**Detailed Responses:**

Thank you very much for your careful reading and for providing many professional and useful suggestions. Based on your feedback, we have revised the manuscript and believe that the quality of the revised manuscript has been enhanced. We hope that you are satisfied with the revised manuscript.

General Comments

I enjoyed reading the manuscript 'Conquering Soil Acidification The Synergistic Effects of Basalt Powder, Lime, and PAM', studied in Jiangxi Province, China.

One important concern is the standard of writing of the manuscript. I could say poor structure of sentences through out the manuscript. It requires restructuring the sentences for easy to   read, clear and concise of the meaning and keep the bonding among the sentences in a paragraph and also paragraphs to sections.

Abstract

The abstract is to be clear and concise aligning with the title of the   manuscript. it could be improved keeping in mind the classical structure of a good abstract.

Response/action: Following your suggestions, we have revised the abstract to ensure a clearer structure. Please see Page 2 line 26-43

26   Soil acidification is a prevalent issue affecting soils globally, characterized by

27   widespread distribution. Acidic soils typically exhibit low pH levels and a depletion of

28   essential cations such as K^+, Ca^{2+}, Na^+, and Mg^{2+}, resulting in diminished soil fertility.

29   Additionally, the presence of free aluminum ions under acidic conditions can be

30   absorbed by crops and leading to toxicity. To address these challenges, this study

31   investigates the efficiency of a combined application of basalt powder, CaO, and

32   polyacrylamide (PAM) in ameliorating soil acidification and its associated problems.

33 The X-ray diffraction (XRD) and X-ray fluorescence spectroscopy (XRF) analysis of

34 basalt powder revealed its chemical and mineral composition, demonstrating its

35 potential for soil nutrient supplementation. The experimental results indicated that

36 basalt powder and CaO in 8/2 and 7/3 ratios optimally adjusted acidic soil pH from 4.16

37 to near 7. The 8/2 ratio, especially with the addition of PAM, significantly enhanced

38 soil resistance to acid damage. Additionally, the application of mixed amendment

39 significantly reduced salinity ion loss (decreased the leaching of K^+ by 58.1%, Na^+ by

40 42.9%, and Mg^{2+} by 26.3%) and effectively inhibited Al^{3+} release (below the detectable

41 limit). The study reveals the mechanisms of elements retention in soil with mixed

42 amendment and suggests that the mixed amendment has high potential in acid soil

43 improvement.

L26-27 introductory sentence -good start.

L28-29 – the objectives is not clear. Is it 'to investigate the potential improvement of acid yellow soil' or ' to investigate the combined application of basalt powder, lime, and polyacrylamide (PAM) for the improvement, ,, ,,, "

Response/action: Our goal is to investigate the ameliorative effects of the combined application of basalt powder, CaO, and polyacrylamide on the deficiencies of acidic yellow soil, including low pH, loss of exchangeable base cations, poor nutrition, and aluminum toxicity.

L30-31 - Do you mean CaO as Lime, then introduce it at earlier. Why these sentence is here? Is the methods to establish the objectives?   Need to be linked with objectices?

Response/action: Apologies for the oversight; CaO is a form of lime, which we have corrected in the manuscript.

L-32 data analysis – XRF is data analysis tool rewrite it.

Response/action: X-ray fluorescence spectroscopy (XRF) is an analytical measurement method, not a data analysis method. It determines the chemical composition of a sample based on the wavelength and intensity of the characteristic X-

rays emitted when the sample is excited by high-energy X-rays. In addition, complementary tests for mineral composition such as X-ray diffraction (XRD) have also been conducted. Please see Page 7 line156-158

155	2.2. Methods
156	The potential for fertility replenishment is assessed by analyzing the chemical and
157	mineral composition of basalt powder through X-ray diffraction (XRD) and X-ray
158	fluorescence (XRF) analyses. The assessment of pH values is achieved by comparing

L-33-41 Results – rearrange and rewrite the results to support the objectives, not only presenting the data.

Response/action: We adapted the results(Please see Page 2 line 35-43)to correspond to the previous research objectives(Please see Page 2 line 30-35)

30	absorbed by crops and leading to toxicity. To address these challenges, this study
31	investigates the efficiency of a combined application of basalt powder, CaO, and
32	polyacrylamide (PAM) in ameliorating soil acidification and its associated problems.
33	The X-ray diffraction (XRD) and X-ray fluorescence spectroscopy (XRF) analysis of
34	basalt powder revealed its chemical and mineral composition, demonstrating its
35	potential for soil nutrient supplementation. The experimental results indicated that

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36	basalt powder and CaO in 8/2 and 7/3 ratios optimally adjusted acidic soil pH from 4.16
37	to near 7. The 8/2 ratio, especially with the addition of PAM, significantly enhanced
38	soil resistance to acid damage. Additionally, the application of mixed amendment
39	significantly reduced salinity ion loss (decreased the leaching of K^+ by 58.1%, Na^+ by
40	42.9%, and Mg^{2+} by 26.3%) and effectively inhibited Al^{3+} release (below the detectable
41	limit). The study reveals the mechanisms of elements retention in soil with mixed
42	amendment and suggests that the mixed amendment has high potential in acid soil
43	improvement.

L-41- 43 - Outcomes – rewrite it to be focused.

Response/action: We have rewritten the results section. Please see Page 2 line 35-43

Introduction

L-46-49 – This sort of sentence structure is used all-around the manuscript. These are not easy to read and understand and free flow of the topic. Please rewrite these sentences to make it concise and clear meaning.

ses of Meanwhile, consequently, Simultaneously, meanwhile ,,,, with thereby ' phrase does not make the text readers friendly for a human. Paragraph structure- make a topic sentence followed by the relevant information.

Response/action: We have revised the language structure of the manuscript. Such as: Page 3 line 57-68.

57	Soil acidification, caused by increased concentrations of H^+ or Al^{3+}, presents
58	several major issues. Firstly, the soil acidification causes the leaching of base cations
59	and the degradation of nutrients. For example, the competition between H^+ and Al^{3+}
60	ions and essential nutrients such as Ca^{2+}, Mg^{2+}, K^+, Na^+, and other nutrient ions for
61	exchange sites leads to leaching and a decline in soil fertility (Alekseeva et al., 2011;
62	Holland et al., 2018; Huang et al., 2017). Secondly, acidic conditions increase
63	aluminum solubility, making plants more likely to absorb aluminum ions while
64	hindering the uptake of key nutrients like Ca^{2+} and Mg^{2+}, leading to toxicity (Alekseeva
65	et al., 2011; Goulding, 2016; Nguyen, 2023). Thirdly, soil acidification activates heavy
66	metal ions in the soil, raising the risk of heavy metal pollution (Hu et al., 2024). It also
67	decreases organic matter content and weakens the soil structure, making it susceptible
68	to degradation (Xu, 2015).

Research gap – discuss the relevant topics in introduction and narrow down into the research gap. Link the research gap with the objectives of the present study.

Response/action: We made changes to the manuscript. Please see Page 6 line 133-144. More details will be in the revised manuscript!

133 These amendments are frequently applied in combination to more
134 comprehensively improve acidic soil properties (Zhang et al., 2023). For instance, Guo
135 (2020) reported that combining limestone, zeolite, phosphate rock, calcium magnesium
136 phosphate, mushroom residue, or pig manure in multi-metal contaminated acidic soils
137 can reduce the bioavailability of heavy metals, increase soil pH, enhance fertility, and
138 improve bacterial diversity, thus promoting the recovery of soil quality. Theoretically,
139 these materials have complementary strengths and weaknesses. Herein, widely used
140 materials including CaO, basalt powder, and PAM were selected to prepare a mixed
141 amendments on acidic soil improvement. The aim of this study was to explore the
142 effects and underlying mechanisms of the mixed amendment application on typical acid
143 yellow soil, especially in the increase of soil pH values, leaching of exchangeable base
144 cations, potential for fertility replenishment, and reducing of aluminum toxicity.

Material and Methods

Soil - L120 reference?

Response/action: Are you referring to the reference for the pH value? The pH value of the sample was measured by us. The content of organic matter is data obtained by the research group using the same batch of soil samples.

If you are referring to the soil pH data from Pingxiang, Jiangxi, China, here is our explanation:

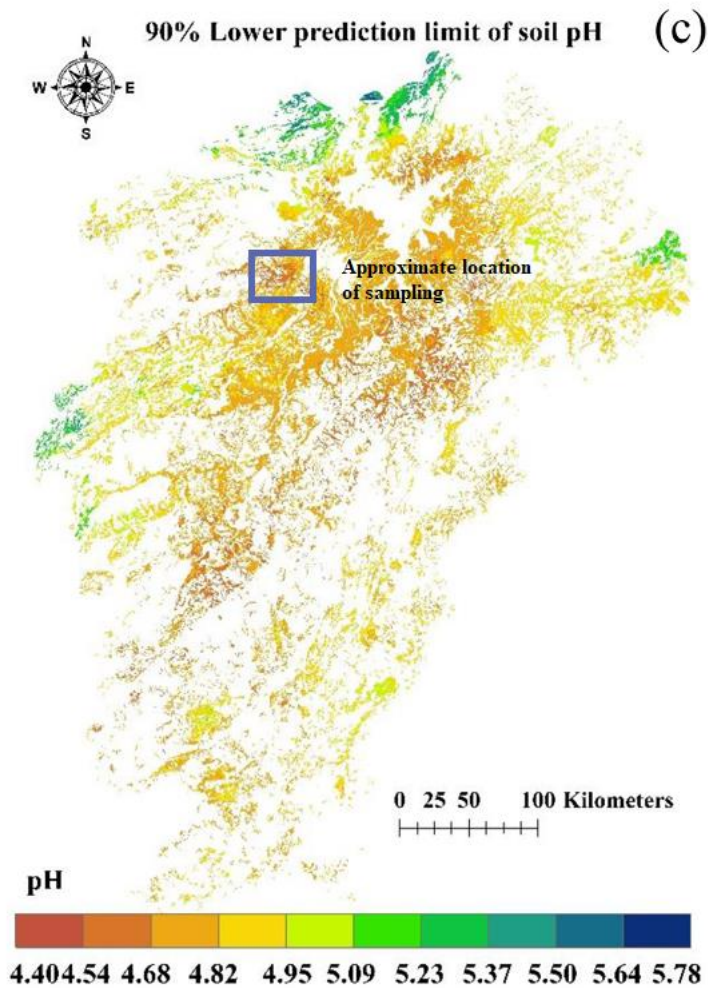
Hu et al. (2024) utilized data from 13,424 surface soil samples in Jiangxi Province, combined with digital soil mapping techniques and machine learning methods, to produce a soil pH map with a 30m resolution. The average pH value of the topsoil in the agricultural fields of this region is 5.21, indicating a severe soil acidification issue (Hu et al., 2024). Specifically, Pingxiang, Jiangxi is located at the position indicated in the following figure (from Hu et al., 2024), with pH values ranging between 4 and 5.

90% Lower prediction limit of soil pH (c)

Approximate location of sampling

0 25 50   100 Kilometers

pH

4.40 4.54 4.68 4.82 4.95 5.09 5.23 5.37 5.50 5.64 5.78

References cited:

Hu, B., Xie, M., Shi, Z., Li, H., Chen, S., Wang, Z., Zhou, Y., Ni, H., Geng, Y., Zhu, Q., and Zhang, X.: Fine-resolution mapping of cropland topsoil pH of Southern China and its environmental application, Geoderma, 442, 116798, https://doi.org/10.1016/j.geoderma.2024.116798, 2024.

Amendments – purchasing procedure is not good use in academic writing.

L124-134 - Make it simplified.

Response/action: Thanks to your suggestion, we have modified this section. Put XRF analysis in the methods. Please see Page 7 line 151-154.

> 151   The experiment used CaO with a purity over 98% and polyacrylamide with a
> 152   molecular weight exceeding 3 million. The basalt powder, with a pH of 9.71 and
> 153   particle size under 38 μm, was made from rocks (Figure 1.) collected in Hui li, Sichuan,
> 154   China.

Results

In Results, the manuscript contains several concepts, which could be presented in Introduction to find the research gap and link the objectives with the gap. For example, L 190 196 is not results.

Response/action: Thanks to your suggestion, our revised manuscript gives an explanation of the concept in the methods section. Please see Page 7 line 156-167

155	2.2. Methods
156	The potential for fertility replenishment is assessed by analyzing the chemical and
157	mineral composition of basalt powder through X-ray diffraction (XRD) and X-ray
158	fluorescence (XRF) analyses. The assessment of pH values is achieved by comparing
159	the numerical changes before and after the addition of materials, using different ratios
160	of CaO and basalt. The optimal effect is determined by adjusting the pH value to a near-
161	neutral range (6.5-7.5), suitable for the growth of most plants and microorganisms(Tang
162	et al., 2013; Fan et al., 2018). Additionally, the acid damage capacity, which is the
163	amount of acid required to lower the soil pH to 3.5 ($\mu mol \cdot g-1$, adding common acid
164	rain acids such as H_2SO_4)(Wang, Jinghua, 1994; Ma et al., 2020), is used to evaluate
165	the soil's resistance to acidification. The leaching of exchangeable base cations and
166	aluminum ions is achieved by conducting leaching experiments to measure the
167	concentrations of K^+, Na^+, Ca^{2+} and Mg^{2+}.

Statistical analysis is a good way to present the data (L 30). There could be several combination of experiments, based on CaO with various proportion (L30). Present these comparative studies and suggest from these the effective combination to gain the outcome.

Response/action: We will incorporate your suggestions in subsequent revisions.

Discussion

In discussion, relate the results to establish the objectives. It could be referred or refuted arguments using other references.

Response/action: We have made the revisions in the manuscript. Such as Page 14-15

339 the adjustment of soil pH levels. Additionally, the addition of basalt powder can

340 increase the soil pH and soil's acid damage capacity, too, because the basalt powder

341 reacts with carbonic acid in the soil solution, neutralizing the soil acid during this

342 process (Swoboda et al., 2022; Dietzen and Rosing, 2023). However, it is important to

Conclusion

As I understood, it was a comparative study among combination of basalt powder, CaO, and PAM mixed modifier on soil enhancement. Rewrite the conclusion that the objectives were achieved.

We have revised the conclusion part and emphasized that the developed mixed additives can achieve the desired goal of acid soil improvement. Such as Page 17 line 402-414

402 **5. Conclusion**

403 This study examines the impact of a combination of basalt powder, CaO, and PAM

404 mixed modifier on acid soil improvement. The findings indicated that the optimal pH

405 adjustment effect (4.16 to 6.86) was achieved when the ratio of basalt powder to CaO

406 is 8 to 2. Furthermore, the application of the mixed modifier demonstrated the potential

407 for soil nutrition supplementing, significantly increased the soil's acid-damage capacity

408 (20.3 mmol/kg), reduced the leaching of K^+(58.1%), Na^+(42.9%), Mg^{2+}(26.3%), Al^{3+}

409 (100%), and accordingly decreased the soil's aluminum toxicity. The results suggested

410 that the combined utilization of these three modifiers holds promise for improving the

411 quality of acidic soil. However, variations in the chemical composition and mineral

412 structure of silicate rocks across different regions result in distinct properties of soil.

413 Consequently, it is imperative to conduct further research tailored to the specific local

414 conditions.

L 376 - It is not worthy to present a new concepts in conclusion without discussing in results and discussion. For example, 'optimal pH' Only one time used in the text. Is it your objectives or comparative tool?

Response/action: We appreciate your recommendations. We posit that the optimal

outcome for ameliorating soil pH is to regulate it to a range near neutrality, as this pH environment is conducive to the viability of the majority of flora and microbial life. Accordingly, we have made the necessary adjustments in the methods section of our manuscript. Please see Page 7 line 160-162

160	of CaO and basalt. The optimal effect is determined by adjusting the pH value to a near-
161	neutral range (6.5-7.5), suitable for the growth of most plants and microorganisms(Tang
162	et al., 2013; Fan et al., 2018). Additionally, the acid damage capacity, which is the

L-378- 382 rewrite coherently with the text.

Response/action: We have rewrite these sentence, please see. Page 17 line 402-403

| 403 | This study examines the impact of a combination of basalt powder, CaO, and PAM |
| 404 | mixed modifier on acid soil improvement. The findings indicated that the optimal pH |

L 384 – 385 ????

Response/action: Our blended soil amendments can significantly improve the properties of acidic soils. However, the chemical and mineral composition of basalt, for example, is not exactly the same for all samples, and the pH values and various properties of soil samples are also not entirely uniform. In practical applications, we need to make simple adjustments based on the local soil pH values. This does not mean that the application is not universally applicable, but rather that further research and verification are needed in agricultural practice.

Additional comments

The manuscript requires a major change/ restructuring in presenting the results. Keep in mind that the literature reviews will be presented in Introduction, to find a research gap, which could be the aims of manuscript. The aims will be achieved by several objectives. To gain the objectives, the appropriate methods will be followed. The data/ results will be presented to achieve each objectives, finally, the aims of the manuscripts.

Response/action: Thanks again for your suggestion, we have restructured the introduction section to correlate with the experimental results and discussion, and the revisions are numerous. You can read the new manuscript if you are interested, and we

hope that you will be satisfied with the revised manuscript.