

Plant diversity affects grassland yield and nitrogen use efficiency

Introduction

Diversity in grassland can be explained by identity and interactions among functional groups. We investigate here the effect of diversity on productivity and sustainability under intensive management.

Can mixtures outperform ryegrass monoculture?

Materials and Methods

- Monocultures of 6 species within 3 functional groups (FG): grass (ryegrass, timothy) ; legume (red and white clover) and herb (chicory and plantain).
- Mixtures from 2 to 6 of the above species combined.
- 150 kg ha⁻¹ yr⁻¹ of nitrogen (N) fertilizer applied to each community (**150N**).
- An additional ryegrass monoculture received 300 kg of N ha⁻¹ yr⁻¹ (**300N**).
- 7 harvests over 2018 : total annual yield (tonnes ha⁻¹) + N Use efficiency (NUE = N harvested/N fertilizer)
- A linear regression model based on FG monocultures and pairwise interactions for data analysis

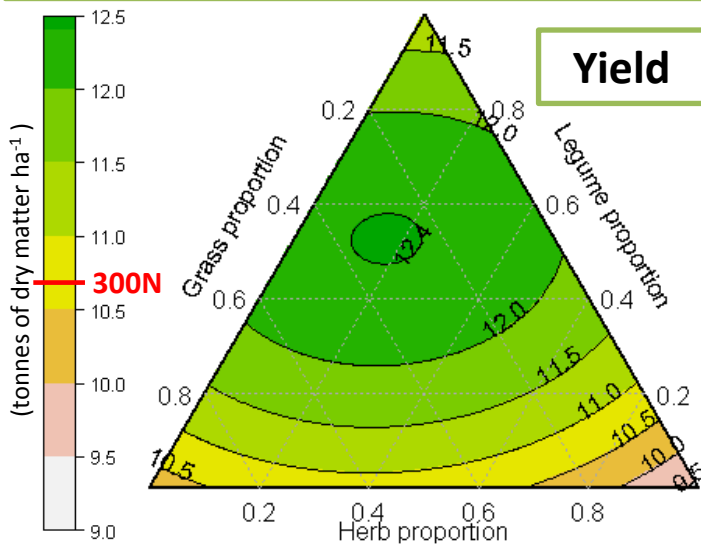


Figure 1: Contour plots of the effect of FG group diversity on 2018 yield at 150N. Performance of 300N treatment indicated on the scale (left).

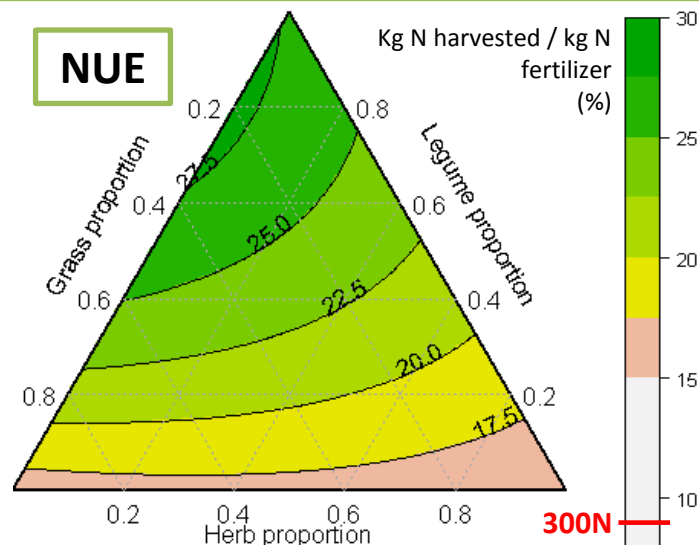


Figure 2: Effect of FG group diversity on nutrient use efficiency (total N harvested in forage yield relative to 150N applied). Performance of 300N treatment indicated on the scale (right).

Results

- Annual yields ranged from 8.6 t ha⁻¹ (chicory) to 11.7 t ha⁻¹ (red clover) for monocultures (Figure 1). Mixtures yielded up to 12.4 t ha⁻¹ (30% grass, 55% legumes, 15% herbs) under 2018 weather conditions.
- At **150N**, higher nitrogen use efficiency was achieved with higher legume content (Figure 2).
- **300N** ryegrass yielded 10.7 t ha⁻¹ with a NUE of 8.8%, and was strongly outperformed by most of the mixtures, especially those containing >20% legume.

Conclusions

Grassland diversity strongly influenced forage yield and nitrogen use efficiency. Diverse mixtures at 150N consistently out-yielded ryegrass monocultures at 300N.

