# Fertilizer regime modifies grassland sensitivity to interannual climate variability.

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## Rationale

Improved understanding of the interactions between management practices and climate variability is critical for the development of sustainable grassland management and the identification of agricultural 'best practices' to improve the resistance of grassland forage production in a changing environment. In the present work, we investigated the interactive effects of fertilizer regime and climate variability (temperature, rainfall) on yield, forage quality and plant diversity in an upland grassland subjected to a gradient of nutrient availability treatments over a 15-year period.

No fertilization *Plot 18* | PK *Plot 19* | NPK *Plot 20*

Experimental fields in june 2020, 15th year of experimentation, of one of the four repetitions per treatment. Photos: F. Louault

## Materials and methods

- Measurements were carried at a long-term research platform in the Massif Central, France (ANAEE-F SOERE-ACBB: Theix) on twelve mown grassland plots (NPK (251 kg N ha-1, 28 kg P ha-1, 177 kg K ha-1), PK (21 kg P ha-1, 128 kg K ha-1) and 'None' (no fertilization).
- Field-scale biomass and forage quality (total N content, dry mass digestibility) was assessed across each paddock at the three cutting dates per year during the growing season (May, July, October).
- Botanical surveys are carried out each year in May using the transect method to determine species presence/absence at 40 points per field.

## Results

Forage production and quality generally showed positive responses to rainfall and negative responses to temperature, whereas the reverse was true for climate-diversity relationships (Table 1). Three variables showed interactive effects of fertilizer and climate (Figure 1), driven by greater responsiveness in the PK treatment (Figure 1).

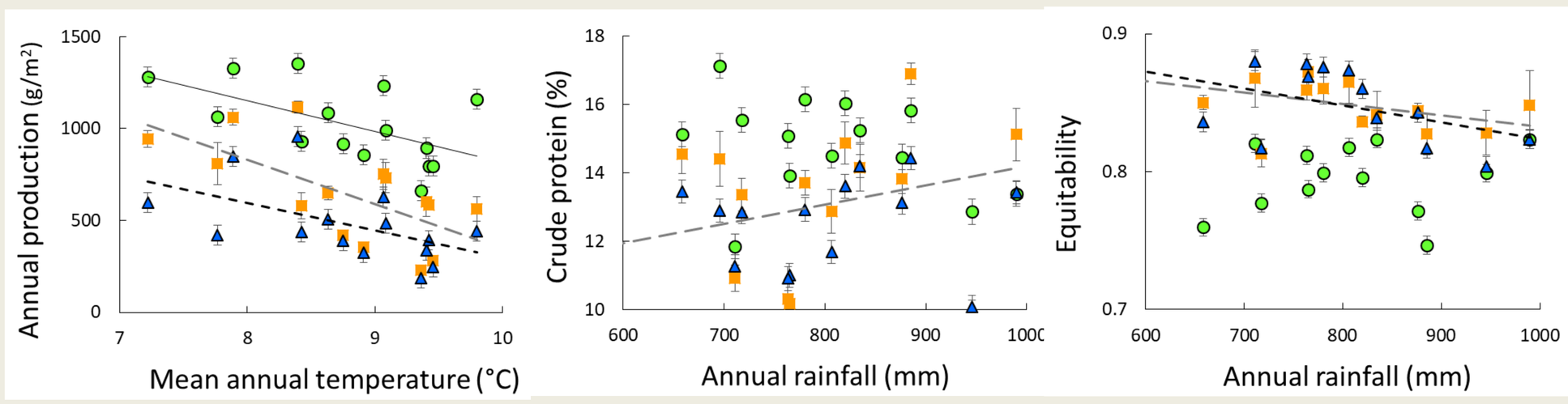


**Figure 1.** Interactive effects of fertilizer treatments and climate indices recorded during the study. Fertilizer treatments are given by: NPK, green filled circles; PK, orange filled squares, 'None', blue triangles. Means and standard errors are presented; n= 4.

## Conclusions

Interactions between fertilizer treatment and climatic variables assessed at the annual scale were not confined to one particular grassland property or climatic index, and were relatively limited. In general, interactions were driven by responses in the PK treatment, possibly linked to greater sensitivity of legumes to climatic variation.

**Table 1.** Directionality of responses of grassland properties to climatic variation and fertilizer treatment. Results represent significant main effects based on GLM analysis (no results are presented for climate variables where fertilizer treatments interact with climate, cf Figure 1; n.s., non-significant climate effects). Fertilizer treatment rankings apply only for cases with no Tmt*Climate interactions.

| Variable | Mean annual temperature | Total annual rainfall | Fertilizer treatment |
|---|---|---|---|
| Biomass production (g/m²) | (see Fig. 1) | ↗ | NPK > PK > None |
| Crude protein (%) | ↘ | (see Fig. 1) | NPK > PK = None |
| Dry matter digestibility (%) | n.s. | ↘ | NPK < PK = None |
| Species number | ↗ | ↘ | NPK < PK < None |
| Evenness | ↗ | (see Fig. 1) | NPK < PK = None |