

Short-term effect of water regimes and defoliation on Sahelian vegetation dynamics using stable isotopes



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Introduction

 Sahelian pastoral livestock production mainly relies on grassland vegetation dynamics for

Sample collection on 07/10/2022





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Methods

Rainout shelter experiment at the natural

- livestock feeding.
- However, semiarid and arid grassland resources are currently affected by the increased weather events and uncontrolled human exploitation.
- Moreover, these problems are projected to increase, negatively affecting livestock productivity.
- Aim of Study: to understand the effects of variable rainfall patterns and defoliation on herbaceous vegetation in the Sahel region.

Figure 1. The experimental design with the rainout-shelters from the fields to the laboratory

Results

rangeland of CRZ, Senegal during the rainy

season: May to October 2022.

Factorial combination of 4 water regimes (WR) with or without defoliation and one control (C) replicated twice.

C, natural rainfall of 306 mm,

<u>▶ 02 wet treatments</u> (W1, W2) with rainfall and irrigation of 20 mm up to 562 mm provided in does of (i) W1 every 4 days and (ii) W2 every 7 days,

► 0<u>2 dry treatments (D1, D2)</u> with rainfall held back (i) early drought D1 between 1st to 15th July, 200 mm and (ii) late drought D2 between 1st to 18th August, 200 mm.

Target variables: Above and Belowground biomass (AGB, BGB), isotopic signatures of carbon (δ^{13} C), and nitrogen (δ^{15} N) of AGB and BGB (Fig 1).

Table 1. Marginal means and standard errors of AGB, BGB (kg/ha), δ^{13} C, and δ^{15} N of AGB (‰) as affected by water regime treatments (WR): control (C), Drought (D1, D2), and Wet (W1, W2). Lower letters indicate significant differences at p< 0.05 between WR within each variable.

- Higher AGB and BGB under the wet treatments (Table 1).
- δ^{13} C values for AGB and BGB were not influenced by WR nor defoliation (p > 0.05, Table 1, data shown for AGB only).
- Also, δ^{15} N values for BGB were not influenced by WR nor defoliation (data not shown).
- However, δ^{15} N for ABG values were strongly influenced by WR (p < 0.01, Table 1).
- In addition, we found positive and significant relationships between AGB and BGB (r2=0.59, p < 0.01); $\delta^{15}N$ AGB and δ^{15} N BGB (r2 = 0.72, p < 0.01) (Fig 2).
- But, the relationships between $\delta^{13}C$ ABG and $\delta^{13}C$ BGB was non-significant (Fig 2).

WR	AGB	BGB	δ ¹³ C	δ ¹⁵ N
С	3 076 ± 1 400 ab	294 ± 187 ab	- 21.4 ± 1.9 a	2.2 ± 1.1 b
D1	3 338 ± 1 043 a	409 ± 106 a	- 18.4 ± 0.9 a	6.5 ± 0.5 a
D2	3 048±1 043 a	372 ± 106 a	- 21.6 ± 0.9 a	6.6 ± 0.5 a
W1	6 381±1 043 b	778 ± 106 b	- 20.9 ± 0.9 a	2.9 ± 0.5 b
W2	6 792±1 043 b	514 ± 106 ab	- 20.4 ± 0.9 a	2.2 ± 0.5 b



Figure 2. Relationships between AGB and BGB (kg/ha) (A); between δ^{15} N values of AGB and BGB(‰) (B); and between δ^{13} C values AGB and BGB (‰) (C), as affected by WR and defoliation (Harvest: no and yes). The relationship was evaluated with R2adj = root mean square adjusted, p = p-value.

Discussion and conclusion

• Short-term water manipulation and defoliation did not vary δ^{13} C values of vegetation probably due to the high C4- grass species and composition.

- However, as plant δ¹⁵N is related to N availability, the increased values under aridity (here, the early and late drought D1, D2) suggested higher N cycling and losses. • The relationships indicate that isotopic signatures of nitrogen (δ^{15} N) was a more meaningful indicator in evaluating the effect of water regime and defoliation in the Sahelian vegetation.
- \bullet Long-term interaction effects of rainfall patterns and defoliation on the dynamics of δ 13C and δ 15N in semi-arid and arid grassland systems should be evaluated.













