

# Multi-species mixtures enhance yield stability in grasslands subjected to simulated drought

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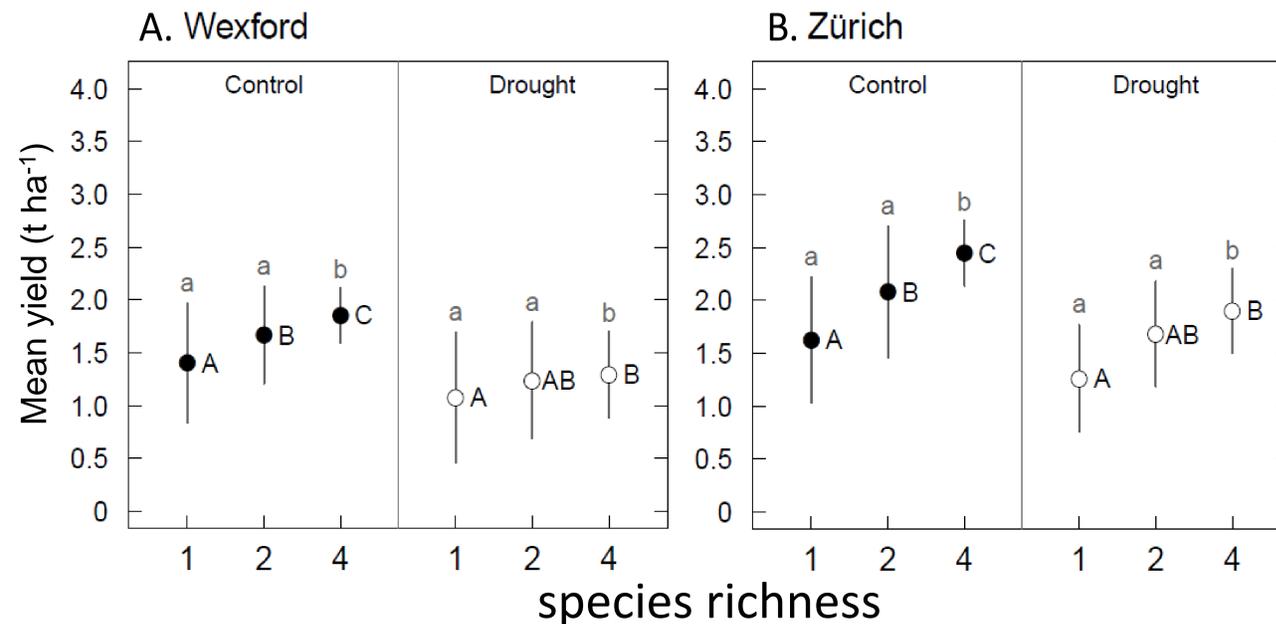
**1. INTRODUCTION:** In intensively managed grasslands, even modest increases in species richness can result in strong yield benefits – but do these benefits persist under environmental stress, such as drought?

We investigated the use of multi-species mixtures in intensively managed grasslands as a practical adaptation strategy for increasing yield stability of intensively managed grasslands under drought.



**2. METHODS:** Experimental drought was imposed on replicated grassland communities using rain-out shelters to achieve 9-week experimental droughts at Wexford (Ireland) and Zurich (Switzerland). Communities (15) comprised monocultures of four species (*Lolium perenne*, *Cichorium intybus*, *Trifolium repens*, *Trifolium pratense*), and 2- and 4- species mixtures of those four species. Yield was harvested by cutting five or six times per annum at Wexford and Zurich respectively. Fertiliser nitrogen was applied: 130 kg ha<sup>-1</sup> yr<sup>-1</sup> at Wexford and 200 kg ha<sup>-1</sup> yr<sup>-1</sup> at Zurich.

## 3. RESULTS: Higher species richness lead to higher mean yields and lower yield variation in both rainfed and drought conditions = yield stability



**Fig. 1.** Effects of species richness and drought on yield mean and standard deviation across harvests under rainfed control and drought conditions at Wexford (A) and Zürich (B). Means are averaged across all six harvests and (values sharing the same capital letter are not significantly different). Standard deviations (SD) represent the plot-to-plot variation (values sharing the same small letter are not significantly different).

## KEY RESULTS

- Under rainfed control conditions, mean yields of four-species communities were 32% (Wexford) and 51% (Zürich) higher than the average of the four monocultures ( $P < 0.001$  both sites) (Fig. 1)
- This positive relationship was also evident under drought, despite significant average yield reductions due to drought (-27% at Wexford; -21% at Zürich)
- At both sites, four-species communities had lower plot-to-plot variance of yield compared to monoculture or two-species communities under both rainfed (-49% smaller standard deviation) and drought conditions (-24%) (Haughey et al. 2018)
- Four-species mixture yields under drought were similar to or exceeded average of monoculture yields under rainfed control.

## 4. CONCLUSIONS

- Species diversity resulted in higher yields, with a strong effect of legumes
- Yield stability was higher in more diverse swards
- Yield stability was evident in both rainfed control and experimental drought treatment.
- These results indicate the high potential of multi-species grasslands as an adaptation strategy against drought events (Hofer et al. 2016)



Example of four-species mixture

**5. REFERENCES** Haughey et al. 2018. Higher species richness enhances yield stability in intensively managed grasslands with experimental disturbance. *Nature. Sci. Rep.*, 8, 15047.  
Hofer et al. 2016. Yield of temperate forage grassland species is either largely resistant or resilient to experimental summer drought. *J. Appl. Ecol.*, 53: 1023-1034.