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Reply on RC2

Jian-Fang Wang et al.

Author comment on "Investigating the effects of herbaceous root types on the soil detachment process at the species level" by Jian-Fang Wang et al., Hydrol. Earth Syst. Sci. Discuss., https://doi.org/10.5194/hess-2022-30-AC5, 2022

Thank you for your comments and detailed revision. We have revised the manuscript according to your suggestion.

This manuscript deals with overland flow lab experiment to study the effects of two different herbaceous type with different root system architecture on the soil detachment process. They explore the influence of 7 plant densities (including the control-bare with no plants). The paper explores the associated interaction between the promoted changes in soil properties as bulk density, soil cohesion, soil aggregation and soil organic content due to the influence of the root architecture and density.

Major concern:

1.As a general, there is a huge effort on the dataset collection and soil laboratorial analyses otherwise, the experimental set-up is poor in terms of statistical confidence. The experimental design is not appropriate for a scientific journal since it counts only with two replicates per treatment (line 178), so the reliability of results and thus conclusions are not convincing me.

Response:

Yes, for some studies, the counts of plant species are four or six. The "Grain for Green" project has been implemented for 20 years. For the abandoned farmland, and the vegetation has succeeded to a stable period. In this stage, *Bothriochloa ischcemum* (Linn.). Keng (BI) and *Artemisia vestita* Wall. ex. Bess (AG) are the dominant herbaceous species. That's the reason that we selected these two herbs.

In previous studies, they choose more plant species than we do. 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 relative large tank (200 cm in length and 50 cm in width) to avoid these possible impact. 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, the tradeoff for this is that we can't set up too many experimental treatments.

In previous studies, the given overland flow condition is considered as unchanged. 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 varied hydraulic parameters were test in the sample area, which means that our treatment was added under the six plant density and two herbaceous plants.

Although there is a shortage in treatment, the repetition was added in this study to ensure the data accuracy. For example, two repetitions were designed for each plant density, the measurement of soil properties and vegetation characteristics were tested for six times, For soil detachment rate test, the runoff and sediment were collected in every 5 seconds, and repeated for 15 times in each soil tank. We will also increase the treatment accounts in future research. For this study, we mainly focused on the effect of herbs on soil detachment at the stable stage of succession. These two herbaceous plants is the main community in study area.

2.I would recommend to explore in the dataset if densities 5 and 10, 15 and 20, and 25 and 30 plant/m^2 could be aggregated, in other words, are differences between 5 vs 10, 15 vs 20, 25 vs 30 plant/m^2? If statistically there are no differences, then you could try to build your treatments based on ranges of 5-10, 15-20, 25-30 plant/m^2, in order to get more statistical confidence, and then properly discuss your results.

Response:

Based on the statistical results, we compare the difference of soil properties under six plant densities. It was showed that soil organic matter decreased with plant density for both two herbs, and the soil erodibility of BI decreased with plant density. For other soil properties, the variation of them with plant density was not very clear.

Following your suggestion, we try to build treatments based on ranges of 5-10, 15-20, 25-30 plant m^{-2}. Then we found that maximum bulk density, cohesion and water stable aggregate values occurred when the plant density ranged between 15 plants m^{-2} and 20 plants m^{-2}. The soil erodibility of AG was high when the plant density ranged between 5 plants m^{-2} and 10 plants m^{-2}.

Also, we revised this part in the paper as following: "In particular, maximum bulk density, cohesion and water stable aggregate values occurred when the plant density ranged between 15 plants m^{-2} and 20 plants m^{-2}. The soil organic matter content increased with increasing plant density. The soil erodibility of BI decreased with plant density. While for AG, it was high when the plant density ranged between 5 plants m^{-2} and 10 plants m^{-2}." (Line 280 to Line 284)

Moderate concern:

3.In mat/met section, any of the soil properties is referenced (line 239-249).

Response: Done as suggested.

The soil properties of bulk density, cohesion, water stable aggregate, organic matter and soil erodibilty were measured by normal methods. The references which measured methods of soil properties were added in the materials and methods (Line 239 to Line 249).

4.Please, define the meaning of "S" type sampling (line 239).

Response: Done as suggested.

"S'' type sampling refers to taking mixed soil sample on the slope (soil tank in this study) in the shape of letter S, and the soil sample would well represent the soil properties of this slope. This part was revised as: "the soil properties were measured by taking mixed soil sample on the slope (soil tank in this study) in the shape of letter S" (Line 240 and Line 241).

5.Number of plots should be 26, including the control-bare.

Response:

You are right. The total number of plots were 26 including the control-bare. Among these, twenty-four plots were used for planting under six plant density and two herbaceous plants. This part was revised as "In total, twenty-six steel tanks were used, and including two control-bare" (Line 178 and Line 179).

6.In 2.5. Statistical analyses should explain if data is normal or non-normal, so the use of parametric or non-parametric test. This item should be properly developed.

Response: Done as suggested.

Before analyzing and quantifying relationships between the soil detachment rate and hydraulic parameters, soil properties, and root traits, the normal distribution of these indexes was test by using the method the one-sample nonparametric tests. The statistical analyses part was also revised (Line 271 and Line 272)

7.From my understanding, soil moisture also influences soil detachment, so repeated overland flow experiments would modify the initial soil moisture content, which must to be considered as a co-factor or factor on soil detachment processes, mainly on repeated overland flow experiences. Proper statistical tools should be properly applied for the repeated measurement statistical analyses.

Response:

Yes, soil moisture has great effects on soil erosion process, which would be correlated to the initial runoff time and soil erosion rate. For the effects of driving force on soil erosion process, rainfall and overland flow is commonly used. Many studies consider the overland flow as a sub-process of the rainfall, and the soil moisture close to the saturated water content when the rill erosion occurs. Hence, they allow the soil sample to fully absorb water (capillary water) and to simulate the effects of overland flow on soil detachment during the rill erosion process. As a result, the effects of soil moisture on soil detachment

is eliminated (Zhang et al., 2003; Wang et al., 2018). In our study, we also to sprinkle water several times for each soil tank until the soil moisture saturated before scouring test. So, in our study, soil moisture would be not affected the soil detachment process.

8.Many equations are used but any of them is referenced, please, equations should be referenced.

Response: Done as suggested.

After much consideration, we think that references should be added. Therefore, the corresponding references of eq.[1] to [9] were added in manuscript (Line 227 to Line 267).

9.English language-grammar must be deeply revised.

Response: Done as suggested.

Before we submit the paper, the full text was revised by a American native speaker provided by the website of Elsevier. This time, the paper was checked by a researcher who worked in the US for almost thirty years.

10.Units should be carefully revised. See line 25 for the soil detachment rate (i.e.: six planted densities ranged from 0.034 kg m^2 s^{-1} to 0.112 kg m^2 s^{-1} for BI and was ranged from 0.053 m^2 s^{-1} to 0.132 m^2 s^{-1} for AG,)

Response: Done as suggested.

All units were checked and revised. The sentences "six planted densities ranged from 0.034 kg m^2 s^{-1} to 0.112 kg m^2 s^{-1} for BI and was ranged from 0.053 m^2 s^{-1} to 0.132 m^2 s^{-1} for AG" was revised as "six planted densities ranged from 0.034 kg m^2 s^{-1} to 0.112 kg m^2 s^{-1} for BI and was ranged from 0.053 kg m^2 s^{-1} to 0.132 kg m^2 s^{-1} for AG" (Line 25).