

1ST EUROPEAN SORGHUM CONGRESS

WORKSHOP

FROM ENERGY PRODUCTION TO FOOD AND FEED

SORGHUM SILAGE AND ITS COMPLEMENTARITY WITH MAIZE AS FEED DAIRY AND BEEF CATTLE



FERARD Alexis, Sorghum silage and its complementarity with maize to feed dairy and beef cattle, ARVALIS FRANCE



INSTITUTE DESCRIPTION

ARVALIS - INSTITUT DU VEGETAL: AN APPLIED AGRICULTURAL RESEARCH ORGANISATION



- Partnerships with
 - French and international basic research (INRA, IRSTEA, and Universities)
 - Development organisms
 - Economic operators (coops...)
 - 410 collaborators
 - 27 local sites in France
 - 120 Research projects



STRUCTURE

- Nutritive value of sorghum silage
- Sorghum silage for dairy cows
- Sorghum silage for young bulls fattening
- Conclusion : main sorghum ID cards







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HOW TO EVALUATE THE ENERGETIC VALUE?

Monocut sorghum: FR Post-registration evaluation for varieties (2010-2014)

Chemical composition Measured values

	Silage us	se (n=87)	Dual-purpose use (n=224)		
	min	max	min	max	
CP (%)	6.0	8.2	6.1	7.9	
NDF (%)	48.7	59.1	48.6	56.0	
ADL (%)	1.8	3.2	2.7	3.9	
OM digestibility (%)	56.8	67.0	55.8	62.6	
Starch (%)	0.0	17.4	8.9	21.3	
Water Soluble Carbohydrates (%)	12.2	24.0	7.7	17.1	

Nutritive value Calculated values

ARVALIS-Institut du végétal, 2015

	Silage	e use	Dual-purpose use		
UFL « fresh » (/kgDM)	0.83	1.01	0.78	0.90	
PDIN (/kgDM)	39	53	39	51	
PDIE (/kgDM)	67	75	68	72	

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HOW TO EVALUATE THE ENERGY VALUE?

Sorghum bicolor

- Energy value: maize equations are NOT reliable for sorghum with poor starch content
- Instead, specific equation needs to be used for all ensiled sorghum forage:

Aufrère et al., 2013:

DM digestibility = 0,643 * silage DM dig._{in vitro} + 23,99 ; (R²=67%; RMSE=2,25)

DM digestibility = 0,684 * silage DM dig._{in vitro} + 21,67 ; (R²=65%; RMSE=2,61)

Sudan grass and Sudan grass*sorghum bicolor

• INRA references \rightarrow nutritive value varies with maturity stage \rightarrow ~ tall-fescue

Grass equations can be used

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HOW TO EVALUATE THE ENERGETIC VALUE?

A very wide diversity of sorghum bicolor



to feed dairy and beef cattle



HOW TO EVALUATE THE ENERGETIC VALUE?

High production of net energy / ha



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HOW TO EVALUATE THE ENERGETIC VALUE?

Sorghum 'silage use': focus on the 2 main types of sorghum without starch



Data summarized by TAWC in 2016 from Bean, B. and T. McCollum (2006 Summary of six years of forage sorghum variety trials





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COMPLEMENTARITY SORGHUM – MAIZE SILAGE

Replacing 50% of maize silage by sorghum silage 'dual-purpose use' (0.81 UFL, 30% of DM, 13% of starch)



Comparison in % to control = maize silage only

BUCHAREST

3-4 NOVEMBER 2016

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COMPLEMENTARITY SORGHUM – MAIZE SILAGE

Replacing 50% of maize silage by <u>BMR sorghum silage 'silage use</u>' (0.92 UFL, 26% of DM, 6% of starch)

Comparison in % to control = maize silage only



ARVALIS synthesis of 5 trials in experimental farms.

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SORGHUM SILAGE AS SOLE FORAGE



ARVALIS synthesis of trials in experimental farms.



SORGHUM 'SILAGE USE': FOCUS ON THE 'GRAIN' TYPE

- Chemical composition close to maize
- Ingestibility higher than maize
- Maintain milk production
- Needs to be harvested at milk-dough stage

 \rightarrow 30-33% of DM (with 25% of starch)

→short length of cut and processing rolls tightened to crack the kernels



/!\ Caution:

harvest at DM>35% → decrease by 10% milk and feed efficiency

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COMPLEMENTARITY SORGHUM – MAIZE SILAGE

Introducing 50% of <u>BMR sorghum</u> in a maize-based diet

Feed cost variation/1000kg of milk

€ / 1000 kg milk		DM yield ¹ of BMR maize (tDM/ha)			
		8	10	12	14
DM yield ¹ of BMR sorghum (tDM/ha)	8	5	0	-4	-6
	10	10	5	1	-3
	12	14	8	5	1
	14	16	12	8	5

Rouillé et al., 2010

Where BMR sorghum can grow normally

→ 0 to 16€/1000L i.e. 0 to 15% of reduction of feed costs for milk production

¹ Non-irrigated crop



COMPLEMENTARITY SORGHUM – MAIZE SILAGE

Introducing 50% of grain or dual-purpose sorghum in a maize-based diet





↘ inputs/ha of forage crop (seeds, irrigation, fertilisation)	フ Milk Fat ンン Milk yield		
Stabilise the DM yield/ha of forage especially in case of continental conditions	Reduce feed efficiency by 10%		
Usually, feed cost/1000 kg of milk will be reduced if DM viold 1.1* DM viold			

DM yield _{sorghum} > 1.1* DM yield _{maize}

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SORGHUM SILAGE FOR BEEF CATTLE → INDOOR YOUNG BULLS FINISHING



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SORGHUM SILAGE INGESTIBILITY: THE KEY POINT

Fattening trial with Limousine young bulls until 420-430 kg carc. weight

Diet: [100% BMR sorghum silage vs 100% Maize silage] + concentrate



BMR sorghum has high ingestibility if DM>25%

Guillaume et al., 2014

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If ingestibility is high \rightarrow ADG similar to maize control

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SORGHUM SILAGE INGESTIBILITY: THE KEY POINT

Fattening trial with Charolais young bulls until 435 kg carc. weight

	3 kg barley + 1,7 kg rapeseed meal				
<u>3 Diets compared:</u>	Control 100% maize silage	50% maize silage + 50% grain sorghum ensiled	Mixed silage (maize + BMR sorghum)		
DM intake (kgDM/d)	10,0	+ 0,30	- 0,15		
ADG (g/d)	1610	+ 10	+ 30		
Fattening duration (d)	220	- 3	- 3		
DM intake / kg of carcass gain	10,3	=	- 0,6		

ARVALIS-Institut du végétal, 2014

BMR sorghum: ~ very good wilted grass \rightarrow very positive on growing perf.

Grain sorghum: very high ingestibility and growing perf. = maize



SORGHUM SILAGE ECONOMIC INTEREST

Introducing 50% of BMR sorghum in a maize-based diet

Feed cost variation / young bull carcass produced

€ / YB		DM yield ¹ of maize (tDM/ha)			
		8	10	12	14
DM yield ¹ of BMR sorghum (tDM/ha)	6	-4	-13	-19	-24
	8	11	-1	-9	-15
	10	27	11	1	-6
	12	42	23	11	3

ARVALIS-Institut du végétal, 2014

Where BMR sorghum can grow normally → 0 to 15% of reduction of feed costs per YB compared to maize

¹ Non-irrigated crop



SORGHUM SILAGE ECONOMIC INTEREST

Other sorghum in a maize-based diet – comparison to 100%maize

	ADG	Feed costs with DM yield sorghum=maize	Feed costs with DM yield sorghum = 1.2 * maize
Grain sorghum UFV>0.85	=	~ 0%	-3 %
PPS sorghum UFV>0.80	-1 to -3 %	~ 0%	-1 to -3 %
Other sorghum UFV<0.80	-5 to -10%	+3 to +10%	-1 to +5 %

With 'silage use' sorghum

 \rightarrow mostly positive on feed costs compared to maize control diets

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DIFFERENT SORGHUM FOR DIFFERENT USES: A SUMMARY



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GRAZED SORGHUM



- Sudan grass or hybids Sudan grass*sorghum bicolor
- Avoid toxicity by grazing not before 40 cm (Sudan grass), 50-60 cm (hybrids)
 - → Usually 5-6 weeks after seeding
- BMR: +12% ADG (Trostle, 2004)

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"SILAGE USE": BMR SORGHUM

Same energy value as maize

Target: mini 25%DM at harvest



- Improve whole diet digestibility
- Slight decrease of DMI
- Maintain milk production /ADG
- Positive effect on feed efficiency
- Profitable even if DM yield sorghum is 5% less than maize



"SILAGE USE": PPS SORGHUM

Energy value is ~90% of maize

Target: at least 25%DM at harvest

High DM yield/ha



- Improve whole diet digestibility
- Slight decrease of DMI, ADG and milk production if sole forage
- Recommanded associated with maize silage
- ♦ Profitable if DM yield sorghum ≥ maize

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"SILAGE USE": GRAIN SORGHUM

Energy value is ~95% of maize

Target: 30%DM at harvest



- Increase by 5 to 10% the DM intake
- Maintain ADG and milk production if sole forage or associated
- Double use crop no lodging
- ♦ Profitable if DM yield sorghum ≥ 1.15 * maize

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"DUAL-PURPOSE USE"

Energy value is 80-90% of maize

Target: at least 25%DM at harvest



- High DM yield of the crop
- Decrease by 5 to 10% DM intake, ADG and milk production
- Recommended as 2-4 kgDM/day/cow, heifers, beef cattle and young bulls with ADG potential<1500g/d</p>
- ♦ Profitable if costs of sorghum ≥ 0.8 * maize

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CONCLUSION

DIFFERENT SORGHUM FOR DIFFERENT USES

High production of net energy/ha

DM intake: Or *∧* (grain)

Milk fat *∧*

Milk production and ADG remain high



Sorgho fourrager De la culture à la valorisation

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PROSORGHD

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