APPENDIX C

Analytical methods – Parameter estimation

Mycorrhizal colonization- Poisson likelihood for zero and not-zero counts with mean λ_i:

$$P(M = m) = \begin{cases} \varphi + (1-\varphi)e^{-\lambda} \ for\ m = 0 \\ (1-\varphi)\dfrac{1}{m!}\lambda^m e^{-\lambda} \ for\ m > 0 \end{cases}$$

And process models:

$$logit(\varphi_i) \sim Normal\ (\omega 1_{plot(i),year(i)} + \omega 2\ plant\ height_i\ ,\ \sigma^2_{\phi})$$

$$log(\lambda_i) \sim Normal\ (\alpha 1_{plot(i),year(i)} + \alpha 2_{habitat(i)}\ light_{plot(i),year(i)} + \alpha 3\ soil\ moisture_{plot(i),year(i)},\ \sigma^2_{\lambda})$$

To estimate the probability of zero colonization, φ, we included a random effect for each plot and year, $\omega 1_{plot(i),year(i)}$, that would then reflect the particular mycorrhizal community associated to that plot and year (for which we did not have any specific information). This parameter was estimated from a prior distribution, $\omega 1_{plot,year} \sim Normal(\omega 1_m,\ \sigma_\omega^2)$, with $\omega 1_m \sim Normal(0,10000)$ and $\sigma_\omega \sim Uniform(0,100)$. The fixed effect associated with initial plant height, $\omega 2$, was estimated from a non-informative prior distribution, $\omega 2 \sim Normal(0,10000)$. Individual random effects were also included, $1/\sigma_\phi^2 \sim Gamma(0.01,0.01)$.

The mean of the percent colonization, λ, was estimated as a function of: plot and year random effects, $\alpha 1_{plot,year} \sim Normal(\alpha 1_m,\ \sigma_\alpha^2)$, with $\alpha 1_m \sim Normal(0,10000)$ and $\sigma_\alpha \sim Uniform(0,100)$; of light levels, $\alpha 2_{habitat}$, which estimated independently for each of our habitats, canopy and gap, $\alpha 2_{habitat} \sim Normal(0,10000)$; and of soil moisture, $\alpha 3 \sim Normal(0,10000)$. Here we also included individual random effects, $1/\sigma_\lambda^2 \sim Gamma(0.01,0.01)$.

Growth rates- Normal likelihood:

$$Growth_i \sim Normal(G_i,\ \sigma_G^2)$$

And process model:

$$G_i = gmax_i \frac{light_i - lo_i}{light_i + \theta_i} + \delta\ soil\ moisture_{plot(i),year(i)}$$

$gmax_i$ represents the maximum growth rate (asymptote) for an individual, and is modeled as a function of the individuals initial plant height and individual random effects, $gmax_i \sim Normal(\gamma 1 + \gamma 2\ plant\ height_i,\ \sigma_{gmax}^2)$, with $\gamma * \sim Normal(0,10000)$ and $1/\sigma_{gmax}^2 \sim Gamma(0.01,0.01)$. The compensation point, minimum amount of light necessary to start growth, *lo*, was estimated as a function of plot's total inorganic nitrogen (NO_3+NH_4) and individual random effects, $lo_i \sim Normal(\kappa 1 + \kappa 2\ Nitrogen_{plot(i)},\ \sigma_{lo}^2)$, with $\kappa * \sim Normal(0,10000)$ and $1/\sigma_{lo}^2 \sim Gamma(0.01,0.01)$. And the half saturation parameter, θ, was estimated as a function of percent mycorrhizal colonization and individual random effects, $\theta_i \sim Normal(\mu 1 + \mu 2\ M_{AMFi} + \mu 3\ M_{EMFi},\ \sigma_\theta^2)$, where $\mu * \sim Normal(0,10000)$ and $1/\sigma_\theta^2 \sim Gamma(0.01,0.01)$. The fixed effects associated with soil moisture, δ, were estimated as $\delta \sim Normal(0,10000)$, and the variance associated to the likelihood was again assigned a non-informative prior distribution $1/\sigma_G^2 \sim Gamma(0.01,0.01)$

Survival- Binomial likelihood:

$$N2_{plot,year} \sim Binomial(N1_{plot,year},\ p_{plot,year})$$

And process model:

$$logit(p_{plot,year}) = \beta 1 + \beta 2\ G_{Pplot,year} + \beta 3_{habitat}\ light_{plot,year} + \beta 4\ soil\ moisture_{plot,year} + \beta 5\ M_{P\text{-}}$$

$_{AMFplot,year} + \beta 6\ M_{P\text{-}EMFplot,year}$

The probability of surviving, $p_{plot,year}$, was estimated as a function of several intrinsic (growth rate and mycorrhizal colonization) and extrinsic (light and soil moisture availability) factors to account for complex interactions and indirect effects of the driving variables. The intercept and fixed effects coefficients were estimated as $\beta_* \sim Normal(0,10000)$.

We tried several models that differed on the inclusion or not, and their allocation (e.g., nitrogen affecting *lo*, θ or *gmax*) and used Predicted Loss (Gelfand and Ghosh 1998) for our model selection criteria as this full model was to complicated to have a reliable estimated of the effective number of parameters necessary to calculate DIC (Deviance Information Criteria; Spiegelhalter et al. 2000). Posterior Predicted Loss is based on the prediction and does not penalize based on the number of parameters but based on the predicted variance. Predicted loss is estimated by adding the goodness of fit, the error sum of squares, and the predictive variance, which would account for overfitting.

LITERATURE CITED

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Spiegelhalter, D. J., Best, N., Carlin, B.P., and Linde, A.V.D. 2000. Bayesian measures of model complexity and fit. Journal of the Royal Statistical Society: Series B (Statistical Methodology) 64:583–639.