Cover letter

Dear editors,

Thank you for your letter and the constructive suggestions from the reviewers regarding our manuscript. These comments are invaluable and will greatly assist us in revising and improving our paper. In light of the suggestions and the reviewers' comments, we have revised the paper entitled ***"Effect of straw retention and mineral fertilization on P speciation and P-transformation microorganisms in water extractable colloids of a Vertisol" (Manuscript number: EGUSPHERE-2024-983)***. The revised portion are marked in track change in the manuscript. Appended to this letter is our point-by-point response to the comments raised by the reviewers. If you have any questions regarding this paper, please do not hesitate to contact us.

We also would like to thank you for allowing us to resubmit a revised copy of the manuscript and hope that the revised manuscript will be acceptable for publication in ***Biogeosciences***.
Looking forward to hearing from you as soon as possible.

Your Sincerely,
Xiaoqian Jiang

Response to Reviewer Comments

Responses to Reviewer 1:

Comments to the Author

This revised manuscript has significantly improved, but many minor construction mistakes and grammar issues need to be carefully and thoroughly revised. Therefore, the recommendation for this manuscript at this stage is a minor revision.

Response: ***We thank the reviewers for their valuable comments, which have greatly contributed to the improvement of the manuscript. We have addressed all suggestions and comments raised by the reviewers in the revised version. Below, please find our detailed responses to the comments.***

Comment # 1:

Abstract

Line 26: increasing which P? Total P I guess?

Response: ***Thank you for your suggestion. We have added "total P" in Line26.***

Line 22-26：In bulk soil, mineral fertilization led to increases in the levels of total P, available P, acid phosphatase (ACP), high-activity inorganic P fractions (Ca2-P, Ca8-P, Al-P, and Fe-P) and organic P (orthophosphate monoesters and orthophosphate diesters), but significantly decreased the abundances of P cycling genes including P mineralization, P-starvation response regulation, P-uptake and transport by decreasing soil pH and increasing total P in bulk soil.

Comment # 2:

Line 29: Could you please specify 'change'?

Response: ***Thank you for your suggestion. We have revised it as suggested.***

Line 28-30: Furthermore, straw retention caused significant differences of relative abundances for more P cycling genes between WECs and bulk soils than mineral fertilization.

Comment # 3:

Line 31: It will be better to add one summary sentence. 'Thus, …' only contains the results from straw retention, lack of context regarding to the mineral fertilization as you mentioned in the title.

Response: ***Thank you for pointing it out. We have added the summary sentence.***

Line 31-34: Thus, mineral fertilization reduced microbial P-solubilizing and mineralizing capacity in bulk soil. Straw retention could potentially accelerate the turnover, mobility and availability of P by increasing the nutrient contents and P mineralizing capacity at the microscopic colloidal scale.

Comment # 4:

Material and Methods

Line 146: If you decide to use abbreviations like SOC, TN here, you need to clarify them at the beginning of your manuscript and use the abbreviations constantly throughout the manuscript. In the abstract as well.

Response: ***We have clarified the abbreviations at the beginning of the manuscript as follows:***

SOC: Soil Organic Carbon

TN: Total Nitrogen

Additionally, we have ensured that these abbreviations are used consistently throughout the manuscript.

Comment # 5:

Line 155: Abbreviation? Check throughout the whole manuscript.

Response: ***Thank you for pointing that out. We have deleted the abbreviation (DOC) in Line 155.***

Comment # 6:

6 Discussion

The subtitles are informative. The construction of the discussion has been remarkedly improved. But there are still many minor grammar and logical issues. Fig.2 and Fig. 4 need to be recognizable to readers, so I suggest greatly increasing the font size.

Response: ***It is a good suggestion. We have increased the font size in Fig. 2 and Fig. 4 to enhance readability.***

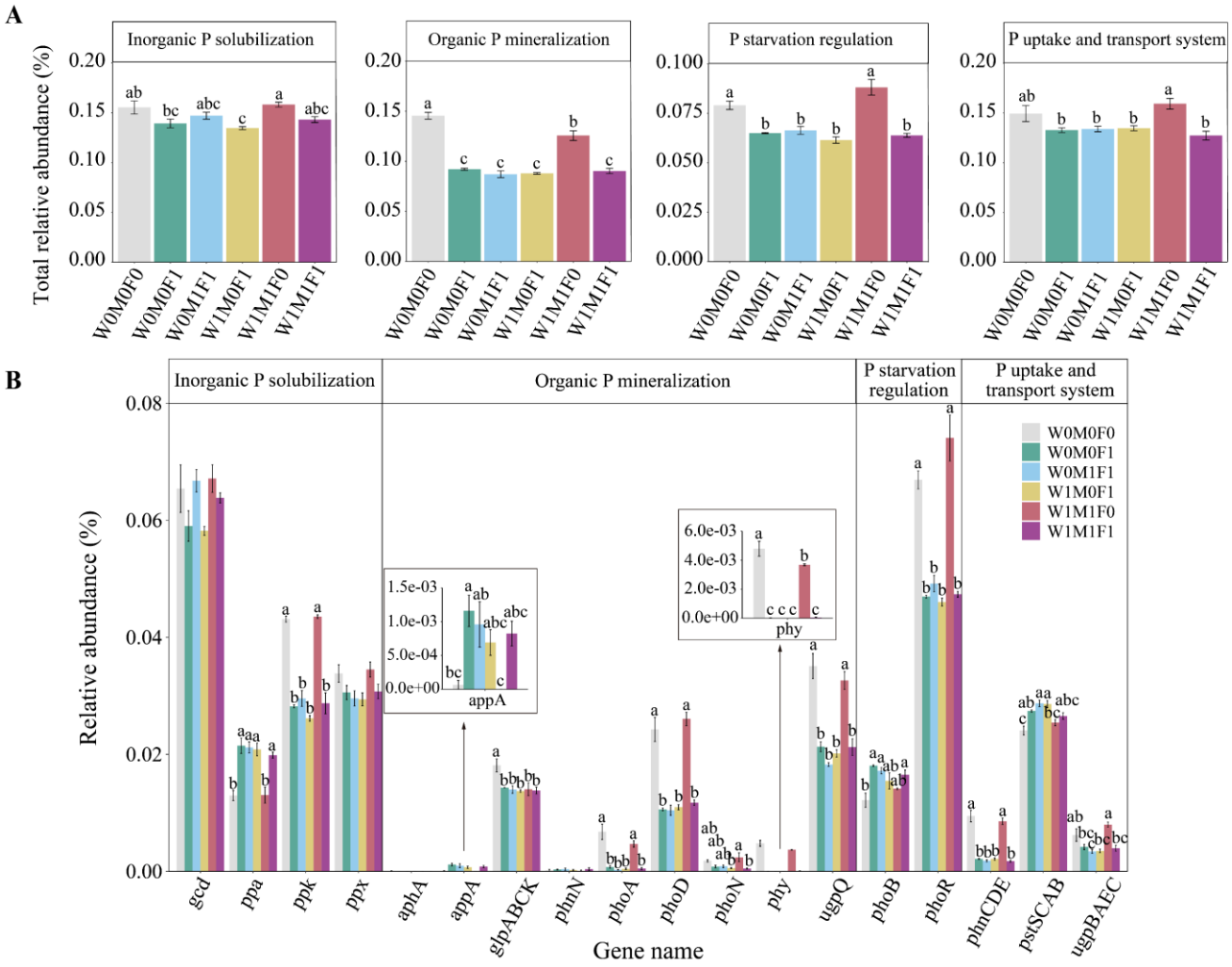

Fig. 2 Relative abundance of genes responsible for microbial inorganic P solubilization, organic P-mineralization, P-starvation regulation, and P-uptake and transport (A) and the individual gene relative abundance (B) in bulk soil

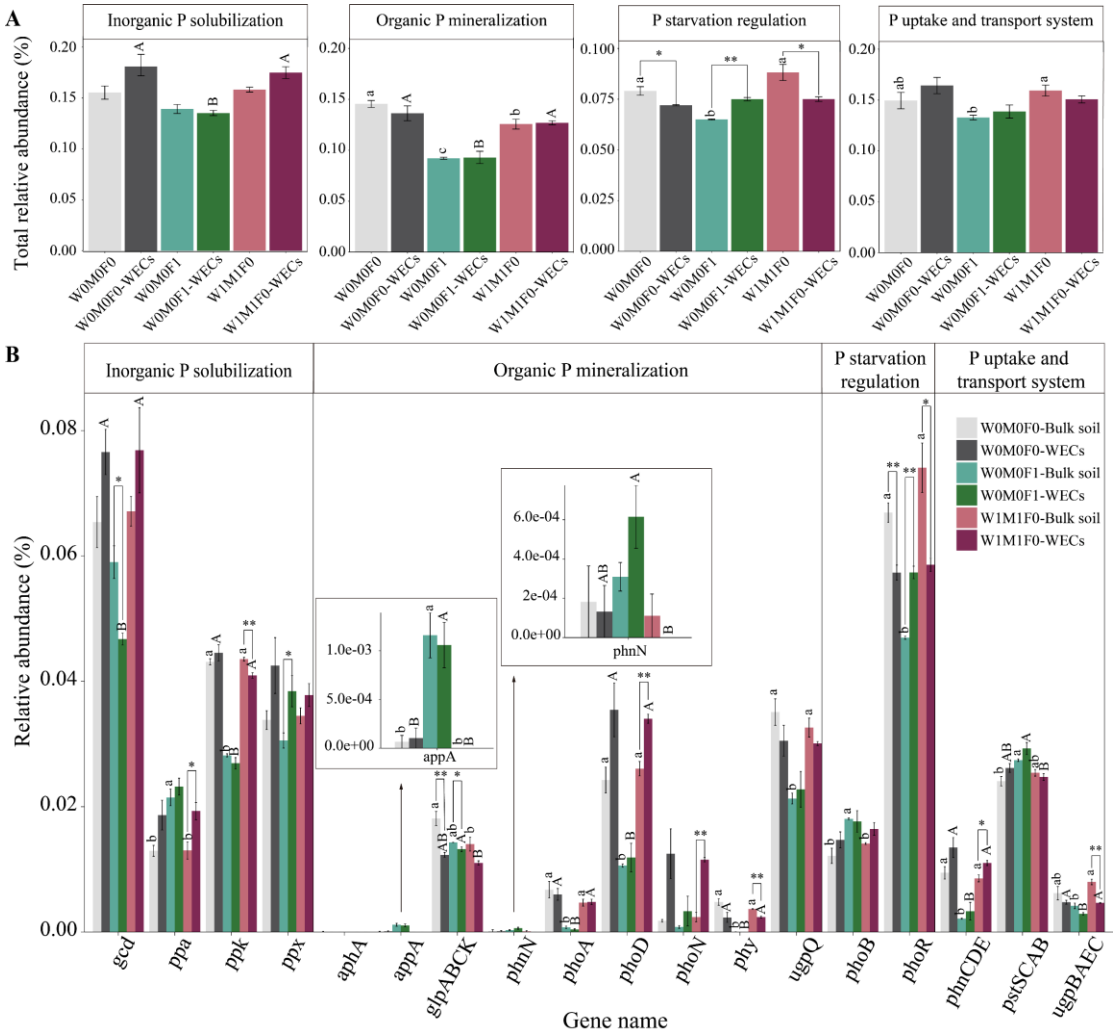

Fig. 4 Relative abundance of genes responsible for microbial inorganic P solubilization, organic P-mineralization, P-starvation regulation, and P-uptake and transport (A) and the individual gene relative abundance (B) in bulk soil and water-extractable colloids (WECs) among the W0M0F0, W0M0F1, and W1M1F0 treatments

Comment # 7:

Line 333-334: For me, 'mineral fertilization decreased soil pH, increase soil TP, thus decreasing the …' has a logical issue. I think these are parallel results obtained from Table 1 and Fig. 2, the causal relationship needs correlation results like Fig. 6.

Response: ***Thank you for pointing that out. We have added the Fig.6 in Line 335.***

Line 334-335: In bulk soil, mineral fertilization decreased soil pH, increased soil TP, thus decreasing the abundances of P transformation genes (Fig. 6).

Comment # 8:

Line 338: Not relevant to your core topic

Response: ***OK. We have modified the description in Line 336-339.***

Line 336-339: The significant increases in soil organic matter and nutrients concentrations under mineral fertilization might be closely associated with the enhanced organic matter from crop residues, root exudates and the input of fertilizers (Tong et al., 2019).

Comment # 9:

Line 407: See comments above.

Response: ***OK. We have revised it as suggested.***

Line 407-409: Straw retention caused significant differences of relative abundances for more P cycling genes between WECs and bulk soils than mineral fertilization (Fig. 4 B) and led to a significant increase of phoD gene in WECs compared with bulk soils.

Comment # 10:

Line 346-353: Where is your own data? Please reference it and demonstrate it.

Response: ***Thank you for your suggestion. We have referenced our data in the manuscript and demonstrated it in Fig. 2.***

Line 348-353: Therefore, in the control and straw retention treatments with lower P concentrations, higher abundances of phoD, phy, phoR, and ugpQ genes were observed in comparison with the mineral fertilization treatments (Fig. 2). Consistent with previous findings (Ikoyi et al., 2018; Dai et al., 2020), mineral fertilization alone or combined with straw retention reduced the abundance of genes about P mineralization (e.g., phoA, phoD, phy, ugpQ), P-starvation regulation (e.g., phoR), P-uptake and transport (e.g., phnCDE) significantly (Fig. 2).

Comment # 11:

Conclusion

The conclusion section should contain the clear main results the same as the Abstract. The summarized paragraphs at the end of each Discussion part can be summarized here. Meanwhile, the conclusion should explain the contribution of your research to the knowledge gap you introduced at the start of the abstract and introduction, and some perspectives if there are any.

Response: ***Thank you for your suggestion. We have revised the conclusion.***

Line 454-464: **This study provides systematic insights into P speciation and P transformation microorganisms at the soil microparticle scale (WECs) compared with bulk soil under straw retention and mineral fertilization. Mineral fertilization decreased soil pH, increased soil TP, thus restricting genes involved in P transformation in bulk soils. Straw retention caused more obvious impact on the accumulation of organic C and total N of WECs and the greater change of P cycling genes between WECs and bulk soils even than mineral fertilization. The significant increase in the abundance of gene encoding for alkaline phosphatase (*phoD*) and *phoD*-harbouring *Proteobacteria* for WECs compared with bulk soils indicated the improved P mineralization capacity of WECs under straw retention. This information provided strong evidences that straw retention could potentially affect the turnover, mobility and availability of P mainly by changing the physicochemical and biochemical processes involved in the P transformation of soil colloids.**