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# Combination of english ryegrass and tall fescue improve yields in a low P soil

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## Background

- Phosphorus (P) is a critical key nutrient to obtain high production in grasslands.
- Overfertilization, have turned almost 60 % of European grassland soils unresponsive to P fertilization and has caused eutrophication and degradation of natural ecosystems.
- The combination of english ryegrass (Lp2) and tall fescue (Fa) has gained interest because of Fa higher tolerance to drought.
- We investigated the performance of the Lp2 and Fa mixture and more palatable combinations under P limitation.

## Materials and methods

We cultivated Lp2 and Fa for two seasons in monoculture and in combination (Lp2Fa) under P limitation (P-) and P fertilization (P+). We also grew the latter species in combination with tetraploid Lp (Lp4) and timothy (Pp) to increase the nutritional palatability, (4sp).



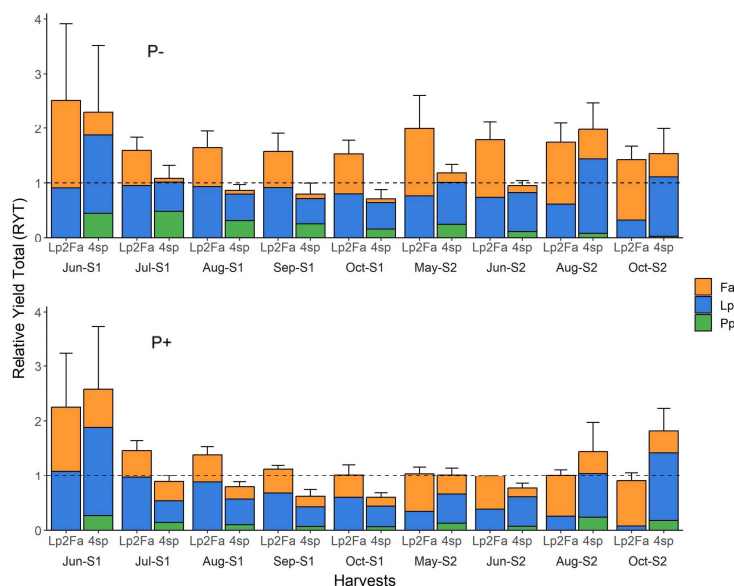
**Figure 1.** Field experiment at Unifarm, Wageningen, The Netherlands.

We measured the following variables:

- Biomass production
- Root traits
- Soil chemical and biological variables

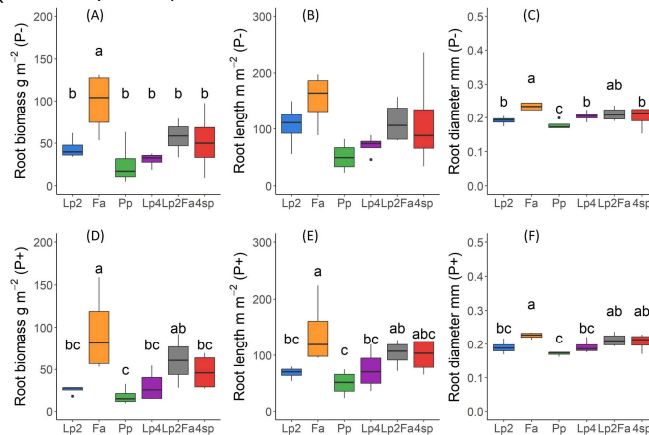
## Results

The combination of Lp2 and Fa resulted in higher cumulative yields and better performance than the monocultures (RYT) in the P- plots (Fig 2). No differences in cumulative biomass production was found when P fertilizer (P+) was applied.



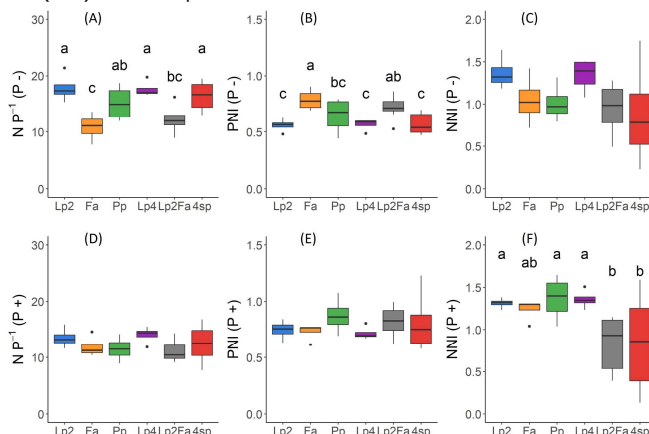
**Figure 2.** Relative yield total (RYT) of the LpFa and 4sp combinations in the P fertilized (P+) and P unfertilized (P-) plots at each harvest.

Fa showed a higher root biomass, length and diameter at deeper soil layers (15-40 cm) than Lp2.



**Figure 3.** Root traits in the deep soil (15 - 40 cm).

Fa withstood better P limitation as shown by the N P<sup>-1</sup> ratio and P nutrition index (PNI) in the P- plots.



**Figure 4.** Nutrient uptake in P unfertilized (P-) and P fertilized (P+) plots. PNI = P nutrition index and NNI = N nutrition index

No statistical differences were found in the soil chemical and biological variables studied both in the P+ and P- plots.

**Table 1.** Selected soil chemical variables and phosphatase activities (PAC and PAK) variables in P- plots. a = mg kg<sup>-1</sup> and b = PNP min<sup>-1</sup> g<sup>-1</sup>.

	Soil P <sup>a</sup>	pH	Microbial P <sup>a</sup>	PAC <sup>b</sup>	PAK <sup>b</sup>
ANOVA	p = 0.761	p = 0.165	p = 0.120	p = 0.369	p = 0.207
Lp2	0.023 ± 0.002	5.18 ± 0.06	0.42 ± 0.30	64.28 ± 3.92	13.11 ± 1.44
Fa	0.021 ± 0.002	5.28 ± 0.10	0.94 ± 0.23	61.69 ± 3.15	15.33 ± 2.14
Pp	0.024 ± 0.002	5.07 ± 0.08	n.a.	n.a.	n.a.
Lp4	0.024 ± 0.001	5.28 ± 0.08	n.a.	n.a.	n.a.
Lp2Fa	0.023 ± 0.001	5.36 ± 0.07	0.74 ± 0.17	52.49 ± 5.06	15.34 ± 0.66
4sp	0.024 ± 0.001	5.19 ± 0.06	1.22 ± 0.16	68.84 ± 10.70	18.04 ± 1.46

## Conclusions

- Lp2Fa combination may increase yields over monocultures under P limitation
- Root traits and P acquisition by roots explained the higher yields of Lp2Fa.
- P fertilization had a minor effect on yields but major on species performance