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Agroscope

Green-chopped sorghum fed indoor to dairy cows: a strategy to mitigate herbage shortages?

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Session 73 – Targeting ecosystem services by grasslands and protein self-sufficiency in cattle production – September 4th, 2024

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Sorghum sp. …in the water tower of Europe[1] ?

(Source: pixabay)

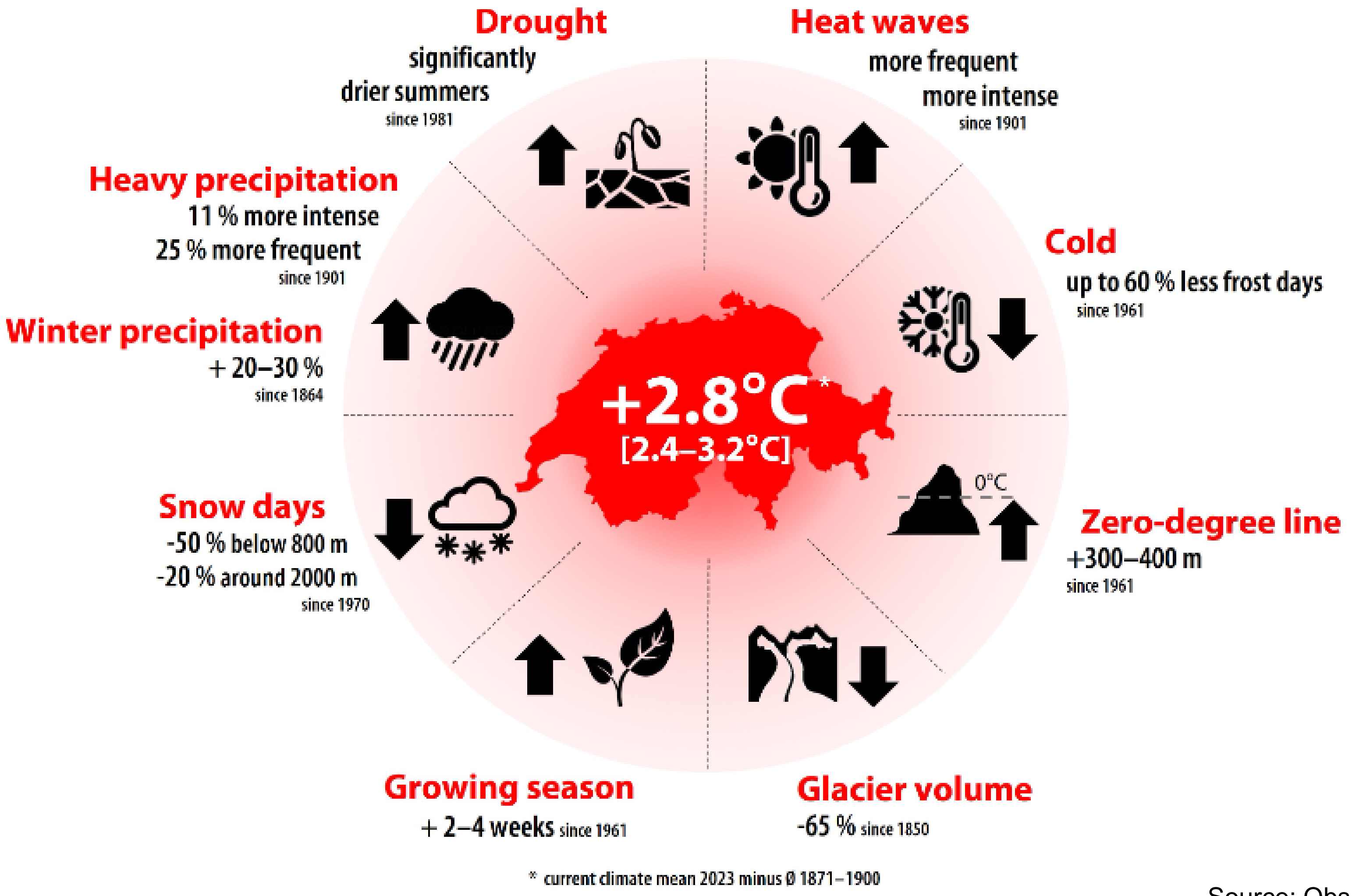
[1] Hydrological Atlas of Switzerland - Home

Sorghum sp. … in the water tower of Europe

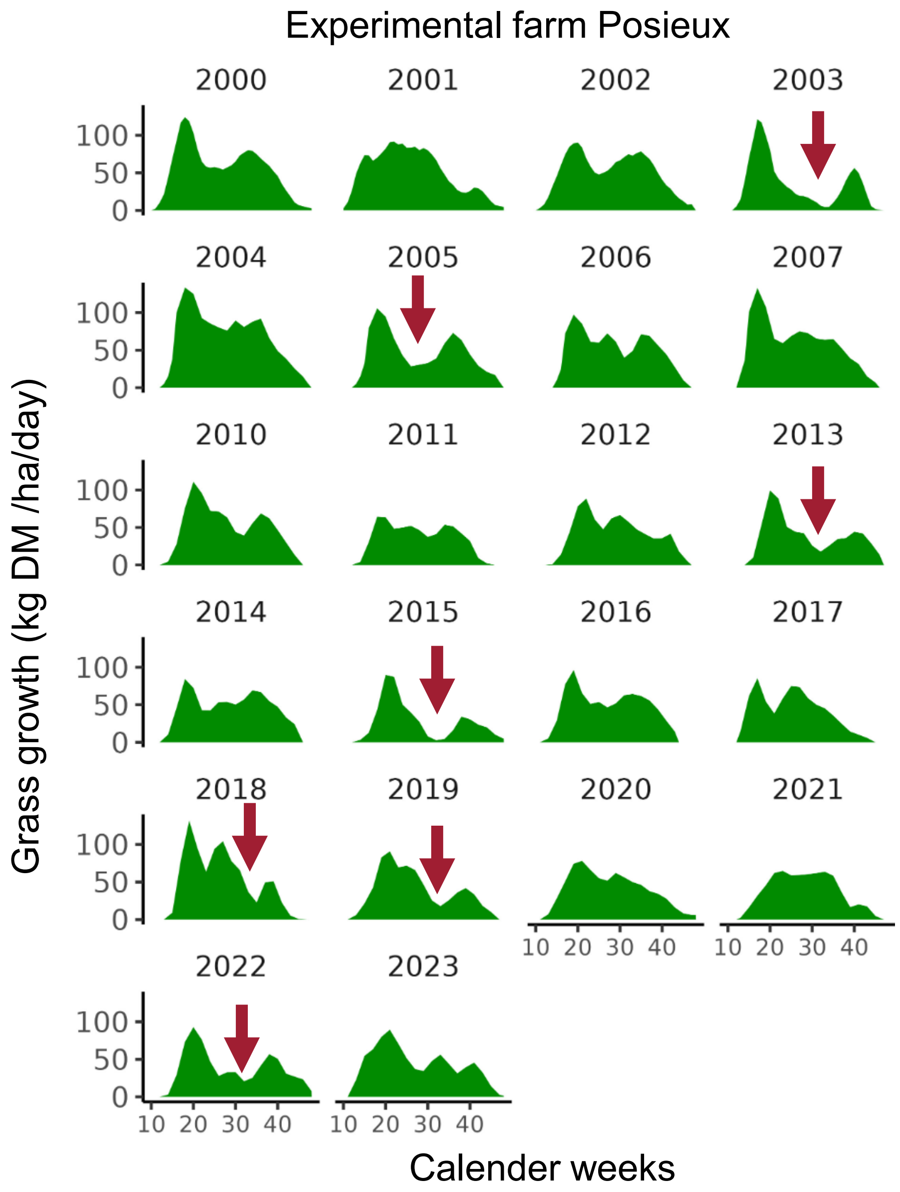
(Source: G. Brändle, Agroscope)

(Source: Drought-affected Alpine pastures get emergency help - SWI swissinfo.ch)

Climatic context



Source: Observed climate change in Switzerland (admin.ch)



How to secure forage resources during summer droughts without depleting winter stocks?

Data by Schori and Hayoz (2024)

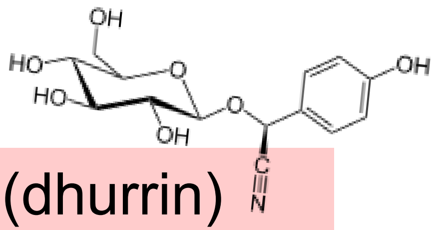
The choice of *Sorghum sp.*

+

- C4 plant
- deep and ramified roots
- leaves with waxy coating
  → Drought tolerance
- Resistance toward common maize parasites (i.e. *Ostrinia nubilalis*, *Dibrotica virgifera*)

-

- Cyanogenic compound (dhurrin)



- Detoxification of HCN in the rumen requires sulfur (S)
- Thiocyanate (SCN) : strong antagonist of mineral and trace elements absorption (Piironen and Virtanen, 1963)

Objective of the experiment

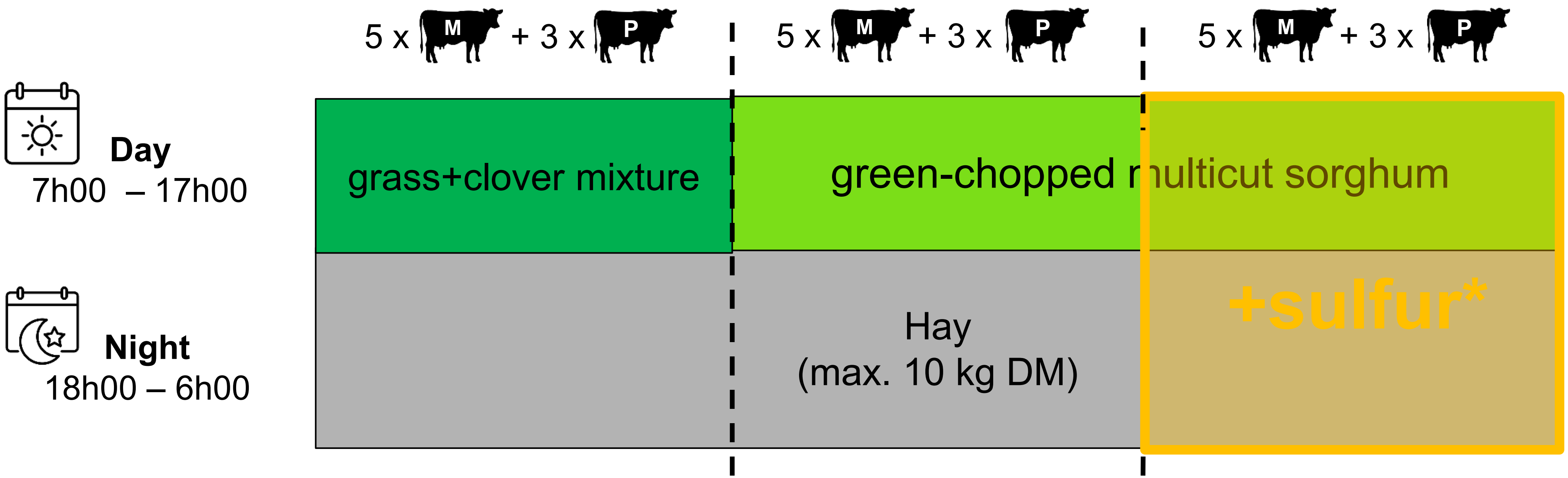
Assess the effects of feeding green-chopped sorghum to dairy cows, with (+S) or without the addition of sulphur, in comparison to fresh herbage from a temporary grassland (grass+clover mixture) on dairy cows on feed intake, milk yield, milk composition, and methane emissions

Forage production

- *Sorghum bicolor* (L.) *Moench x Sorghum sudanense* (Piper) *Stapf.* hybrid (variety «Pacific Sweet»)
- Sowing density 25 kg ha^{-1}, 12.5 cm row spacing
- 22 units of N ha^{-1} , 15 days after sowing
- 4 mowings (70 ares each) staggered by 1 week to reach same growth stage
- No herbicides required - hand weeding of thornapple (*Datura stramonium*) prior to 1st cut

Experimental design

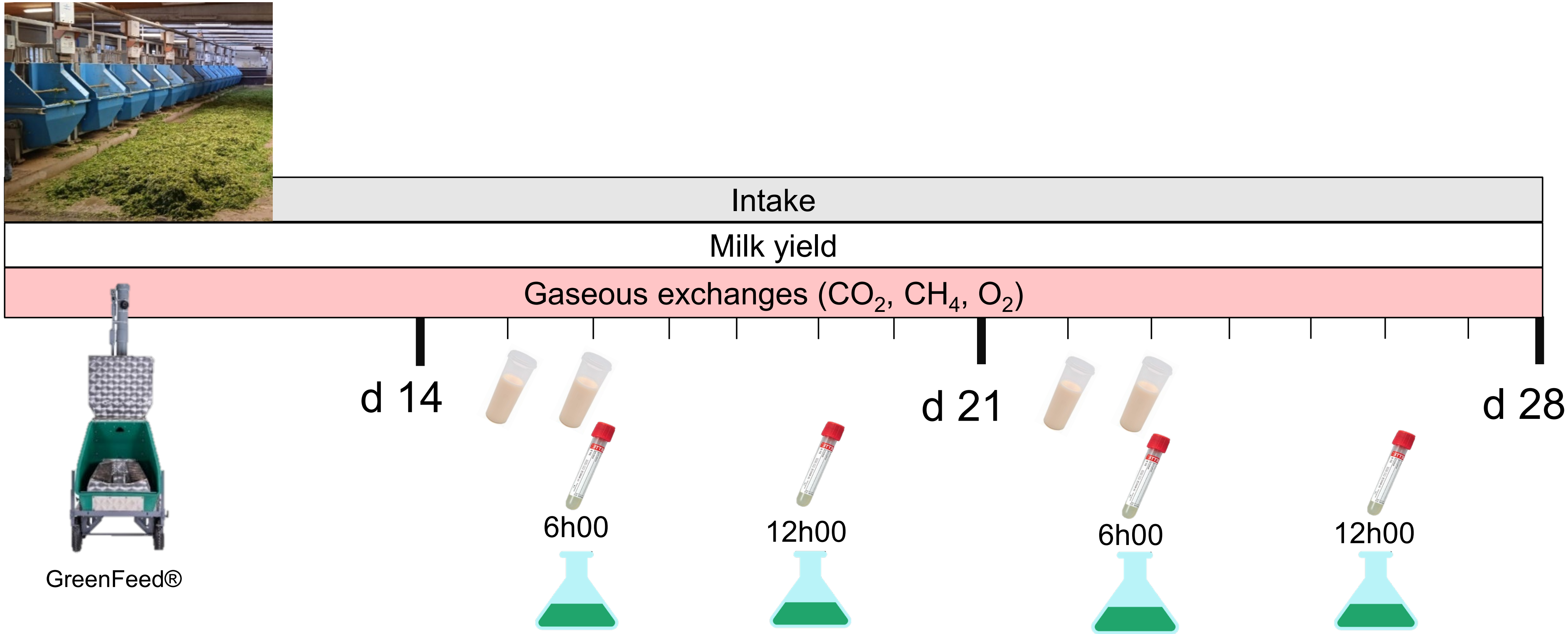
- Unbalanced randomized block design:
  - 24 primi- (n=9) and multiparous (n=15) Holstein dairy cows
  - 178 ± 31 DIM, 637 ± 53 kg BW, 26.0 ± 4.3 kg/d at the beginning of the experiment
- Free stall barn with 32 RIC bins
- Access to 2 concentrate feeding station and 2 GreenFeed® stations (2,6 ± 0,5 kg concentrate per day)
- Duration: 28 days



Cantonal experimental autorization: 2023-09-FR / 35757

* Added as calcium sulfate dihydrate to concentrate feed (18 g S / kg DM)

Measurements and samplings



Data analysis

- Linear mixed effects models in R (v. 4.3.3)
- Results displayed as least square means and SE of the mean

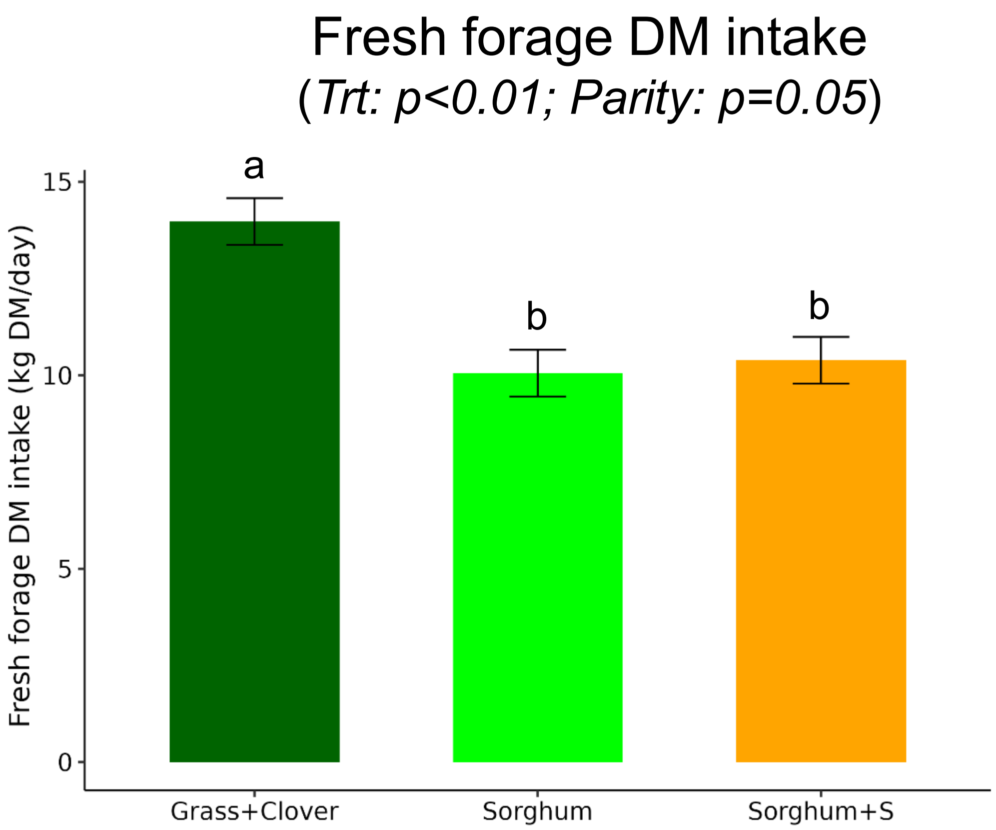
Chemical composition of the forages

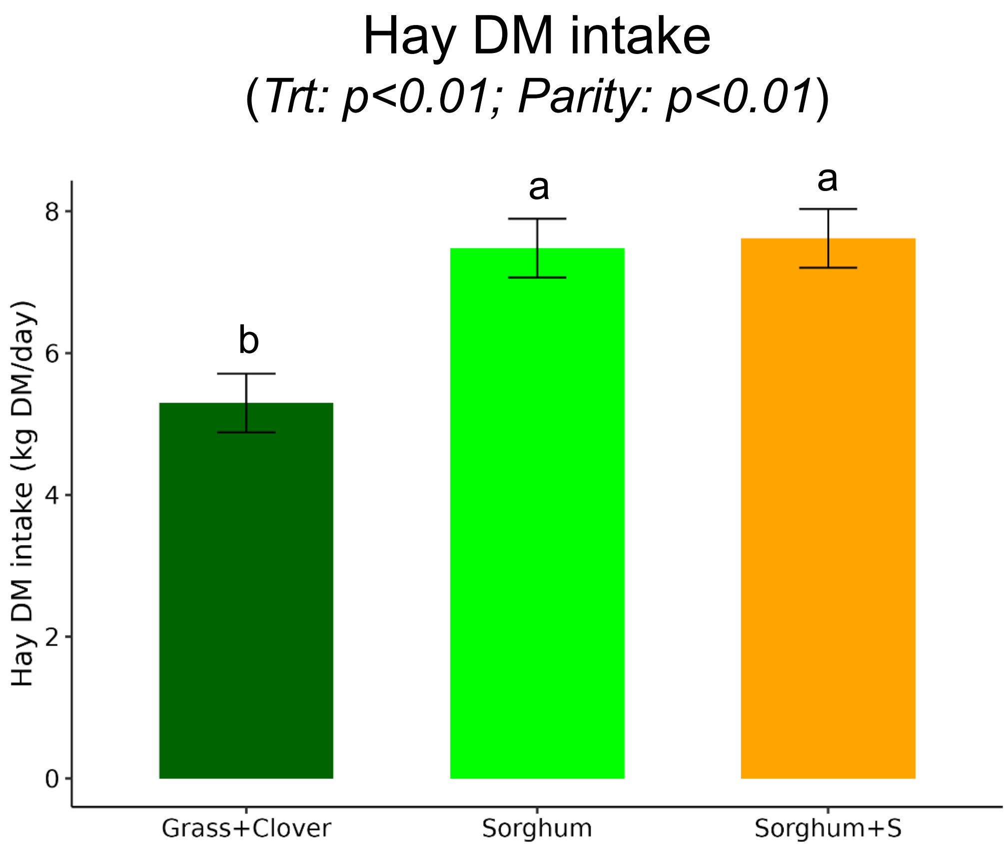
g/kg DM	Sorghum hybrid 2^{nd} regrowth (n=4)	Grass+clover mixture 4^{th} regrowth ** (n=4)
Dry matter, %	14.8 ± 1.9 *	21.7 ± 5.9 *
Ash	137 ± 31.5	100 ± 4.0
CP	124 ± 27.3	202 ± 37.6
$aNDF_{om}$	594 ± 22.9	449 ± 40.9
ADF_{om}	348 ± 22.5	275 ± 27.2
Ca	6.0 ± 0.2	12.3 ± 1.0
P	3.3 ± 0.38	4.0 ± 0.62
Mg	2.8 ± 0.37	2.6 ± 0.31
K	30.3 ± 0.84	26.8 ± 1.5

** On a fresh weight:
59% *Trifolium repens, T. pratense*
38% *Lolium perenne, Poa annua*
2% of diverse species (*Taraxacum officinale, Plantago major*)

*Determined daily

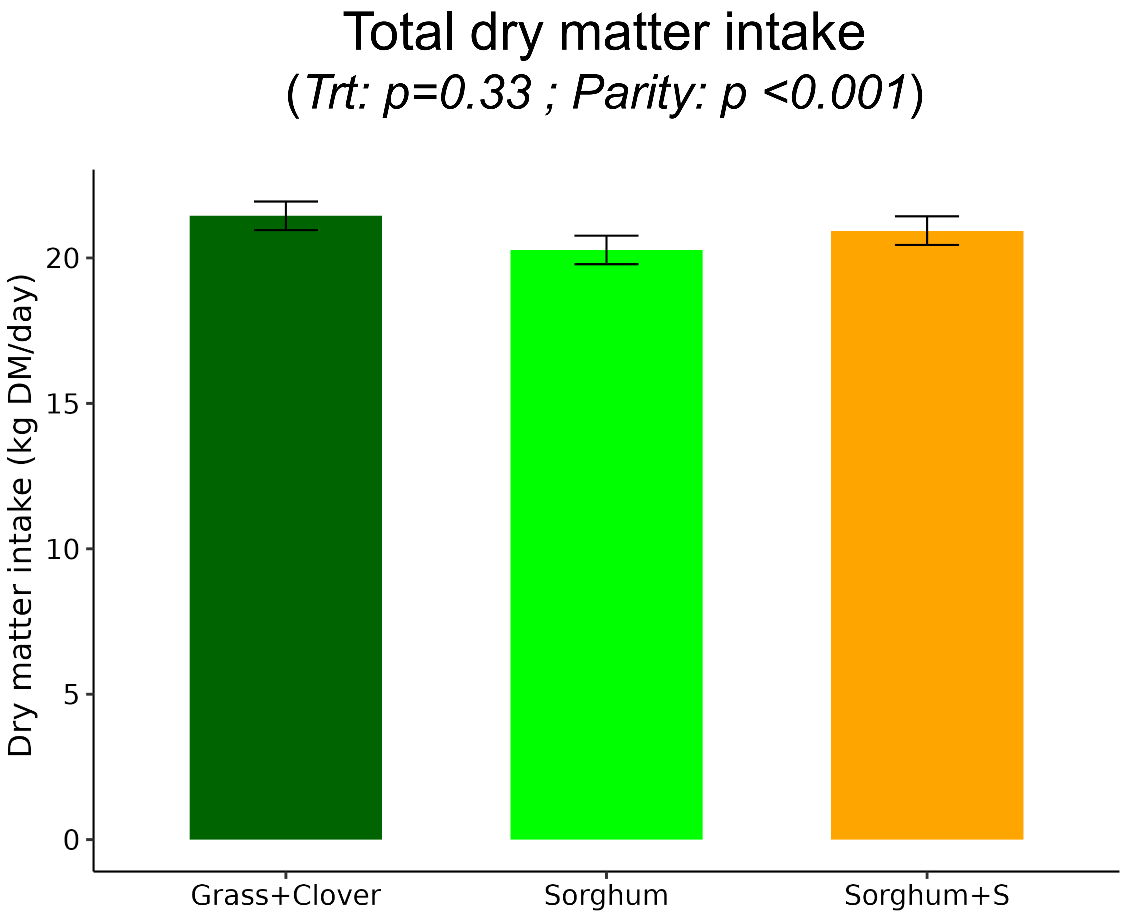
Forage dry matter intake





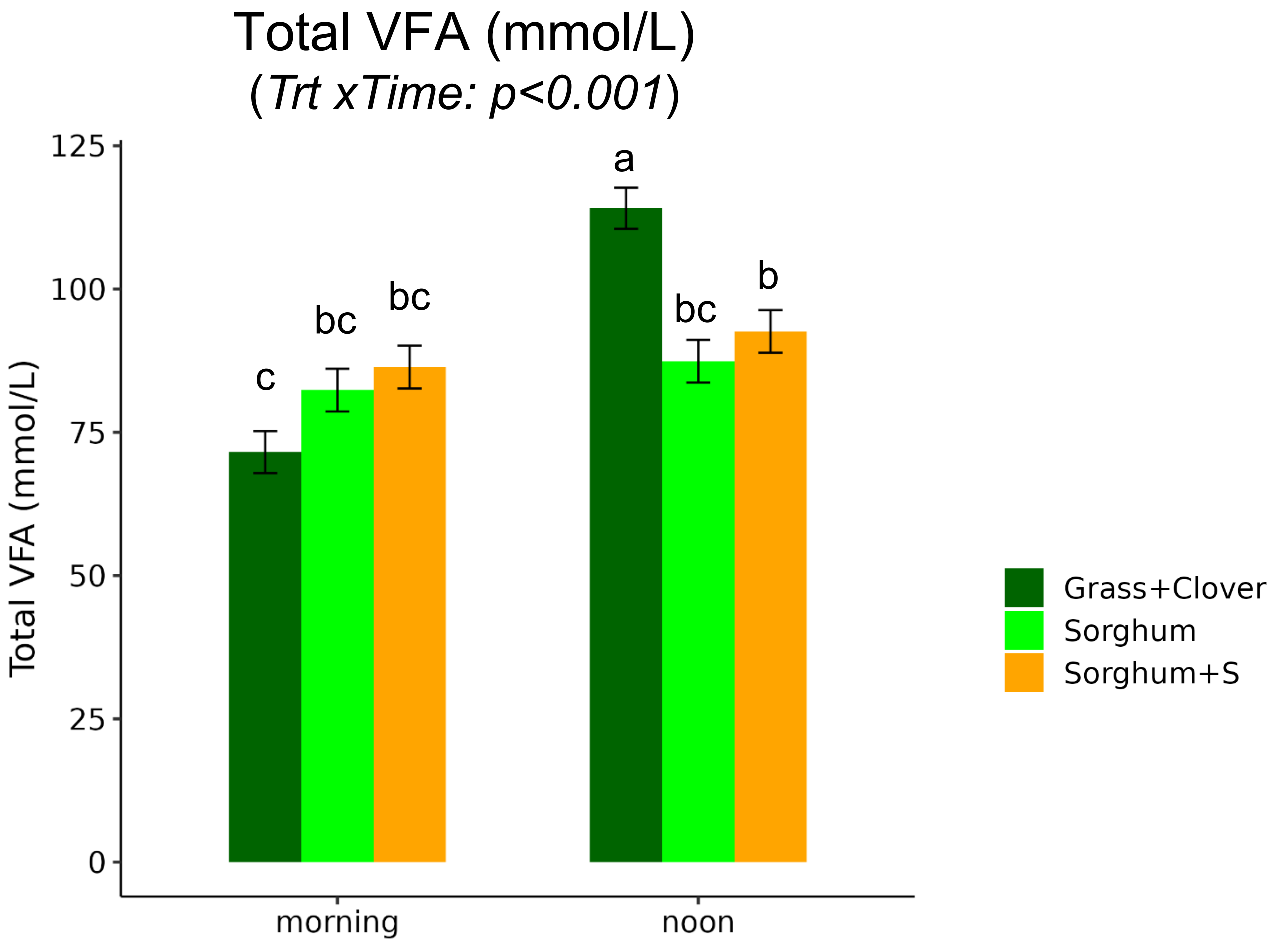
Intake data averaged over the last 14 days.

Total dry matter intake

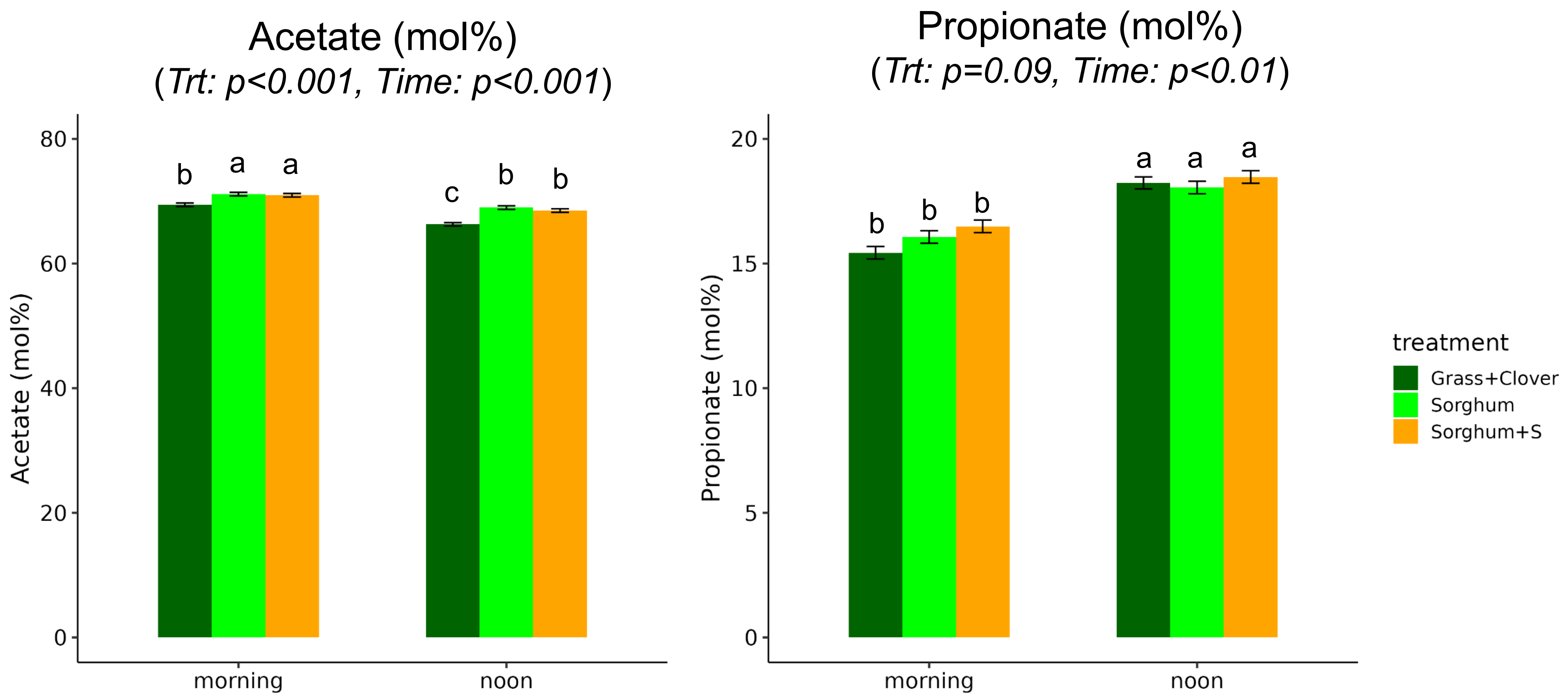


Intake data averaged over the last 14 days.

Ruminal fermentation



Ruminal fermentation



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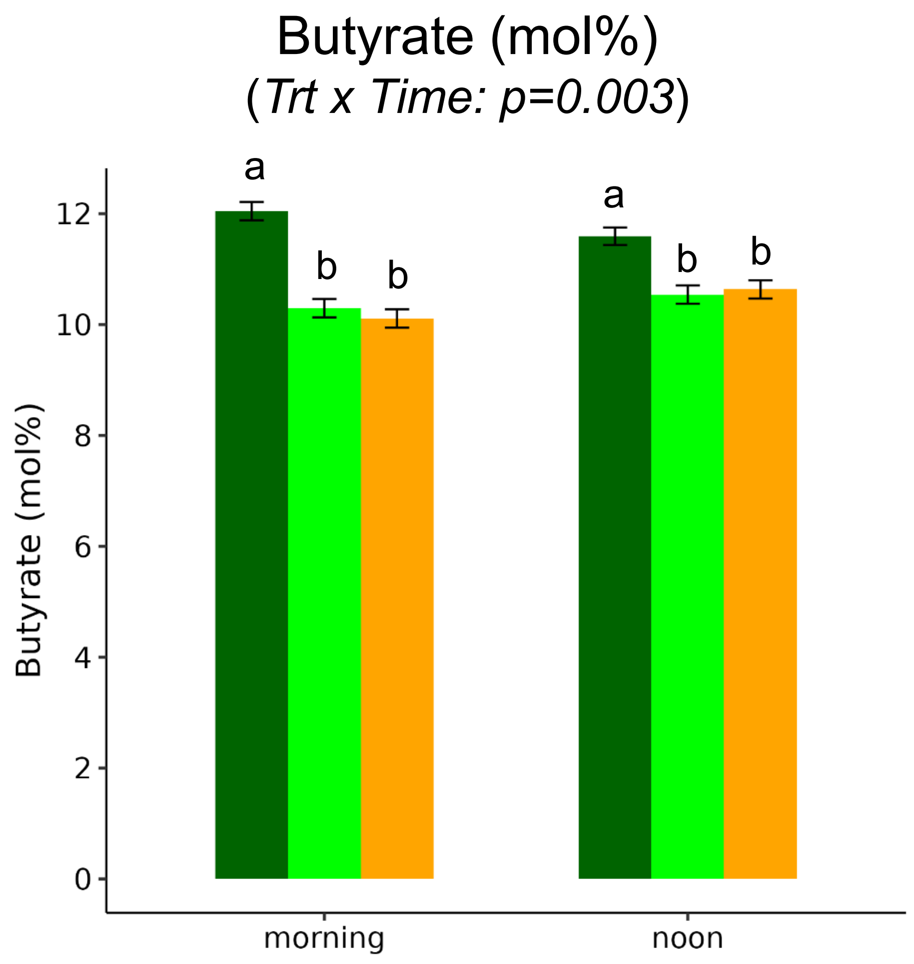
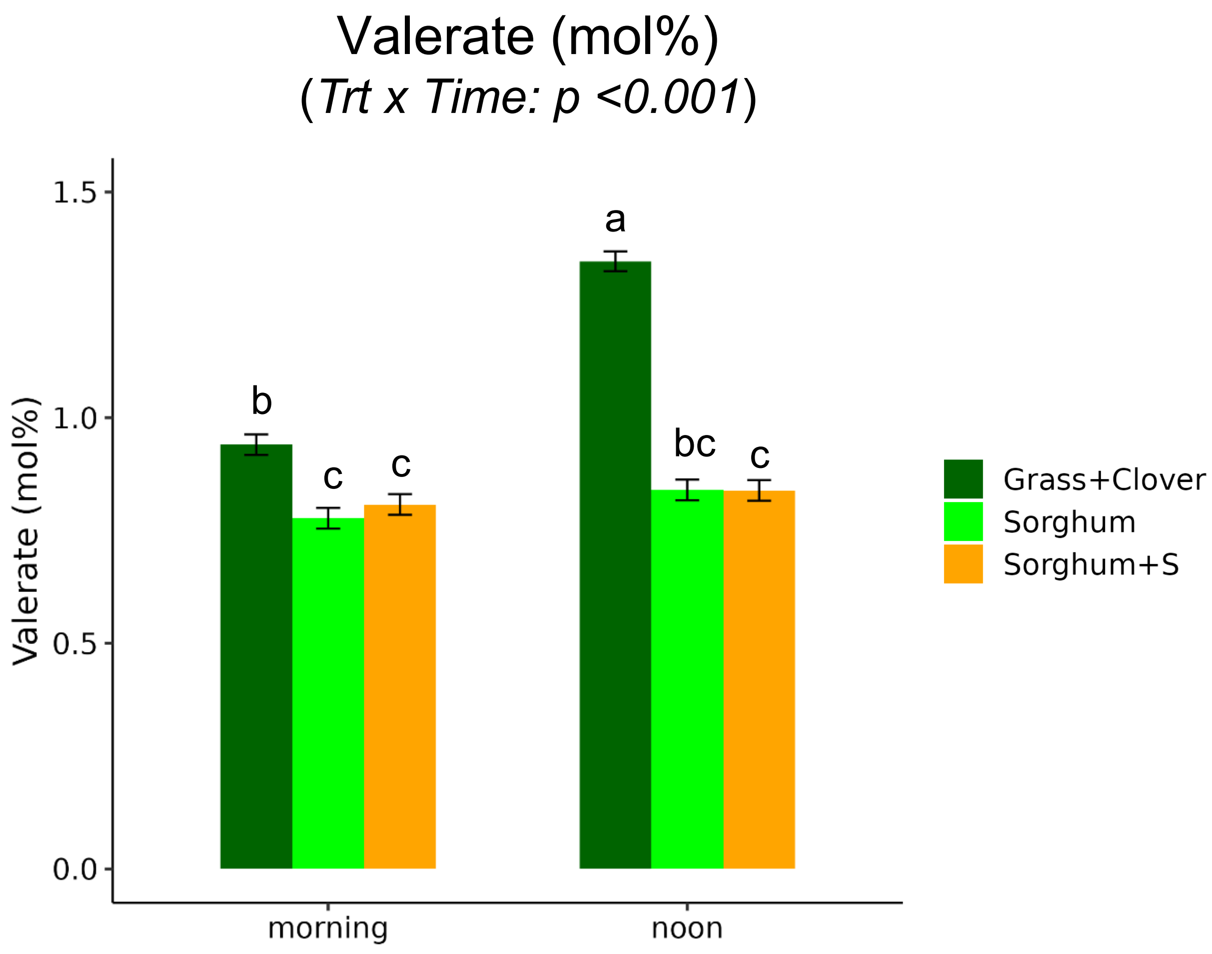
Ruminal fermentation

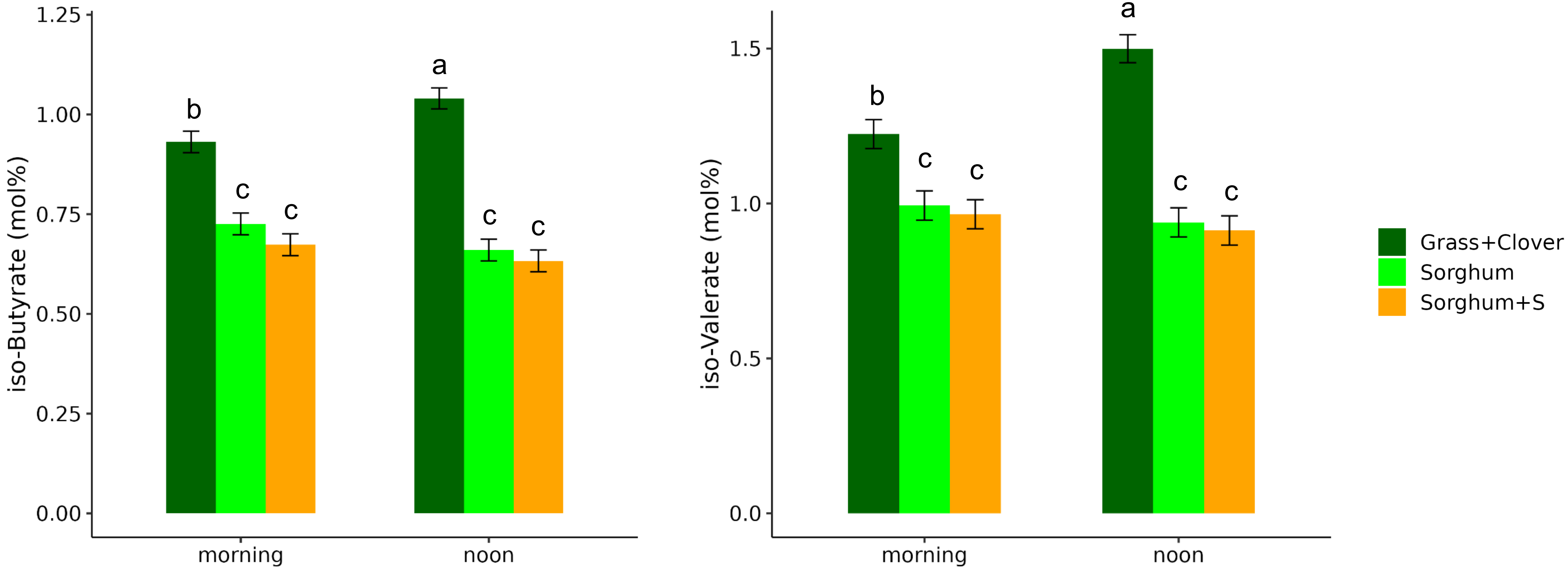




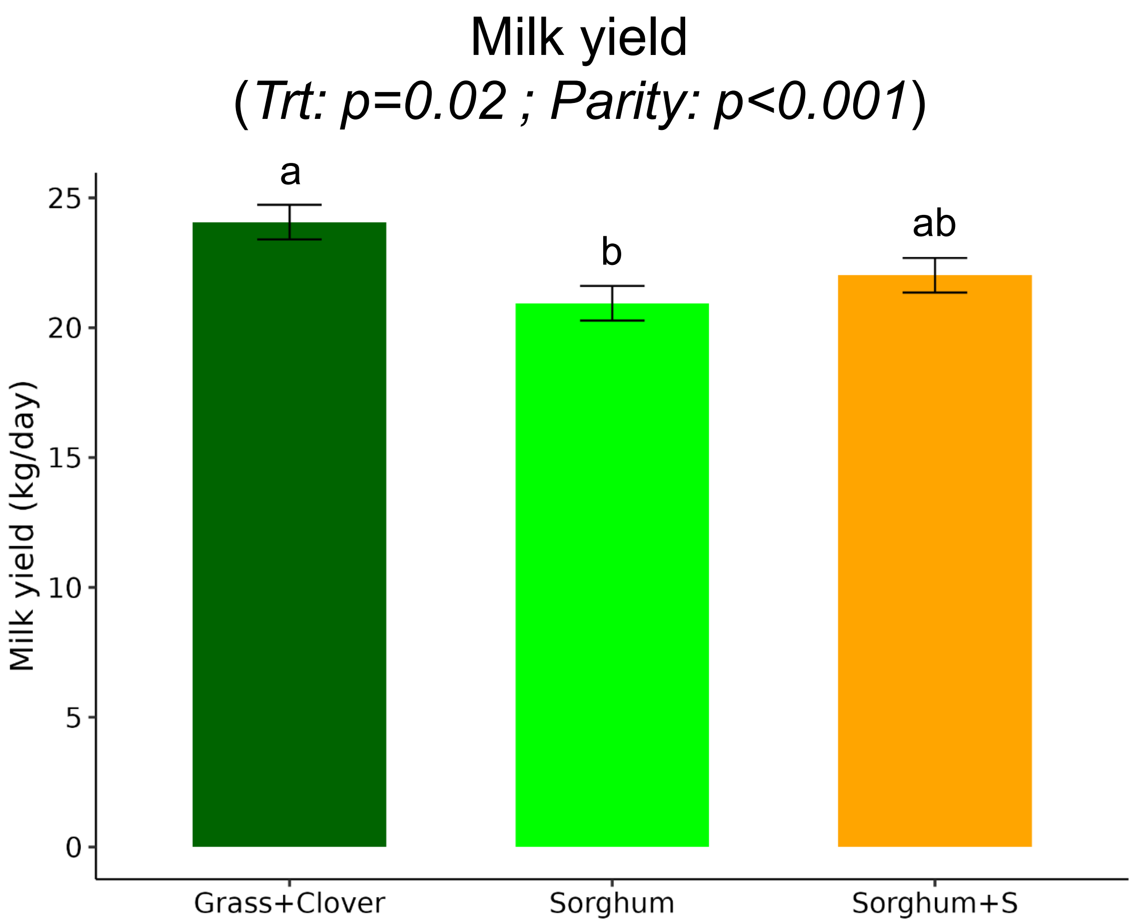
Ruminal fermentation

iso-Butyrate (mol%)
(*Trt x Time: p<0.001*)

iso-Valerate (mol%)
(*Trt x Time: p<0.001*)



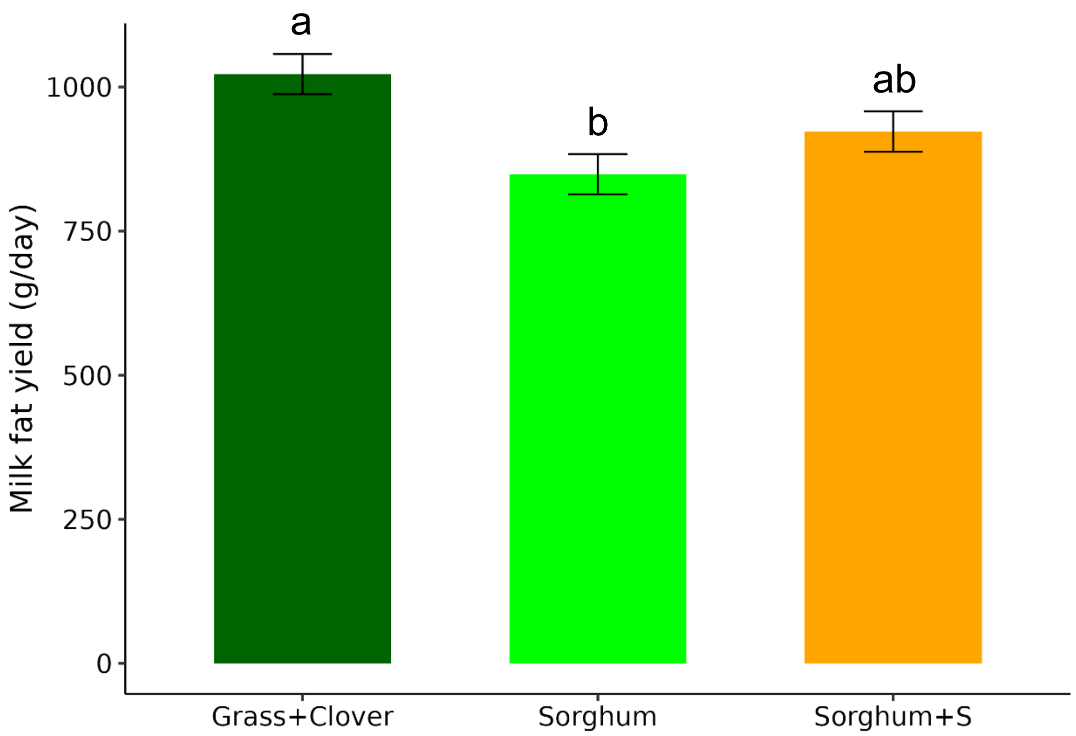
Milk production



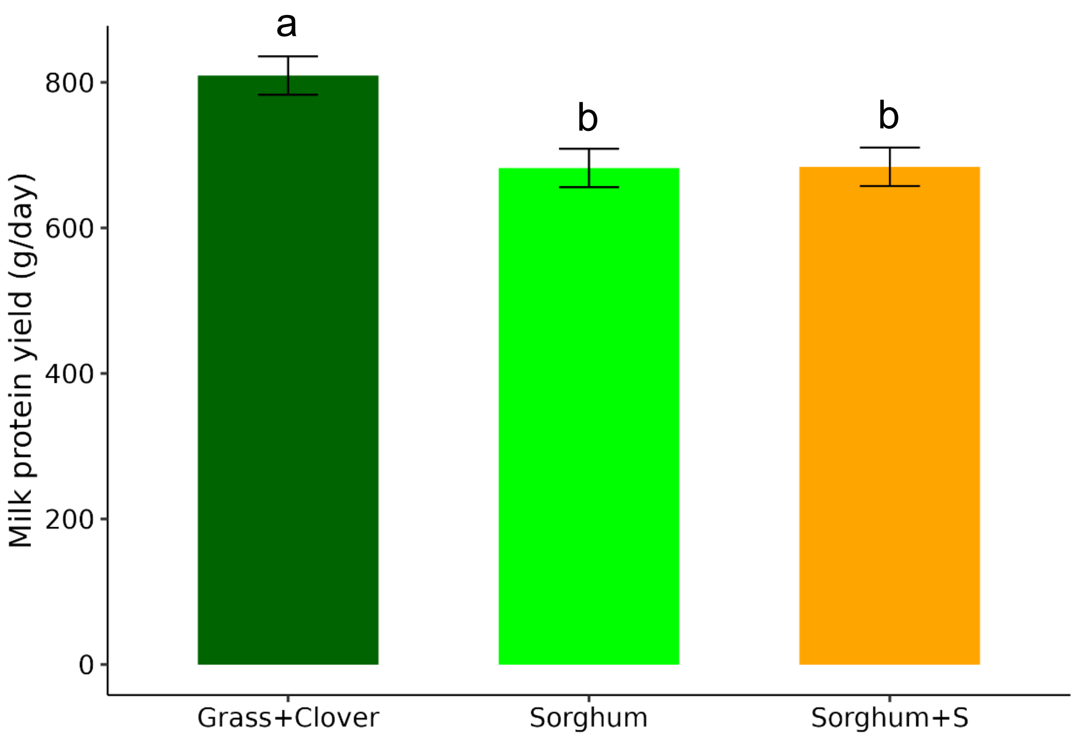
Milk yield averaged over last 14 d. Initial milk yield introduced as covariate in the model.

Milk solids production

Milk fat yield
(*Trt: p=0.02 ; Parity: p=0.002*)

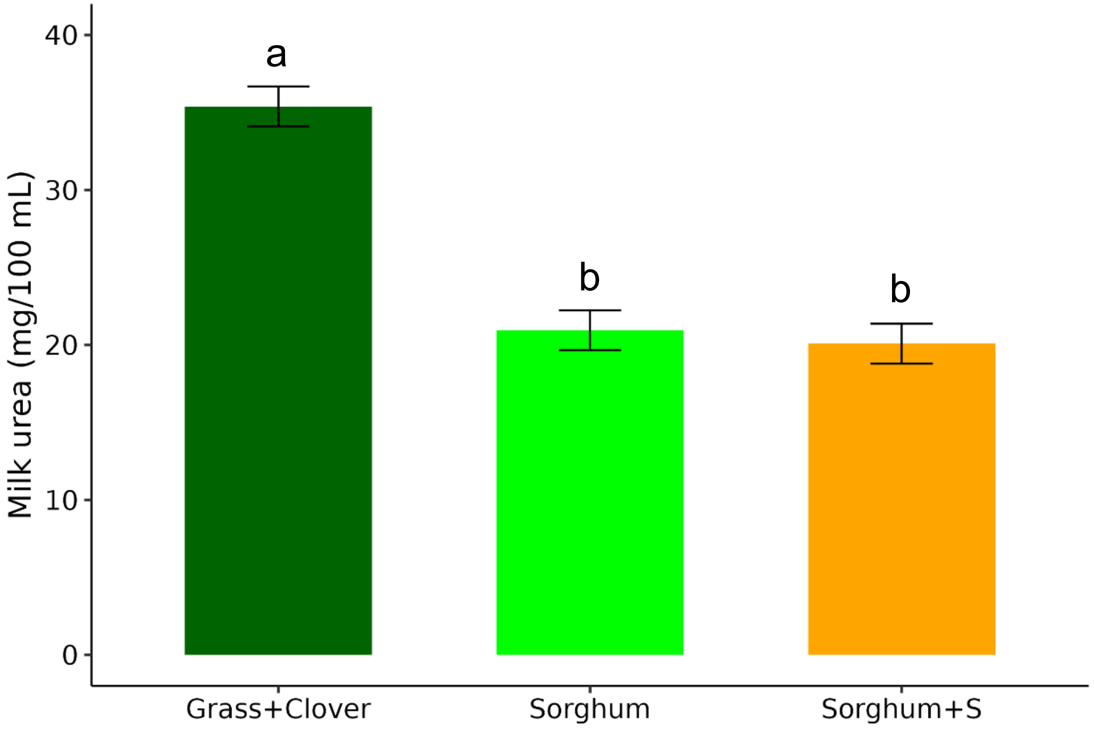


Milk protein yield
(*Trt: p=0.007 ; Parity: p=0.02*)

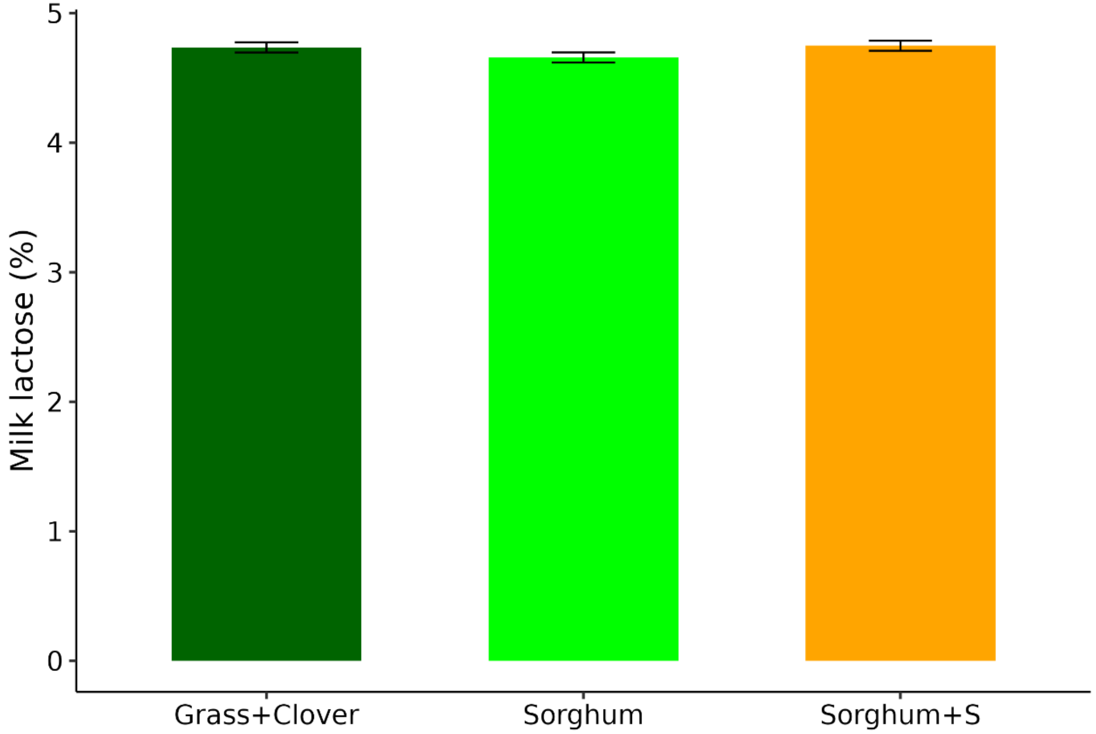


Milk composition

Milk urea
(*Trt: p<0.001 ; Parity: p=0.23*)



Milk lactose
(*Trt: p=0.18 ; Parity: p<0.001*)



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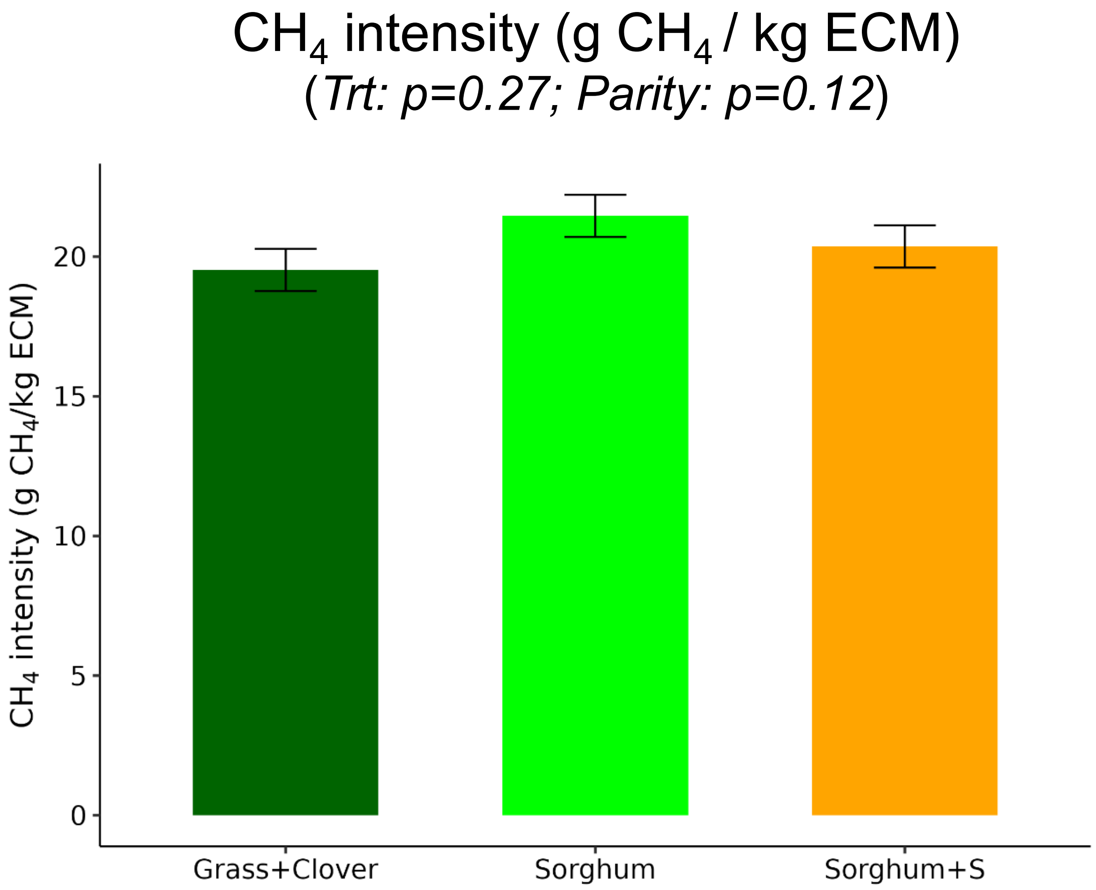
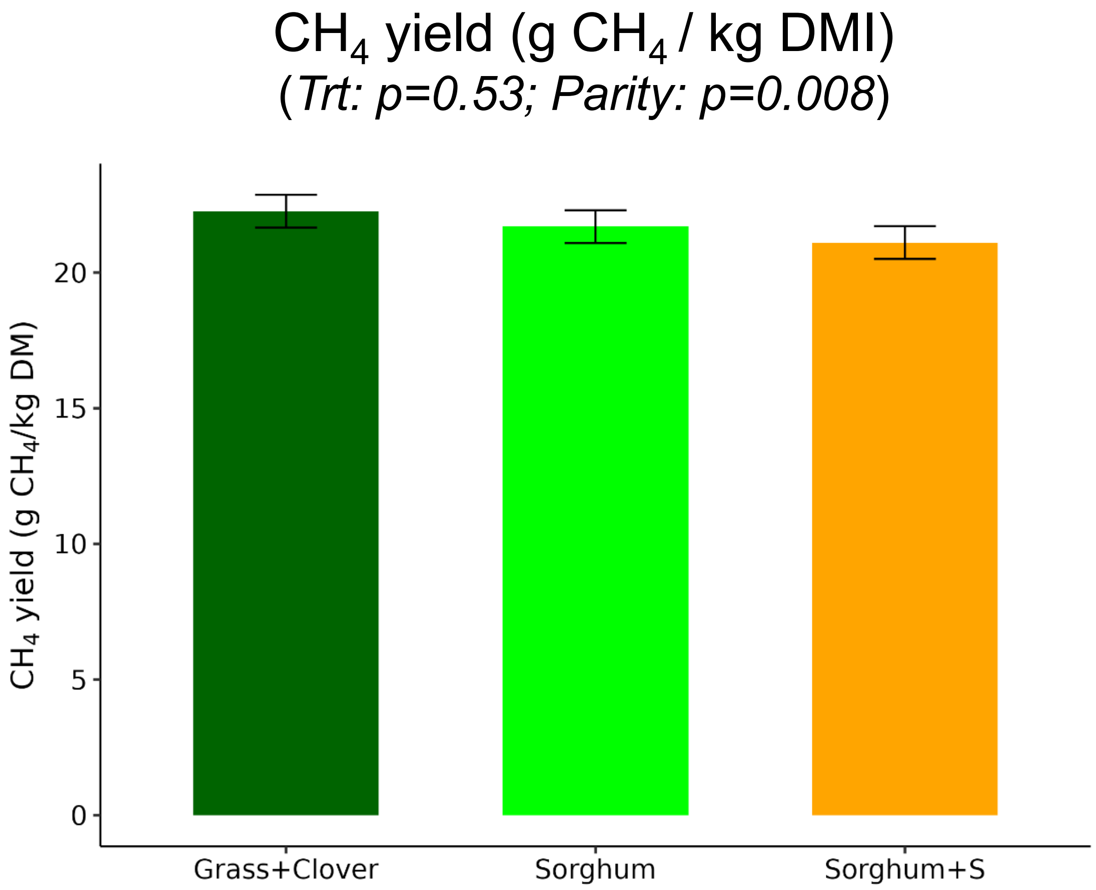
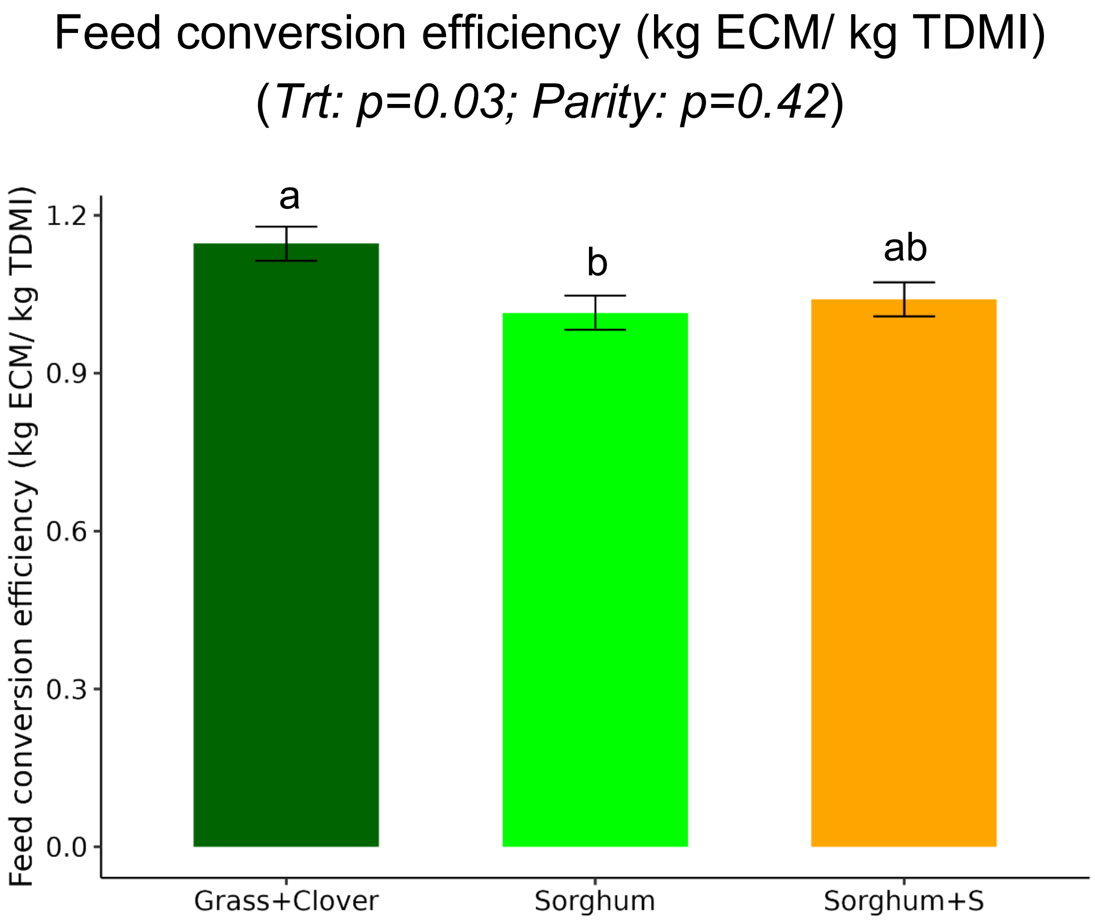
CH_4 emissions





Data averaged over the last 14 days. CH_4 data treatment and identification of outliers according to Coppa et al. (2020) in *Methods*

Feed conversion effciency



Preliminary conclusions

→ Multi-cut sorghum may secure forage during herbage shortages, but…
- ↓ total VFA production (6h after feeding)
- ↓ milk yield and ↓ milk solid yields in comparison to grass+clover mixture
- ↓ feed conversion efficiency (kg ECM / kg DMI) (without additional S)

→ Further analyses are required to evaluate effectivity of sulfur addition to fresh sorghum-based diets, and the effects of thiocyanate antagonism on mineral and trace mineral absorption

→ Targeting protein self-sufficiency? Mixture of sorghum with annual clovers may provide forage richer in metabolisable protein

→ Of course *Sorghum sp.* may not be the only solution to herbage shortages due to drought, anticipation of climate change effects on grasslands (and on their multifunctionality), and adaptation of grassland mangement practices have to be considered

Thank you for your attention!

- We thank Yvo Aeby and all the staff of the experimental farm in Posieux
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More information on *Sorghum sp.* in Switzerland














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