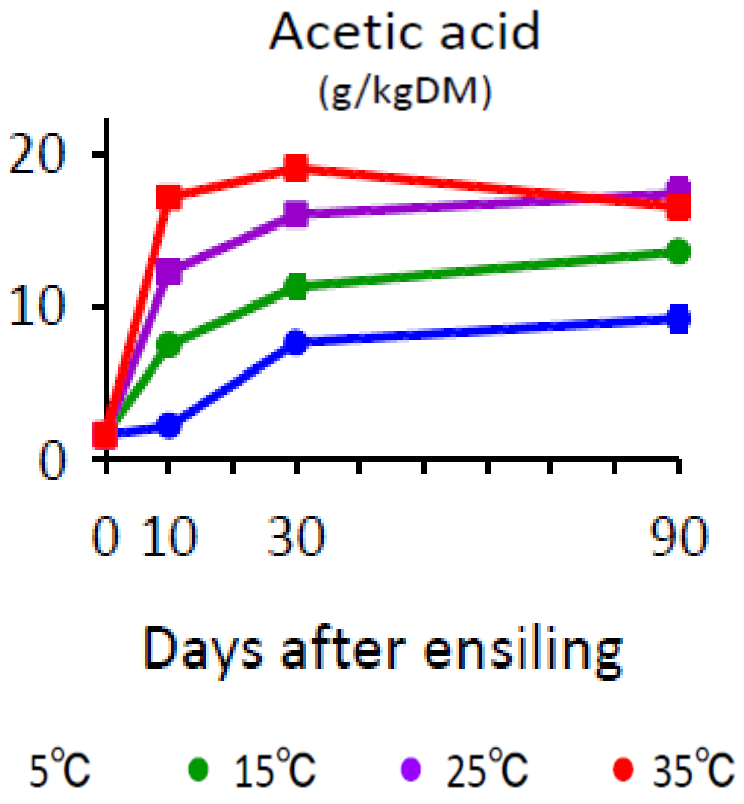
Warmer temperature during fermentation and longer storage improve aerobic stability

Storage period

Storage temp	Stability test	10 days	30 days	90 days
5℃	5℃	O	O	O
	25℃	×	×	O
15℃	15℃	O	O	O
	25℃	×	O	O
25℃	25℃	O	O	O
35℃	25℃	O	O	O
	35℃	O	O	O

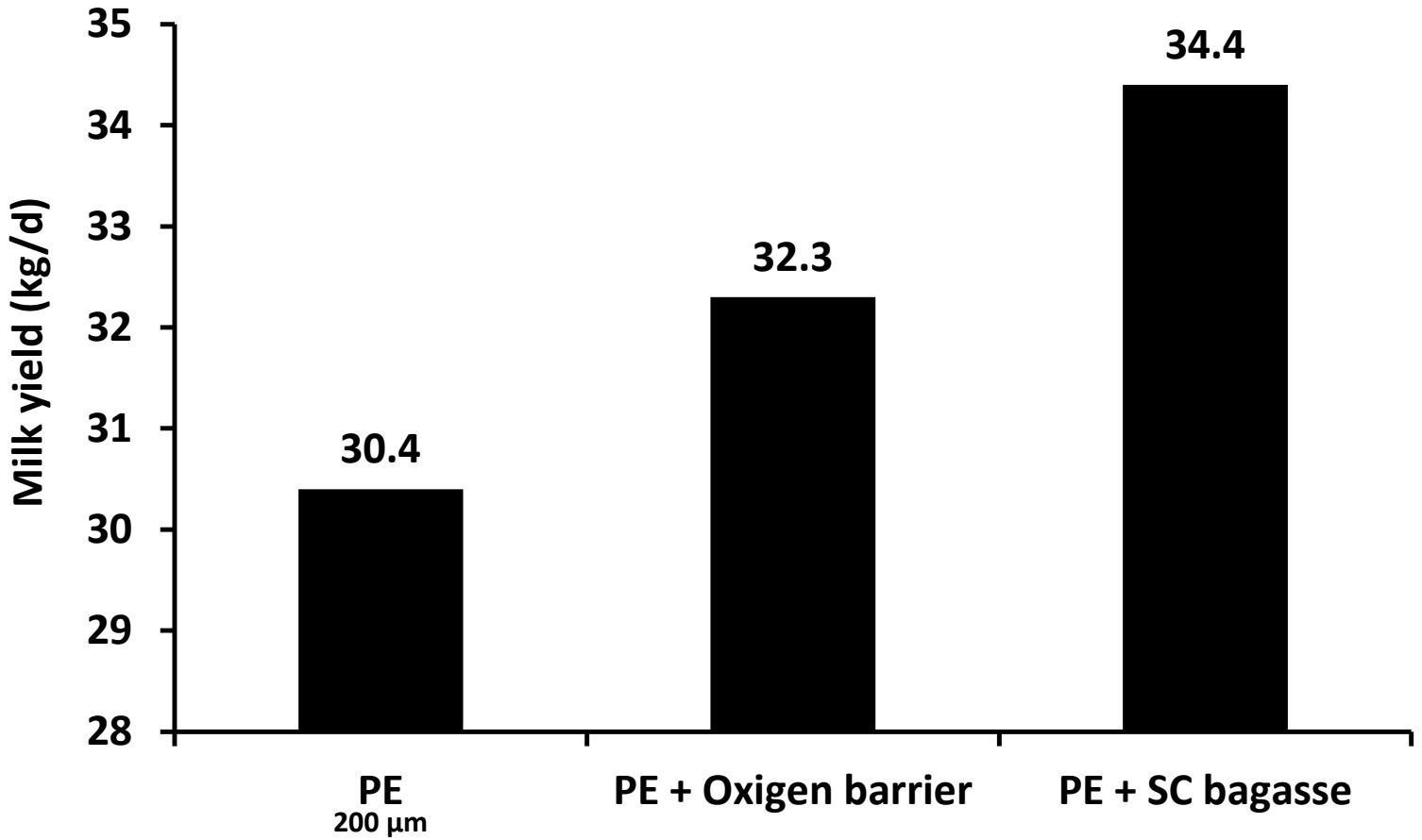
× : Unstable

O : Stable (≥ 7 days)



Source: Nishino and Wang (2012)

Sealing greatly impacts animal performance



inedible silage 7.4% 3.9% 2.9%

Only edible silage was offered to the cows

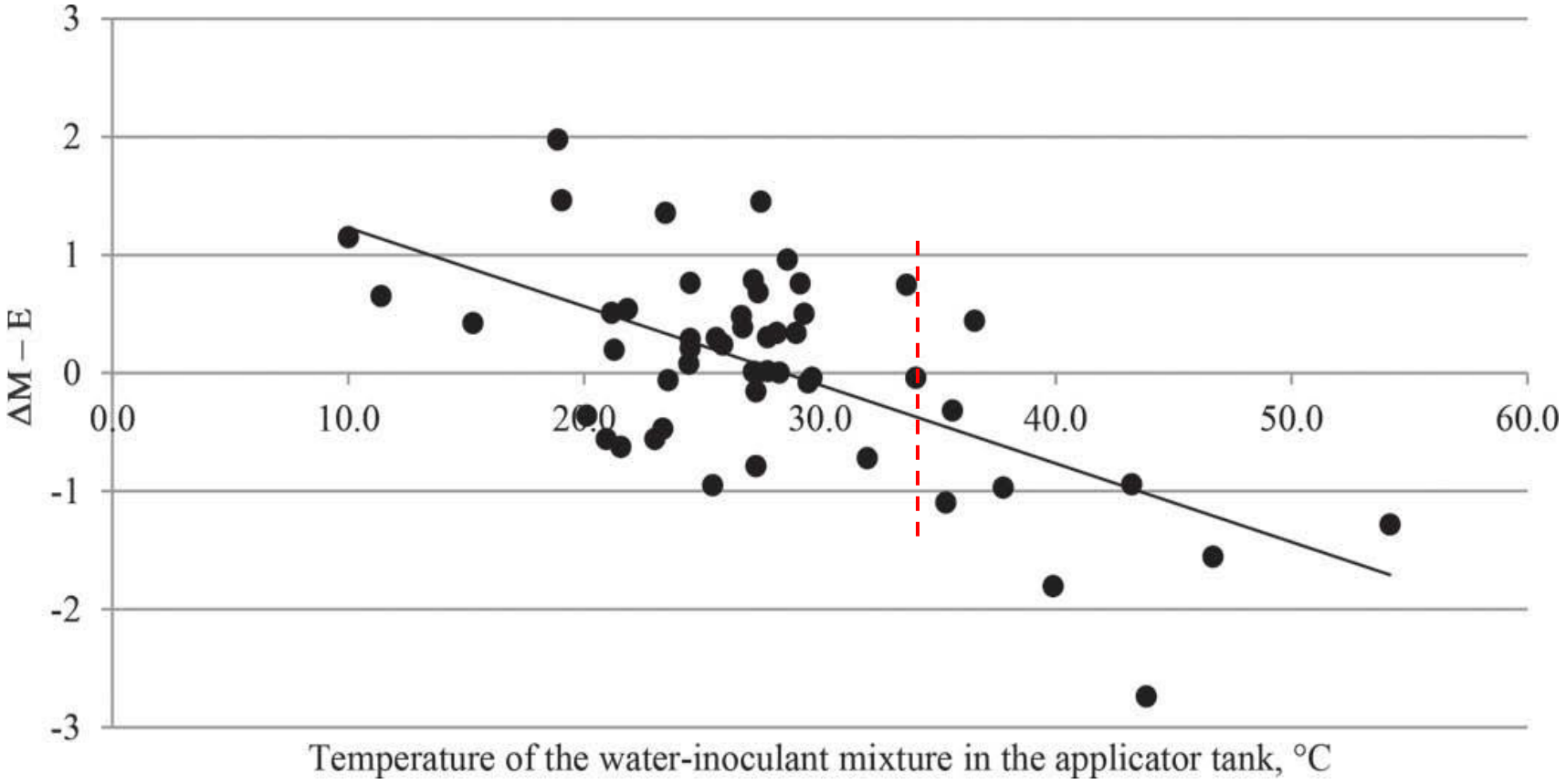
Source: Amaral et al. (2014)

Applying inoculants in hot zones

Approx.
1/4 of farms
use silage
inoculants
in Brazil

Source:
Novinski (2013)
Bernardes and Do Rêgo (2014)
Da Silva et al. (2016)

High temperatures (>35°C) of inoculant-water mixes potentially reduce the numbers of viable LAB



ΔM − E = enumerated cfu of viable LAB minus the calculated cfu of expected LAB

Fonte: Windle and Kung (2016)

Insulating the tank might alleviate the problem

Courtesy: O. Queiroz

VOC in sugarcane silages

High content of sol. sugars

(>35% of DM)

High count of yeasts

(>6 log cfu/g)

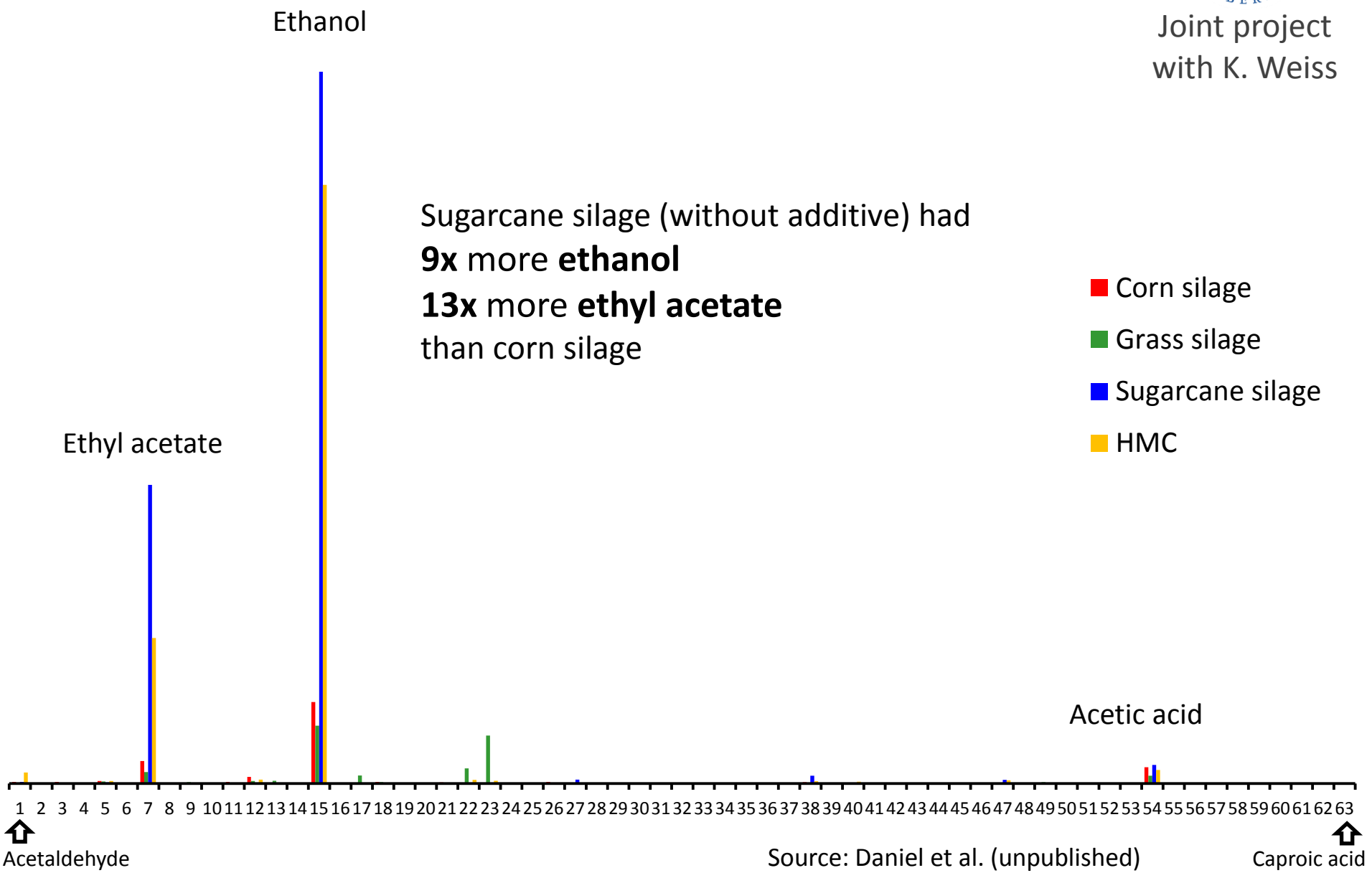
⇨

High content of ethanol and other VOC

(up to 20% of DM)

Head-space (GC-MS) of selected tropical silages

Joint project
with K. Weiss



Source: Daniel et al. (unpublished)

Additives can mitigate VOC emissions in sugarcane silage

Source: Daniel et al. (2015)

Additional info on silage made in hot regions

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Silage review: Unique challenges of silages made in hot and cold regions[1]

T. F. Bernardes,*[2] J. L. P. Daniel,† A. T. Adesogan,‡ T. A. McAllister,§ P. Drouin,# L. G. Nussio,‖ P. Huhtanen,¶ G. F. Tremblay, G. Bélanger,** and Y. Cai††**

*Department of Animal Science, Federal University of Lavras, Lavras, 37200000, Brazil
†Department of Animal Science, State University of Maringá, Maringá, 87020900, Brazil
‡Department of Animal Sciences, Institute of Food and Agricultural Sciences, University of Florida, Gainesville 32611
§Research Centre, Agriculture and Agri-Food Canada, Lethbridge, AB, Canada T1J 4B1
#Lallemand Specialties Inc., Milwaukee, WI 53218
‖Department of Animal Science, University of São Paulo, Luiz de Queiroz College of Agriculture, Piracicaba, 13418900, Brazil
¶Department of Agricultural Research for Northern Sweden, Swedish University of Agricultural Sciences, Umea, S-90183, Sweden
**Agriculture and Agri-Food Canada, Quebec Research and Development Centre, Québec, QC, Canada, G1V 2J3
††National Institute of Livestock and Grassland Science, Tsukuba, Ibaraki, 305-0901, Japan

Final remarks

- Much knowledge on silage in the tropics has been transferred from traditional centers located in temperate zones

- In recent decades, there has been significant scientific progress on tropical silages, including the formation of new silage scientists

- Farmers need more extension services and more cooperative actions (machinery, consumables, technical support)

- Silage market is a window of opportunity in tropical areas

Thank you for your attention!