Comment on bg-2022-165
Anonymous Referee #1

The study uses experiments and models to assess ectomycorrhizal fungal (EMF) biomass production and turnover during five months in a Norway spruce forest. It is combining an experimental series on the EMF production with localized N or P amendments with modelling and testing both for dependency on the growing season. It reads smoothly and the content is easy to follow. Significance of the work is already given by the importance of the host tree species and its role for boreal geochemical cycles.

Novel aspects are in acknowledging that turnover rates of fungal hyphae might differ according to season and combining phosphorus fertilization of a P-limited forest with testing localized N and P amendments at the same time. Its results confirm and extend earlier findings on EMF behaviour under different P and N regimes and are well summarized in the abstract (L21-L32).

However, there are discrepancies between the expectations the title stirs by its wording ("fungal biomass"), the aim formulated in the introduction (L128-L130), the hypotheses (L146-152) and the methods. Wording and presentation of goals of the manuscript should be unified and unique aims/results be highlighted: 1) please choose a term that can be derived from the methods and use it uniformly, e.g., “EMF biomass production”, because the distinction from similar terms (“fungal biomass”) throughout the manuscript is unclear. 2) the hypotheses are unconnected bullet-points, which is making them very generic; please integrate them into the last part of the introduction together with the reasoning behind them, especially as a body of prior studies followed similar questions. 3) turnover/seasonality was a central aspect in the study, it should be involved in a hypothesis, too.

Specific Comments:
- Title: “fungal biomass production” includes all types of fungal lifestyles, including the quantitatively very important group of saprotrophs. However, most of the manuscript uses the term “EMF production”. Therefore, I suggest to change the wording or explain in detail in the text how EMF production could be a proxy for other fungal lifestyles.

- Abstract:

L12: To me, it is not clear, how you arrive at “fungal production” here, when you specify in L10 that you estimated EMF production. This should be clarified throughout the manuscript.

- Introduction:

L86: EMM abbreviation is not explained. Do you mean extrametrical mycelium? (same in L502, L569)

L97: Ekblad et al. 2016 do not use the term fungal standing biomass

- Methods:

Experiments: was there any kind of control to examine the share of non-EMF fungi in the ingrowth bags, like ingrowth bags in a root-free area of soil, or amplicon sequencing of the EMF that were found in the ingrowth bags? – It would be very helpful to have clear knowledge to which degree this experiment was able to capture the term “EMF biomass production” used throughout the manuscript.

L188-190: drilling a new hole and placing an ingrowth bag in it and re-placing an ingrowth bag by putting it into an existing hole seem to be two different kinds of disturbance. Is there any knowledge on this?

Models: I am not versed in modelling and Bayesian inference, wherefore I could not review parts based on this in detail. However, the models seem well thought trough. Unfortunately, there is no explanation of data sources. The statements “the methodology allows us to draw information from publications” (L313) and “Priors for δ□□□k and δ□□□k were derived from the literature” (L322) are too vague. How was this done and which publications were used? Please explicitly state if this is based on data from Hagenbo et al. 2017 (L334) or new estimations. -- All data sources should be clarified and the data made available.
- Results:

L380: do you mean “… apatite, urea, and not amended meshbags”? 

L389-294 / Fig. 2: Please mention the number of data-points for each boxplot, either by plotting or mentioning n in the figure caption. As I understood the methods section, each box in figure 2 is resembling three samples (one pooled sample per plot), accordingly n = 3. In this case, a boxplot is not very useful in summarizing the data and another type of graph could better be chosen.

L398-403 / Fig. 3: having connecting lines between the points, on first glance indicates a time series with one starting point, but in fact there are for example several 30 and 60 day starting points and the samples are independent of each other. Therefore, deleting the lines (or making them dotted) would be useful. Additionally, labelling the x-axis with “incubation time of ingrowth bags [days]” would also help for understanding.

- Discussion:

L481-482: “The fact that more incubation periods and a larger number of bags were used makes the present study more reliable.” Please clarify: more reliable than what study? And what is the difference implied by “more … periods” and “larger number”?

L486: the term “extramatrical mycelium” has not been introduced in the text, so far.

L486-487 “P as a nutrient regulating fungal growth in boreal forest was not reported before”: Please exactly define what fungal growth stands for in this case or reword for avoiding conflicts with earlier studies. For example, Aleida et al. 2019 (ref. in this manuscript) already wrote for the same forest: “Soil EMF communities responded more strongly to P than to N” which can be read as P is regulating fungal fungal growth. Not to mention the body of literature therein: “Ekblad et al. (1995) found that the production of extramatrical mycelium peaked under low P conditions. In a field study comparing Norway spruce (Picea albies) forests of varying P status, Rosenstock et al. (2016) observed greatly enhanced EMF biomass from ingrowth meshbags in the P limited forest [...] in P-limited forests, fungal biomass is enhanced by the presence of mineral P sources like apatite (Hagerberg et al., 2003; Berner et al., 2012; Rosenstock et al., 2016). Bahr et al. (2015) reported that apatite addition stimulated ingrowth of EMF in meshbags, especially in N-fertilized plots.” (Almeida et al. 2019, https://doi.org/10.1016/j.funeco.2018.05.008). Why aren’t those references seen as reports of P as nutrient which is regulating fungal growth?
L504: It would be worth mentioning that an independent second method measuring the decrease in belowground C allocation due to P is needed for verification in further studies.

Technical corrections:

L21: “EMF and was” – missing word

L65: missing period

L118: EFM?

L389-294 / Fig. 2: please label left and right panels (a, b). Remove the cluttering design of R-ggplot’s standard output (grid lines, grey facet-boxes. Y-axis label: what is “per g” referring to? Quartz? Please choose a more exact way to label the y-axis like “µg [Ergosterol] / µg [...]”

L398-403 / Fig. 3: Remove the legend and explain in the caption. Remove the cluttering design of R-ggplot’s standard output (grid lines, grey facet-boxes. Y-axis label: what is “per g” referring to? Quartz? Please choose a more exact way to label the y-axis like “µg [Ergosterol] / µg [...]”

L604 typo: not --> no