Response to Referee Teresa Paço (RC1) to

preprint egusphere-2024-2504: "Effects of moss restoration on topsoil water dynamics in a temperate vineyard"

Thank you very much for your thoughtful and positive review. We really appreciate the time and effort you put into your valuable and helpful feedback. Please find the answers to your comments in the table below. We will also incorporate them into our manuscript.

Reviewer comments	**Authors responses**
"Your manuscript addresses a quite interesting topic, still quite unexplored. Mosses have the ability to retain water and prevent soil evaporation, contributing also to prevent erosion, among other benefits, and they don't compete with plant roots for resources. Although the idea is appealing, some practical barriers might arise for implementation. Please see some further comments and suggestions."	We thank you for the positive evaluation and for highlighting the relevance of moss-based approaches in soil and water regulation. We appreciate the constructive suggestions regarding practical implementation and address them in the following comments.
"l. 83: "Mosses have been successfully cultivated under controlled greenhouse conditions" - please provide some references for this. It's true that they can be cultivated but the the growth rate is slow (DOI: 10.3390/plants10112523). To increase the efficiency of the production process, mosses can also be screened for adequate physiology (DOI: 10.3390/w12061748) or selected using ecological criteria (DOI: 10.3390/urbansci3020057). Please discuss this in the paper addressing the viability of using mosses as ground cover in vineyards, which are large cultivated areas. How long would it take to cover the space inter rows with mosses?"	We thank you for these helpful suggestions and references. The moss cultivation for the moss mats used in this study was carried out in collaboration with a private company, where propagation under controlled conditions has proven to be feasible and relatively efficient. The methodology or specific production protocols have not yet been published. However, scaling this approach to the level required for full inter-row coverage in vineyard systems remains an open question. At present, reliable estimates of the time required to achieve complete coverage are not available, as this depends on site-specific conditions and production scaling, and would require further applied research. We have clarified these aspects more explicitly in the revised manuscript (lines 81-86 and under 4.1) and are currently preparing a follow-up manuscript with more information on moss restoration.
"l. 108: the treatments surface is small (40 cm x 40 cm); is it enough to ensure that lateral water movements in the sub-surface soil are absent and won't mask the results? The moss mats dimensions are also 40 cm x 40 cm? Could this be related to the non-significative difference in mean topsoil moisture among treatments?"	We appreciate this important methodological question. The 40 × 40 cm plots correspond exactly to the size of the installed moss mats, and treatments were therefore spatially matched. While this setup allows a controlled comparison of surface soil moisture directly beneath moss cover, we acknowledge that the small plot size

	may not fully exclude lateral subsurface water movement from adjacent soil. However, given the low slope angle of approximately 5°, we consider the influence of lateral subsurface flow to be limited. We clarified this in the revised manuscript (lines 123-125 and 135-137).
"l. 453-4: " it can also impede infiltration, and its root system plays an important role by increasing the soil porosity and infiltration rates"; this seems contradictory, please rephrase.	Thank you for the observation, we have revised the wording (lines 483-486) to improve clarity and consistency regarding the effects of moss cover on soil structure and infiltration.
"Conclusions: *"Mean topsoil moisture did not differ significantly among treatments, with a tendency toward slightly higher moisture in bare soil plots." - this can be explained by being driven by higher infiltration in bare soil, if analysed for short periods, or, if related to soil evaporation rates, it should be the opposite. Please clarify this better.* *Please provide further emphasis on the advantages of moss cover over bare soil, as this is not very clear."*	We appreciate this comment and suggested explanation. We have clarified this better and provided further emphasis on the advantages of moss restoration over bare soil in the revised manuscript (lines 585-596, 589-590, 595-597).

Response to Referee Jesús Rodrigo-Comino (RC2) to

preprint egusphere-2024-2504: "Effects of moss restoration on topsoil water dynamics in a temperate vineyard"

Thank you very much for your thoughtful and positive review. We really appreciate the time and effort you put into your valuable and helpful feedback. Please find the answers to your comments in the table below. We will also incorporate them into our manuscript.

Reviewer comments	**Authors responses**
"The manuscript contains useful information on soil moisture dynamics following the previously published study on runoff and erosion from the same experimental vineyard. However, the scientific independence and novelty of the present contribution are not sufficiently demonstrated. Although the analysed variables differ (soil moisture response times, drying rates and soil moisture dynamics vs rainfall simulations), the study was carried out on the same experimental setup, treatments, site conditions and monitoring framework previously published by the authors. As a consequence, a substantial part of the scientific context, experimental rationale and interpretation overlaps with earlier work."	We appreciate this observation. While the study is based on the same experimental site and moss restoration treatments as Gall et al. (2025), it addresses a clearly different research question, focusing on soil moisture dynamics rather than runoff and erosion processes. The present work is based on independent data sets (meteorological measurements and TMS4 soil moisture logger data), whereas the previous study used rainfall simulation and runoff/sediment measurements. Thus, the experimental context is shared, but the data sources, objectives, and hypotheses are distinct. We therefore consider the present manuscript to provide a novel contribution by evaluating a different functional aspect of moss mats in vineyard systems. We have clarified this in the revised manuscript (lines 111-113).
"The manuscript would also benefit from a broader discussion regarding the transferability of the results beyond the specific experimental site. The study was conducted in a single vineyard under particular soil, climatic and management conditions, making it difficult to assess whether similar responses would be expected across the diversity of vineyard systems found in Germany and other European vine-growing regions."	We agree that transferability is an important point. The present study was designed as an initial field-based assessment of moss mat effects under real vineyard conditions. While conducted at a single site, it provides first insights into their potential function and limitations under specific soil–climate conditions. In the revised manuscript, we have added a discussion noting that further studies across a broader range of vineyard environments are needed to assess variability and improve transferability of the findings to other regions (lines 599-606).
"The ecological suitability and establishment potential of the selected moss species across different vineyard environments remains unclear. The manuscript demonstrates successful establishment under the conditions of the study site, but provides little discussion regarding the geographical distribution,	We acknowledge this important point. The present study demonstrates successful establishment and short-term performance of the selected moss species under the specific conditions of the experimental vineyard. However, the focus of this work was not to provide a full biogeographical or

ecological tolerance and long-term persistence of these species under contrasting soil properties, climatic conditions and management practices. As a result, it is difficult to evaluate the practical applicability of the proposed restoration strategy at broader spatial scales."	ecological niche assessment of these species. Information on broader ecological tolerances, geographic distribution, and long-term persistence across different vineyard environments is still limited and represents an important direction for future research. We have added clarification in the discussion to emphasize that the applicability of the approach across contrasting climatic, soil, and management conditions remains to be tested (lines 599-606).
"Furthermore, the hydrological interpretation focuses primarily on surface soil moisture dynamics, while several important processes commonly reported in temperate vineyard systems are not considered. In many Central European vineyards, water redistribution is strongly influenced by preferential flow pathways, macropore flow, lateral subsurface flow and subsurface runoff processes (Hewlett runoff vs Hortonian one). These mechanisms may play a significant role in hillslope hydrological connectivity and water availability, particularly during prolonged wet periods or intense rainfall events. Since such processes were not investigated or compared (becasue most of the typical German vineyards are on steep slopes), the extent to which the observed moisture patterns can be extrapolated to vineyard-scale hydrological functioning remains uncertain. The discussion should acknowledge that the reported effects describe near-surface soil moisture responses at the plot scale in Hortonian runoff type and may not necessarily translate into equivalent changes in water storage, hydrological connectivity or water availability at larger spatial scales."	We agree that processes such as preferential flow, macropore flow, and lateral subsurface redistribution are important components of vineyard hydrology in temperate and sloped systems. The present study was intentionally focused on near-surface soil moisture dynamics in order to isolate the immediate effects of moss cover under field conditions. Detailed characterization of subsurface flow pathways or hillslope-scale hydrological connectivity was beyond the scope of this work and was not directly measured. We have clarified in the revised manuscript that our interpretations are therefore limited to surface soil moisture responses and should not be extrapolated to full vineyard-scale hydrological functioning without further dedicated studies. Adjustments in the revised manuscript on this topic in lines 125, 135-137, 439-444.
L31: "grape"	Thank you for the suggestion. We have changed the word "wine" to "grape" (line 31).
L.50: "try to not repeat references"	We appreciate the comment and generally agree that references should not be repeat in the same paragraph; however, we believe the repeated citation in this particular case is appropriate as it supports multiple

	statements within the paragraph and ensures clarity for the reader.
L.78: "maybe, it would be great to include a paragraph with previous work done in Germany about soils where your idea would be great to stopp erosion, improve water retention… no just focussing on your papers and specific area"	We appreciate the reviewer's suggestion to place our study within the broader context of German vineyard soil research. The manuscript already includes brief references to this context in lines 76–80. In addition, the studies by Kirchhoff et al. (2017) and Dittrich et al. (2021) are cited as further examples of research on vineyard erosion in Germany, although they are not discussed specifically with regard to erosion mitigation. The primary focus of the present manuscript, however, is not on erosion control or the comparison of soil management strategies, but rather on soil moisture dynamics in relation to moss cover under the specific conditions of the study site. We therefore consider the current framing of the literature to be appropriate for the scope and objectives of this work and prefer not to expand the discussion into thematic areas that are not directly addressed by our study.
L.104: "add IUSS-WRB, 2022"	We have added the IUSS-WRB, 2022 reference in the text (line 107) and references.
L.105: "I would include pictures to give the readers an idea about the area, not obligating to read your previous papers"	Thank you for the suggestion. We agree that additional visual material can help readers better understand the study area. Therefore, we have added a new figure (Figure 1, line 115) to the revised manuscript, which includes photographs providing an overview of the study site.
L.107: "how many vine rows?"	Thank you for the suggestion, we specified the number of rows (4) in the text (line 121).
L.110: "it would be great to know if this mosses can survive under different conditions, can you add a table with the range of values they can manage?"	We cannot provide a table of environmental tolerance ranges. The moss species investigated in this study have not been systematically evaluated under different environmental conditions, and determining their tolerance limits was beyond the scope of the present work. We therefore consider this an important topic for future research and have addressed this in the discussion (lines 599-606).
L.130: "maybe a table or figure would make this much easier to be read"	We appreciate the suggestion, however we believe the current textual presentation is

	clearer in this case, as the information is integrative rather than easily separable into tabular or schematic form. We therefore prefer to keep the current format.
L.153: "coordinates would be great too"	Thank you for the suggestion. We added the coordinates of the weather station (line 167).
Figure 1 (now Figure 2): "are these common numbers? please, contextualize this"	We appreciate this suggestion and agree that additional context would improve interpretability. We have added a comparison of the meteorological variables of the study site to the German national averages both in text (lines 177-180) and table (table 1). We have also adjusted the text under 2.5 to further improve the interpretability of figure 2.
L.256: "maybe bold fonts are not needed"	We acknowledge this point, but we find that the bold formatting improves readability and helps guide the reader through key points. We would therefore prefer to retain it where used.
L.411: "still miss some comments related to German soils and German climate"	We thank you for the remark. We have included additional contextualization within German climate conditions (figure 2 and lines 177-180). We also added further specification of the soil parameters (lines 108-110).
L.437: "in some German soils Hewlett runoff was detected, especifically in the Mosel Valley, is here the same dynamic? please, mention this and comapre them because this is typical of German vineyards and mosses could solve the issue or stop this"	We appreciate this interesting point regarding runoff generation processes in steep vineyard systems such in the Mosel Valley. However, the present study does not investigate runoff mechanisms or subsurface stormflow pathways, but focuses exclusively on near-surface soil moisture dynamics under moss cover. Therefore, we cannot directly assess or compare our results to Hewlett-type runoff processes. Any potential influence of moss cover on broader hillslope hydrological connectivity remains speculative and requires further targeted investigation.
L.548: "much better as a one paragraph summarizing all"	We are glad that you appreciate the structure of the conclusion.
L.567: "too long"	We acknowledge the last paragraph of the conclusion to be slightly longer and have shortened it were possible (lines 599-606).