Reviewer #1:

Thank you for your valuable comments on this manuscript. We have carefully revised our paper followed by your comments.

This paper presents a laboratory scouring experiment to study the effects of two herbaceous on the soil detachment process. The experimental design is reasonable, but the results shown in the manuscript are not convincing in my view.

Major issue:

1.The fitting results in Fig.3, Fig4. and Fig. 6 are not good (with low R^2). I very much doubt the applicability of the equations shown in Fig.3, Fig4. and Fig. 6. So, as I stated above, the results shown in the manuscript are not convincing.

Response:

The fitting results in Fig.3, Fig.4 and Fig. 6 showed low R^2. This mainly because independent variables used in these figures would all affect the soil detachment process. When all these factors considered, the R^2 was 0.58 (Eq.[10]). So, when we use one of these factors, the R^2 is low.

Before we do this job, the correlation analysis was used to detect the relationship between these factors and soil detachment rate. We think that high correlation coefficient might be have a strong effect on soil detachment, and their effects on soil detachment might also be expressed as functions. After all, quantitative relationships are more intuitive than correlation coefficients. Finally, when we simultaneously considered the root traits, soil properties and hydraulic parameters, the performance seems satisfactory with a relatively high R^2.

2.According to the title of this manuscript, it aims to compare the differences between BI and AG in affecting the soil detachment process. However, in Fig.3-6, the results of BI and AG were fitted using the same equation which I think is unreasonable. To be specific, if the effects of two herbaceous on the soil detachment process are different

and worthy to study, the relationships in Fig.3-6 should be different between BI and AG. It is easy to see from Fig.4, for example, the distribution characteristics of the result points between BI and AG are very different, which I think is a reason for the poor fitting results.

Response:

Your suggestion is right. At first, we also want to separate these differences that caused by two different herbaceous plants, while the performance was not very good. The reason why we did not do that is the following reason. For fig.3 (now is the fig.4), plant density is the experiment treatment and it is the same for both two herbaceous plants. For the fig.4 (now is the fig.5), the variation of hydraulic parameters was mainly due to the soil surface. The aboveground part of plants was cut and the overland flow was used to detect the soil detachment rate. In this way, the impact of species in soil detachment may not be very strong. For the fig.5 (now is the fig.6), soil property such as bulk density would be varied after the vegetation growth. But the difference of bulk density between these two herbaceous plants might be slight. Overall, these two herbs only grew for one year. For the fig.6 (now is the fig.7), we put the data of the two herbs together mainly because there is a prior knowledge, that is the root length density would represent the difference between root types. Many previous studies generally use the root biomass to built the relationship between soil erosion rate and root traits. Some studies believe that the root biomass would not well reflect the effects of root type on soil erosion, and the root length density or the root surface area density are suggested and the effects of root type on soil erosion would be included. As reported by De Beats et al. (2007), Knapen et al., (2007), and Wang et al. (2021). the root length density or root surface area density would generally be used to represent root morphological differences induced by root type between herbs.

Although some studies sample the undisturbed soil from nature grassland. But some problems they would not be solved very well. For example, in the sampling process, the root would not completely collect due to the limitation of the sample (generally used the rectangular ring with 20 cm in length and 10 cm in width, or circular

ring with 10 cm in diameter). The scouring process by overland flow may also affected by the edge wall of the steel ring. The roots of other herbs are also mixed in the sample ring. These factors would all affect the results. It is because of this, we planted the herbs in relatively large tank (200 cm in length and 50 cm in width) to avoid these possible impacts. With these large soil samples that used in this study, our results would well reflect the effects of herbaceous plant root system on soil detachment, for the root system integrity can be maintained and the initial soil properties of all sites keep consistent, and the influence of edge effect on test results can be ignored. Besides, there are no other herbs root in the sample soil, it is helpful for us to study the effects of herbaceous plants root system on soil detachment at species level. However, when we use the large tank to plant herbs, the data would be limited, so we put all the data together to promote the effectivity of the data. Your suggestion is very important for our future research, and we will do our best to increase the amount of data in future study.

3.In this scouring experiment, the value of overland flow is constant (1.5 L s^{-1}). So, the scientific significance of this paper is very limited. To my knowledge, the overland flow should have significant effects on soil detachment. In the present manuscript, all the results are derived under a constant overland flow; and if the results are applicative under other overland flows or not? I doubt it! So, Eq. 10 may be correct only under the specific experimental conditions of this manuscript.

Response:

In previous studies, their soil sample were collected under nature grassland, and they would give five or six condition of overland flow, for the soil sample was relatively easy to collect. As mentioned above, the disadvantages are also obvious. For the given overland flow condition that reported by previous study, the variation of overland flow are ignored when the overland flow through the sample area. This is mainly because the hydraulic parameters cannot be measured, for the sample size is small, especially for short length. In fact, the hydraulic parameters in the sample area are closely related

to soil erosion. In this study, the hydraulic parameters were test in the sample area. Although only one condition of overland flow was given in this study, but there are six plant density and two herbaceous plants, which means twelve conditions of overland flow were used in this study. Besides, for the hydraulic parameters that used in the Eq.[10] was not a constant, it's twelve.

Based on above mentioned, we emphasized in the article that we measured the hydraulic parameters of the scouring zone, and this part was revised as: "The flow velocity of scouring zone and water temperature were measured every 5 s".(Line 218 and Line 219).

4.In Fig. 7, the predicted soil detachment rate and the measured soil detachment rate are compared. What are the data of measured soil detachment rate? Are they derived from other experiments or just the results of the present experiment? If the datasets used to build Eq. 10 are in turn used to validate Eq. 10, the result is nonsense.

Response:

Yes, we use the measured data to build the Eq.10. For this study, the soil detachment capacity was affected by the hydraulic parameters of overland flow, the soil properties and root types. The method of stepwise was used to fit the effects of these factors on soil detachment. For one hand, factors that had no effects or little effects would be eliminated. For another hand, the selected parameters in Eq.10 would well reflect the effects of overland flow, soil properties and root types on soil detachment. You are right, the performance of Eq.10 showed in fig.7 was only applied to this study.

In this study, the selected two herbaceous and soil properties are typical of the hilly and gully area of the Loess Plateau. The Eq.10 might be used in this area. For other region, as you mentioned, this equation should be calibrated. Following your suggestion, we would verify this equation with another independent data in future study and make the equation more widely applicable.

Moderate issue:

5.According to the manuscript, I recognize that repeated experiments are designed. However, the results of the repeated experiments are not shown in the manuscript. At least, the average values and the standard deviation of the repeated experiments should be described. Because the deviations of the repeated experiments have significant effects on the results shown in Table 1. If the deviations of the repeated experiments are very large, the comparing results between the BI and AG would be questionable; i.e. we would be not sure that the differences between BI and AG result from the species' difference or the experimental error.

Response: Done as suggested.

Our experiments were indeed repeated experiment. According to your suggestion, we have increased the standard deviation of soil properties, such as bulk density, cohesion, water stable aggregates, soil organic matter and soil erodibility in table 1. We also added the standard deviation of velocity, shear stress and Darcy-weisbach friction factor in table 3.

6.In the Materials and methods section, there are not any figures describing the experimental conditions and treatment design. This makes readers difficult to have a clear understanding of your experiments.

Response: Done as suggested

We realized that the schematic diagram describing the experimental conditions and treatment design could clearly show the experimental process. This makes readers easy to have a clear understanding of our experiments. Following your suggestion, we added the schematic diagram of the experimental treatment in the materials and methods of the manuscript (Fig.1).

7.In the present manuscript, many equations have been used. The authors must add the corresponding references to the manuscript.

Response: Done as suggested.

We previously considered Eq.[1] to [9] to be the most commonly used calculation formulas, so we did not add references. As you mentioned, references for these equation were important, and the corresponding references of eq.[1] to [9] were added in manuscript. (Line 227 to Line 267).