Effect of N fertilization on the biomass of soil fungal groups in production grasslands

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INTRODUCTION

Nutrient fertilizer application is thought to more likely favour saprotrophic microorganisms than obligate symbionts, such as arbuscular mycorrhizal fungi (AMF), which are generally not selected for by the plant host when nutrients are in excess, as is the case under management with fertilisation. Plant species diversity enriches AMF functional diversity, but the impact on saprotrophic fungi (SF) is variable.

QUESTION

The impact of different levels of both plant diversity and mineral N fertilizer application on the soil fungal community of production grasslands.

MATERIAL AND METHODS

Two field experiments (Alnarp and Lanna) were established in the south of Sweden. Both sites included a two-factorial experiment, i.e. four plant species mixtures (PM) and two N fertilization levels (0 and 60 kg ha^{-1} yr^{-1}), with an additional level (120 kg ha^{-1} yr^{-1}) in Alnarp. After 5 years soil (20 cm depth) and vegetation were sampled. SF and AMF biomass was estimated extracting phospho- and neutral lipid fatty acids (PLFAs and NLFAs) from soil (Frostegård et al., 1993).

PM1 - *Dactylis glomerata* (100%)

PM2 - *Phalaris arundinacea* (33%), *Festuca arundinacea* (33%), *Dactylis glomerata* (33%)

PM3 - *Medicago sativa* (12.5%), *Trifolium hybridum* (12.5%), *Trifolium repens* (12.5%), *Galega orientalis* (12.5%), PM2 (50%)

PM4 - Commercial diverse meadow seed mixture (from Pratensis) (75%), PM3 (25%)

RESULTS

	ALNARP		LANNA	
Soil pH	**5.78**	± **0.03**	4.14	± 0.02
SOM (%)	**5.48**	± **0.26**	3.81	± 0.05
C_s (%)	**2.77**	± **0.13**	1.68	± 0.03
N_s (%)	**0.22**	± **0.01**	0.12	± 0.00
Total.P_s (mg/100 g)	**148.18**	± **13.12**	89.66	± 4.14
Av.P (mg/100g)	**75.7**	± **4.67**	2.19	± 0.16
Clay (%)	6.47	± 0.21	**11.69**	± **0.18**
Sand (%)	**82.89**	± **0.45**	68.04	± 0.49
Silt (%)	10.64	± 0.33	**20.27**	± **0.40**
Bulk (g cm^{-3})	1.13	± 0.01	**1.25**	± **0.02**
Stones (%)	**18.56**	± **0.87**	6.00	± 0.37

Table 1: Properties of the soil samples: pH, soil organic matter (SOM), total carbon (C_s), total N (N_s), total phosphorous (Total.P_s), available phosphorous (Av.P_s), soil texture (% of sand, clay and silt), bulk density and % of stones. Bold means the average is significantly higher (t-student).

- Alnarp: higher pH, SOM, total C, N and P and available P; loamy sand texture.
- Lanna had higher bulk density and less % of stones; sandy loam texture.

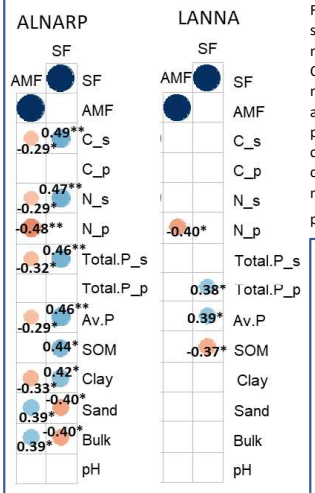

Figure 1: Correlations between saprotrophic fungi (SF) and arbuscular mycorrhizal fungi (AMF) with soil (total C, N and P, available P, soil organic matte, % of clay and sand, bulk density and pH) and plant (total C, N and P) properties. p=plant; s=soil. Blue and red colours indicate positive and negative correlations, respectively. White square means non significant correlation.

p<0.05* p<0.001 **

- AMF: Negatively correlated with plant N in both sites.
- SF: Positively correlated with available P in both sites.

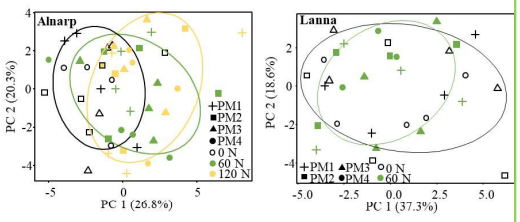

Figure 2: Principal component analysis of the PLFA dataset of the samples from Alnarp and Lanna, with four different plant mixtures (PM) and N applied (0, 60, 120 kg N ha^{-1}).

- Alnarp: Small impact of fertilization on soil microbial community structure
- Lanna: No impact of treatments

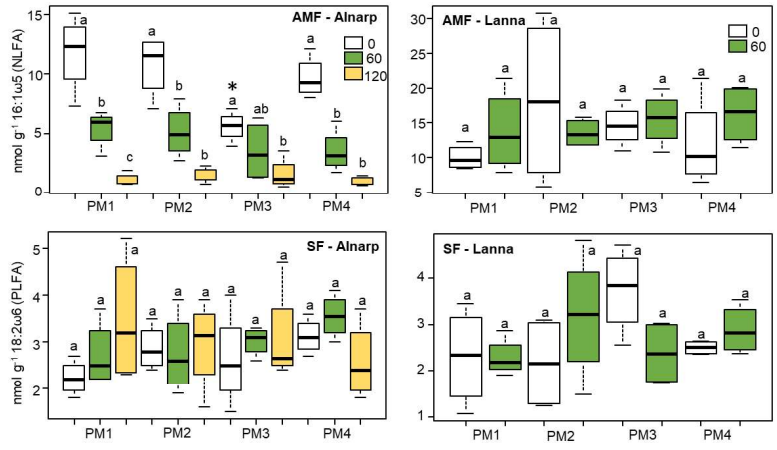

Figure 3: The amount (nmol g^{-1}) of biomarkers of arbuscular mycorrhizal fungi (AMF) and saprotrophic fungi (SF) in relation to fertilisation levels (0, 60, 120 kg ha^{-1}) and plant mixtures (PM) in the Alnarp and Lanna. Different letters and * indicate significant differences in fungal biomass under different fertilization levels and plant mixtures, respectively.

- Alnarp
  - AMF biomass decrease with N fertilization and under plant mixture 3 without fertilizer
- Lanna
  - Bigger AMF biomass, no impact of fertilization or plant mixture

CONCLUSION

Our findings suggest that the response of soil fungal biomass to mineral N fertilizer application has a strong site-specific component, and the reduction in the abundance of AMF, which was more sensitive than SF, only occur under specific soil and site conditions

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