Effects of stocking density and climatic conditions on forage and soil intake of crossbred beef heifers in a montane grazing system

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Introduction

Climate change is often discussed in terms of warming and the resulting heat stress on livestock but less in terms of the impact of intense rainfall events in full grazing systems (Bernabucci, 2019). The aim was to study forage and soil intake, digestibility and forage selection in crossbred heifers facing such environmental challenges in montane pastures managed under two stocking densities.

Material and Methods

All procedures performed on animals were approved by Ethics committee of Switzerland (n°2020_45_FR).
Two herds of 32 growing cattle each (crossbred heifers and steers) grazed continuously for 111 days in the Swiss Jura (1200 m a. s. l.). The trial took place in July 2021 over two consecutive periods (P1 and P2) of 10 days each, using four paddocks in a crossover design testing the effect of stocking density (SD): low or high (9.1 and 14.8 livestock unit/ha, respectively). Individual feed intake and digestibility were estimated over the last five days of each period on eight crossbred heifers (290 ±16 kg BW) from a Brown Swiss dam and an Angus (×An, *n*=4) or Limousin sire (×Li, *n*=4) within each herd. The n-alkane/Ytterbium double indicator technique was used, with $C_{32}H_{66}$ and Ytterbium as external markers, $C_{31}H_{64}$ and $C_{33}H_{68}$ as internal markers for forage, and acid-insoluble ashes as internal marker for soil (Jurjanz et *al*., 2012). Three grazing exclusion cages (1.5 m × 1.5 m) were installed in each paddock. Plant community composition and forage biomass were determined in each paddock after grazing in 1 × 1 m plots in three paired grazed and ungrazed area (i.e. under exclusion cages) having the same initial vegetation composition (55% grasses, 20% forbs, 25% legumes, DM basis Dominant species were *Lolium perenne* and *Dactylis glomerata* for grasses, *Taraxacum officinale* and *Plantago lanceolata* for forbs, *Trifolium repens* and *Trifolium pratense* for legumes. Statistical model (MIXED procedure, SAS 9.4.) for individual intake and digestibility data included the fixed effects of period, SD, crossbreed, Period×SD, SD×crossbreed and the random effect animal. For forage selection data, model included the fixed effects of period, SD and their interaction.

Results and Discussion

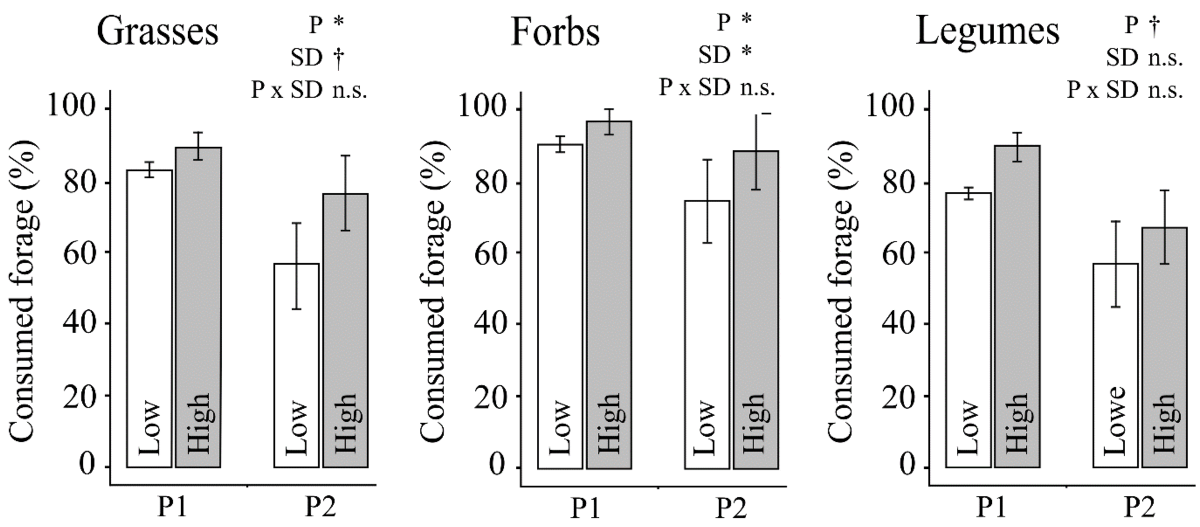
The periods differed in terms of meteorological conditions, with a wetter P1 (150 mm of rain in 8 days out of 10) and a drier P2 (47 mm of rain in 3 days out of 10). During P1, the high SD led to a decrease in forage intake but an increase in soil intake (Table 1) as well as to a soil intake proportion of 7.7 *vs* 3.5% of total DM intake with the low SD. The digestibility of DM and OM was diminished by 8.2 and 5.7% during P1 in high compared to low SD. The wetter P1 led to higher trampling and soiling of the forage, which combined with its lower availability, could explain such effects. The drier P2 resulted in rapid forage growth and availability, presumably vanishing the effect of SD on forage intake and DM digestibility. Accordingly, the amount and proportion of soil intake (1.6%) was lower in P2 than in P1, but still higher values were recorded for high *vs* low SD in P2. Crossbreed ×An ingested more forage than ×Li. Such effect and level of intake were remarkably close from the ones observed in heifers of the same crossbreeds and BW fed with a grass silage and hay diet (×An 7.0 and ×Li 5.8 kg DM/d; I. Morel, unpublished data). No effect of period and SD was detected for the percentage consumption of legumes (Figure 1). Conversely, the percentage consumption of grasses and forbs were higher in P1 and for high SD.

Table 1. Body weight, intake and digestibility of growing heifers at pasture according to weather conditions, stocking density and crossbreed.

	Period (P)												
	1 (Wetter)		2 (Drier)		Cross-breed (CB)			*P*-value					
	Stocking density (SD)												
	Low	High	Low	High	×An	×Li	SEM	P	SD	CB	P*SD	SD*CB
BW (kg)	287	281	296	298	294	286	5.4	< 0.001	< 0.01	0.33	0.61	0.29
Intake (kg/d)												
Forage	6.4[a]	5.2[b]	6.3[a]	6.9[a]	6.8	5.6	0.27	< 0.001	0.15	< 0.01	0.02	0.12
Soil	0.23[b]	0.42[a]	0.10[c]	0.20[b]	0.24	0.24	0.026	< 0.001	< 0.001	0.54	0.69	0.56
Digestibility (%)												
DM	69.3[a]	61.1[b]	66.7[a]	68.6[a]	67.0	65.9	1.00	0.02	< 0.01	0.31	< 0.001	0.97
OM	72.7[a]	67.0[c]	70.0[b]	72.4[a]	70.8	70.2	0.72	0.03	0.01	0.47	< 0.001	0.37

[a-c]LSM with different superscript differ ($P < 0.05$) within row and period*stocking density.

Figure 1. Estimated forage percentage consumption for each plant functional group for the two stocking densities (SD: Low, High) during the two grazing periods (P: P1, P2). Significant effects of P, SD and their interactions are indicated (* $P < 0.05$; † marginally significant $P < 0.1$; n.s. not significant).



Conclusion and Implications

An increased frequency of extreme weather events is expected in the future. Adaptive processes, at the animal and farm levels will be required to cope with such environmental challenges. Under such conditions, adapting stocking density in full grazing systems may improve forage quality and reduce soil intake of beef cattle.

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References

Bernabucci U 2019. Climate change: impact on livestock and how we can adapt. Animal Frontiers 9, 3-5.

Jurjanz S, Feidt C, Pérez-Prieto LA, Ribeiro Filho HMN, Rychen G and Delagarde R 2012. Soil intake of lactating dairy cows in intensive strip grazing systems. Animal 6, 1350-1359.