Taxonomic and functional biodiversity positively influence agronomic characteristics of permanent grasslands

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Context

European permanent grasslands

are one of the main source of fodder (Eurostat, 2017)

may host a high botanical diversity (Wilson et al, 2012)

Context

Biodiversity vs. Production

- Trade-off (Le Clec'h et al, 2019)
- Hump-shaped relation (Guo, 2007)
- Positive relation (Finn et al, 2018)

Functional diversity?

Effect of taxonomic and functional **diversity**

on fodder quantity and quality

in **permanent grasslands** managed by farmers,

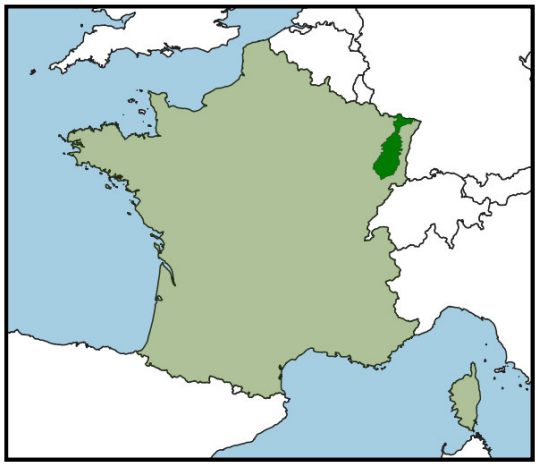
under environmental and management **gradients**

Methods

59 grasslands from the Vosges Mountains

Gradients of

- climate (184 to 1222 m a.s.l)
- soil properties (pH 4.2 – 8)
- management (0 to 259 kgN.ha^{-1})



Methods

Predicted characteristics

calculated from botanical relevés

- Pastoral value, flexibility of management (Theau et al, 2017)

calculated from vegetation analyses

- Yield
- NDF, ADF, ADL, CP, mineral content
- Potential milk production (INRA, 2010)
- Antioxidant activity

Predictors

Methods

calculated from botanical relevés

- Taxonomic diversity (Hill, 1973)
- Functional diversity (Leda Traitbase: Kleyer et al, 2008)
- Soil N fertility and humidity (Ellenberg, 1992)

Farmers interviews

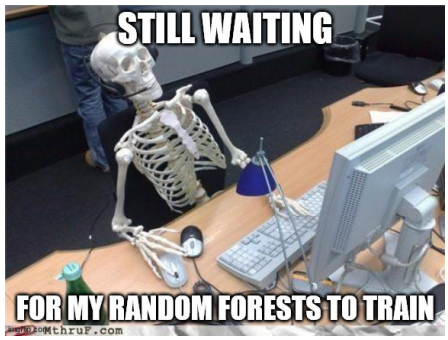
Soil analyses

Topographic and climatic models

Analysis

Methods

Spatial random forests (Benito, 2021)



Selection of the best predictors

Direction of the correlation between predictors and characteristics

Results

Agronomic characteristics	R^2
Yield (1100 d.g)	**0.68**
Pastoral value	**0.68**
NDF	**0.56**
ADF	**0.50**
ADL	**0.45**
CP	**0.56**
Mineral content	**0.55**
Milk potential	**0.45**
Flexibility	**0.58**
Antioxidant activity	**0.41**

Results

Agronomic characteristics	R^2	Management					Environment				
		Soil N fertility	LUI	Number of cuts	Proportion of cut	Degree day	Soil humidity	Elevation	Soil sand content	Soil pH	Soil depth
Yield (1100 d.g)	0.68	+		+							
Pastoral value	0.68	+								+	
NDF	0.56	+			+	+		-		+	
ADF	0.50	+			+	+	-	-		+	
ADL	0.45	+	-	-	+	+	-	+			
CP	0.56	+				-	+				
Mineral content	0.55	+				-	+			+	
Milk potential	0.45		+			-		+			
Flexibility	0.58	-								-	
Antioxidant activity	0.41								-		-

Agronomic characteristics	R^2	Management					Environment					Biodiversity			
		Soil N fertility	LUI	Number of cuts	Proportion of cut	Degree day	Soil humidity	Elevation	Soil sand content	Soil pH	Soil depth	Taxonomic richness	Shannon exponential	Functional richness	Rao's Q diversity
Yield (1100 d.g)	0.68	+		+								-	+		
Pastoral value	0.68	+								+			+	-	
NDF	0.56	+			+	+		-		+					
ADF	0.50	+			+	+	-	-		+					+
ADL	0.45	+	-	-	+	+	-	+							+
CP	0.56	+				-	+								
Mineral content	0.55	+				-	+			+		+	+		
Milk potential	0.45		+			-		+							
Flexibility	0.58	-								-			-		
Antioxidant activity	0.41								-		-				

Discussion

Hump-shaped relation biodiversity-production… (Guo, 2007) but random forests could identify relations

Relation between biodiversity and agronomic characteristics depends on considering taxonomic or functional diversity (Brun et al, 2019)

Relation biodiversity-nutritive value mostly positive (contrary to Schaub et al, 2020)

Conclusion

Only 3 out of 10 characteristics were negatively related to biodiversity

Biodiversity conservation and agricultural production can both benefit from synergies

Role of biodiversity in face of climate change?

Taxonomic and functional biodiversity positively influence agronomic characteristics of permanent grasslands

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