Dear reviewer:

Thank you for providing many constructive suggestions concerning our manuscript (EGUSPHERE-2022-1390) entitled "The higher relative concentration of K^+ to Na^+ in saline water improves soil hydraulic conductivity, salt leaching efficiency and structural stability". Here are our specific responses to your comments.

If any questions, please don't hesitate to let us know, and we would like to have more discussions with you!

Thank you for your consideration.

Sihui Yan, Tibin Zhang, and on behalf of all authors

Review 1

In 1999, I performed a column study of almost equal design on 3 chernozem soils pH 6,8-8,6), together with a master student. Our question was to simulate the vertical transport of a single addition of NPK fertilizer solution by rainwater, containing sulfate and phosphate as anions, beneath anionic trace elements. Addition of K^+ led to the release of all other soluble cations, like Na, Li, Mg, Ca, Sr, Ba and H^+ (acidification!). In this work, the goal is the substitution of sea water intrusion by KCl fertilizer, which is not so clear from the abstract.

It is well known that clay minerals exert stronger affinity to K^+ and NH_4^+ than to Na^+ and others.

Question 1: From the experimental part, it is not quite clear that obviously the NaCl and KCl solutions (of equal conductivity) had not been added to columns run in parallel, but subsequently to the same columns (I took this from figures 3 and 5).

Response: Our soil column experiments were set up with different sodium to potassium ratios at the same EC level, and saline water was infused into the soil column in five times. Alternate leaching was formed to provide enough time for cation leaching, water redistribution and pore structure changes (Lines 150-153). The soil column was saturated after the first irrigation, and subsequent irrigations were also with saline water of the same treatment. The addition of saline water increases the salt content and also promotes salt leaching. We, therefore, wished to simulate the effect of different sodium-to-potassium ratios of saline water on soil water-salt transport and macropore distribution under such irrigation conditions.

Question 2: 6 liters of approximate pore volume is realistic. But how much salt solution was added, and was there a wash-down with water in between?

Response: We calculated the pore volume in the soil to be 6 L. The first irrigation was expected to saturate the soil, i.e. the irrigation water filled all the pores in the soil. Therefore, our irrigation volume was the calculated pore volume of 6 L. However, because of the limitation of the soil water holding capacity, some of the water was leached outside of the soil column, and the volume of leachate was about 0.5 L. After 2 days after the end of the leaching (the end of the redistribution of soil water), to keep the soil saturated, we irrigated the soil with the same saline water as the first irrigation solution, with a volume of 0.5 L, and the subsequent irrigation was repeated four times (Lines 166-169). Thus, there was no wash-down in between.

Question 3: What had been measured to obtain the amount of released salt?

Response: To determine the amount of salt released, we measured the volume and electrical conductivity of the leachate. The leachate was collected at 3 h intervals when the leachate started to drain. The leachate was stored in 100 ml wide-mouth polypropylene reagent bottles, volume and electrical conductivity of the leachate were measured. Maybe this fact was not clearly expressed in the article, and we will do a detailed revision of the article later. Thank you for your reminder.

Question 4: Only Na and K, but also Ca, Mg, Sr, Ba, sulfate, carbonate? These data are completely missing!

Response: The experiment you did in 1999 was very comprehensive and took into account many aspects, and your study was very informative for our experiment. We did this experiment because, first of all, K^+ does affect Na^+ leaching, however, the presence of Na^+ could still cause soil clay particle dispersion, which thus inhibits water infiltration and prevent salt leaching. Secondly, the change of soil pore structure during water redistribution could affect the rate of soil water and salt transport, which are factors affecting Na^+ leaching. We, therefore, set up this experiment to analyze the combined effects of K^+ and Na^+ interactions on soil water and salt movement. In order to exclude the effect of other factors, the ion concentration contained in the soil we chose was very low (Table 1), so the effects of K^+ and Na^+ on other ions were not considered. Thank you very much for your suggestion, we should do more related research in this respect in the future study, and we hope we can keep the academic communication with you in the future.

Question 5: (Line 212) The abbreviation Ksat is misleading, because this is not saturated potassium, but saturated hydraulic conductivity!

Response: The fact that Ksat is defined as the abbreviation of Saturated Hydraulic Conductivity of Soil is widely accepted in the field of soil physics. Based on this fact, we still prefer to use this expression.

Question 6: (Fig. 2) The given saturated hydraulic conductivity obviously starts from differently pretreated soils, if the test solutions had been added to the same column subsequently. My main discipline is analytical chemistry, and not soil physics - no comments upon hydraulic parameters

Response: The saturated hydraulic conductivity, as shown in Figure 2, was determined on the soil after different pretreatments. Initially, all physicochemical properties and external conditions of the soil were the same, and we assumed that the original saturated hydraulic conductivity of all soils was the same. After saline water irrigation, the action of cations in the soil and changes in the pore structure affected the saturated hydraulic conductivity, so we determined the saturated hydraulic conductivity with different pretreatments. Thank you again for your comments.