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## Purple moor grass induces a rapid decrease of photosynthesis in young oak after forest clear-cutting

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## Introduction

The purple moor grass (*Molinia caerulea* (L.) Moench) is a well-known resource competitor to the detriment of tree regeneration in many boreal or temperate forests of the Northern hemisphere. This study aimed at investigating to what extent soil nitrogen capture in interaction with light availability drives the early establishment of competition between oak (*Quercus petraea* (Matt.) Liebl.) and *Molinia* seedlings.

## Experimental design

Two-year-old oaks were grown in 20 L pots, alone or in combination with *Molinia*, for two levels of light availability (11 and 55% of incident photosynthetically active radiations) in a greenhouse. Leaf photosynthesis measurements and soil <sup>15</sup>N-labelling were used to monitor changes in carbon assimilation and soil nitrogen uptake between and within species under well-watered conditions during early time of growth (Fig. 1).

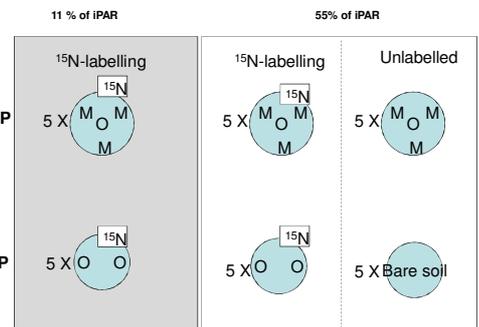


Fig. 1 Experimental set-up. O : oak ; M : *Molinia* ; <sup>15</sup>N : pot labeled with K<sup>15</sup>NO<sub>3</sub>. SP : sole-grown; MP : mixed plants receiving either 11% or 55% IPAR

## Results

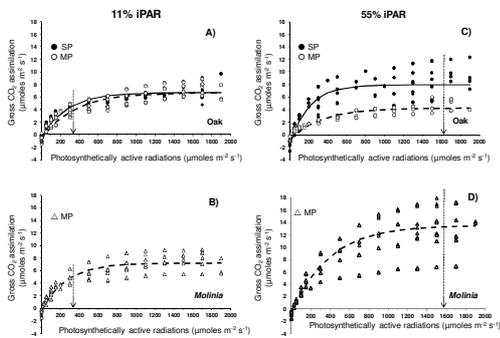


Fig. 2 Photosynthetic light response curves (μmol CO<sub>2</sub> m<sup>-2</sup> s<sup>-1</sup>) in oak (*Quercus petraea* (Matt.) Liebl.) seedlings (A and C) and *Molinia* (*Molinia caerulea* (L.) Moench) (B and D) leaves when oak was sole-grown (SP) or grown with *Molinia* (MP) under 11% or 55% IPAR. Points and lines correspond to experimental measurements and fitted equations, respectively. Dotted arrows indicate the levels of PAR reaching the canopy under 11% or 55% IPAR growing conditions

- Presence of *Molinia* had no significant effect on short-term oak seedling growth regardless of the light availability. However, increase in incident light resulted in strongly decreased photosynthesis capacity in oak. Meanwhile, photosynthesis capacity strongly increased in *Molinia* (Fig. 2).

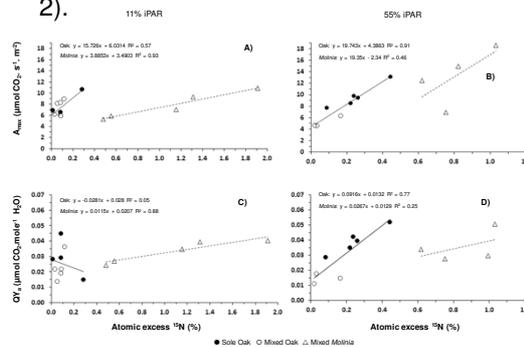


Fig. 3 Relationships between maximum gross assimilation (A<sub>max</sub>), apparent quantum yield (QY<sub>a</sub>) and atomic excess <sup>15</sup>N (%) in leaves in oak (*Quercus petraea* (Matt.) Liebl.) seedlings and *Molinia* (*Molinia caerulea* (L.) Moench) when oak was sole-grown (SP) or grown with *Molinia* (MP) under 11% (A and C) or 55% IPAR (B and D). Regression equations and coefficients for each species are listed into figures.

## Conclusion

A response model to explain such a behavior of oak grown with *Molinia* under unbalanced light resource may fit supply/demand theory (Davis et al. 1998). In our experimental design, there is a switch from a competition for light to a competition for below-ground resources. As *Molinia* can easily grow under a wide range of irradiance, growth in *Molinia* was strongly improved when light availability increased due to a larger photosynthetic capacity (especially A<sub>max</sub>). Improved photosynthesis increased shoot and root growth that, in turn, increased both N demand and subsequent N capture by *Molinia*. Relationships between parameters characterizing photosynthesis (maximal gross CO<sub>2</sub> assimilation (A<sub>max</sub>), apparent quantum yield (QY<sub>a</sub>)) and <sup>15</sup>N atomic excess (i.e. newly N taken up) in leaf in both species suggests that soil N availability as well as capacity to efficiently capture soil inorganic nitrogen might be one of the key-players among soil resources in driving the short-term establishment of dominance of species in an oak-*Molinia* mixture in the early phase of the regeneration, ultimately driving success or not of oak trees.

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