Authors’ responses to Editor and Reviewers comments on the manuscript of “Differential response of plant transpiration to uptake of rainwater-recharged soil water for dominant tree species in the semiarid Loess Plateau”. Manuscript ID: hess-2021-351.

Dear Editor and Reviewers,

We deeply appreciate you for giving us an opportunity to revise our manuscript. The marked-up manuscript version is highlighted the changes by using the red colored text in the manuscript (track-changes version). Here are the point-to-point responses (responses in upright Roman) to the Editor and Reviewers comments (*original comment in Itali*).

Editor

Major Comments:

1) Your manuscript was read by four reviewers, who were generally interested in the study and made some useful comments to improve the manuscript. I see you have already made a large effort to improve the manuscript and it is good to see already the revised manuscript accompanying your response to the reviews. I think several corrections have improved the paper, amongst others the change in terminology made the paper easier to read. I do think that some of the responses to the reviews led to new unclarities or were not always very much to the point. As an example I add here some comments on your responses to reviewer 1. Seeing that you have made a significant effort and I do believe the manuscript has improved, I recommend to reconsider the article after major revision and will send it to the reviewers to get their opinion on the revised manuscript.

Response: Suggestions accepted. Thanks for these meaningful suggestions, the relative sentences for runoff calculation and plant uptake deep soil water description in response to **Reviewer 1**, and for two hypotheses description in response to **Reviewer 2** have been rewritten in the revised manuscript.

1) In response to runoff calculation, we added the relative sentence in “2.4 Rainwater, plant stem, soil water, and leaf sample collection and measurement” subsection in “**2 Materials and methods**” section as follows: “In addition, no runoff was generated during the selected rainfall events in three plantations according to the simulated result from the HYDRUS-1D model (Appendix A), which is based on the Richards' equation to describe soil water dynamics (Šimůnek et al., 2008). This model has been widely used to simulate the runoff and soil water dynamics in the Loess Plateau (Yi and Fan, 2016; Bai et al., 2020; Wang et al., 2020b)." (Page 8 Lines 195-199).

In the revised manuscript, the HYDRUS-1D model was used to calculate the runoff during the selected rainfall events in three plantations. This model has been widely used to simulate the runoff and soil water dynamics in the Loess Plateau (Yi and Fan, 2016; Bai et al., 2020; Wang et al., 2020b). The detailed information of this model, the basic data sources should be inputs in this model, the calibration and validation of this model, and the runoff result calculated by this model can be observed in **Appendix A** in the revised manuscript.

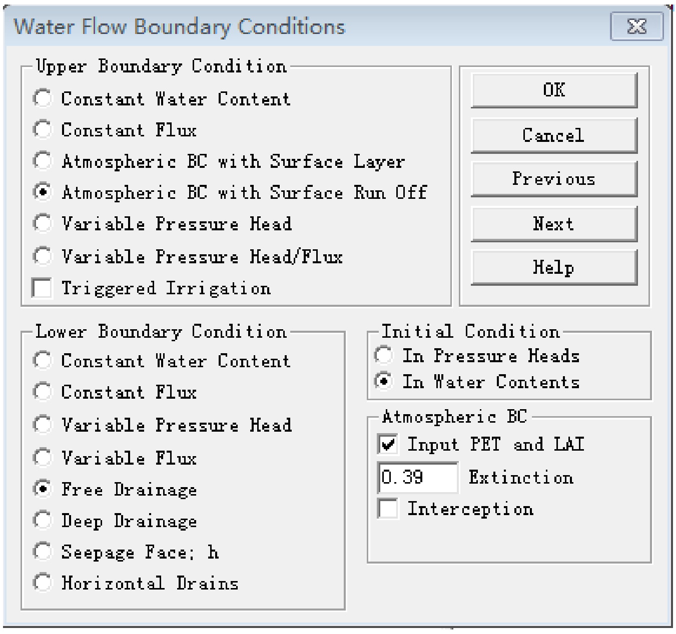
In Appendix A, **firstly**, we described the equation of the HYDRUS-1D model. After that, we pointed that this model has been widely used to simulate the runoff and soil water dynamics in the Loess Plateau (Yi and Fan, 2016; Bai et al., 2020; Wang et al., 2020b). The relative sentences can be observed as follows: "

The HYDRUS-1D model is based on the Richards' equation (Richards, 1931) to describe soil water dynamics (Šimůnek et al., 2008; Šimůnek et al., 2013):

$$\partial\theta/\partial t=\partial/\partial z\left(K(h,z)((\partial h/\partial z)+1)\right)-S_r(z,t) \tag{1}$$

where θ, t, h, and z are the soil moisture content (SW, cm^3 cm^{-3}), simulation time (day), pressure head (cm), and vertical coordinate (cm), respectively. $K(h, z)$ and S_r (z, t) are the unsaturated hydraulic conductivity (cm day^{-1}) (Mualem, 1976; van Genuchten, 1980) and root water uptake (cm^3 cm^{-3} day^{-1}), respectively.

This model has been widely used to simulate soil water hydrological processes with HYDRUS-1D software (Šimůnek et al., 2013), such as soil water content dynamics and runoff in the Loess Plateau (Yi and Fan, 2016; Bai et al., 2020; Wang et al., 2020b). The model was used to calculate the runoff for each plantation type in this study, after calibration and validation this model using the observed SW. Based on suggestions in Yi and Fan (2016) and Bai et al. (2020), the atmospheric boundary condition with surface runoff and free drainage were selected as upper and lower boundary condition, respectively, to calibrate and validate this model and calculate runoff (Fig. A1).



Upper Boundary Condition
○ Constant Water Content
○ Constant Flux
○ Atmospheric BC with Surface Layer
● Atmospheric BC with Surface Run Off
○ Variable Pressure Head
○ Variable Pressure Head/Flux
☐ Triggered Irrigation

Lower Boundary Condition
○ Constant Water Content
○ Constant Flux
○ Variable Pressure Head
○ Variable Flux
● Free Drainage
○ Deep Drainage
○ Seepage Face; h
○ Horizontal Drains

Initial Condition
○ In Pressure Heads
● In Water Contents

Atmospheric BC
☑ Input PET and LAI
0.39 Extinction
☐ Interception

Figure A1. The upper and lower boundary conditions selection in HYDRUS-1D software (Version 4.15).

” (Pages 1-2 Lines 2-18 in Appendix A)

Secondly, the basic data sources should be inputs in this model were clearly descripted. These data sources included the observed meteorological, plant, and soil hydraulic parameters.

For meteorological parameters, the relative sentences can be observed in “**1.1 Meteorological parameters” subsection in “Appendix A”** as follows: “The meteorological parameters required for HYDRUS-1D include relative humidity, wind speed (W_S), air temperature, rainfall amount, and reference evapotranspiration (ET_0). Daily relative humidity, maximum, minimum and average air temperatures, W_S, and rainfall amount were measured by a weather station approximately 500 m from the research plots. The ET_0 (cm day^{-1}) was calculated through method described by Allen et al. (1998). The detailed information can be observed in “2.2 Environmental parameter measurements and ET_0 calculation” subsection in the manuscript.” (Pages 2-3 Lines 24-29 in Appendix A)

For plant parameters, the relative sentences can be observed in “**1.2 Plant parameters” subsection in “Appendix A”** as follows: “The plant parameters required for HYDRUS-1D include plant height, root depth, and potential transpiration rate. Plant height and root depth in each plantation type can be observed in Table S1 and Figure S4 in the manuscript, respectively. The leaf area index (LAI) was measured monthly, from May to September, for each plantation type using a LAI-2200 (LiCor Inc., Lincoln, USA). The potential transpiration rate (cm day^{-1}) was calculated using the Beer equation (Ritchie, 1972) based on the measured LAI and extinction coefficient value (0.39) suggested in Šimůnek et al. (2013).” (Page 3 Lines 31-36 in Appendix A)

For soil hydraulic parameters, the relative sentences can be observed in “**1.3 Soil hydraulic parameters” subsection in “Appendix A”** as follows: “The saturated soil water content (θs) and hydraulic conductivity (Ks), van Genuchten model parameters (α and n), and residual soil water content (θr) were required parameters for HYDRUS-1D. The Ks, θs, and soil bulk density (BD) at soil depth intervals of 0-20, 20-50, 50-100, and 100-200 cm were measured in July 2018 using the cutting ring (Wu et al., 2016) and constant water head (Reynolds et al., 2002) method in each plantation type. The soil particle composition was determined using a Mastersize 2000 (Malvern Instruments Ltd., UK). Additionally, the slopes for these three plantation types were required for HYDRUS-1D. The detailed information can be observed in “2.1 Study site” subsection in the manuscript. The measured soil hydraulic parameters for the three plantation types are shown in Table A1. The Rosetta pedotransfer function was used to calculate θr, α, and n (Jana and Mohanty, 2012; Bai et al., 2020).

Table A1. Measured soil hydraulic parameters and particle composition in both pure and mixed plantations

	Soil depth (cm)	Soil particle composition			Soil hydraulic parameter		
		Sand (%)	Silt (%)	Clay (%)	θ_s (cm^3 cm^{-3})	*BD* (g cm^{-3})	*Ks* (cm day^{-1})
H. rhamnoides pure plantation	0-20	26.4	63.5	10.1	0.37	1.28	75.7
	20-50	22.2	61.6	16.2	0.34	1.4	70.3
	50-100	23.5	63.1	13.4	0.32	1.44	55.4
	100-200	24.7	63.8	11.5	0.29	1.48	50.6
P. tomentosa	0-20	25.8	62.2	12	0.35	1.21	82.4

pure plantation	20-50	23.7	62.5	13.8	0.35	1.33	73.7
	50-100	22.2	61.5	16.3	0.31	1.42	58.9
	100-200	24.9	64.8	10.3	0.3	1.45	52.6
Mixed plantation	0-20	25.5	63.8	10.7	0.36	1.25	78.5
	20-50	24.3	62.7	13	0.35	1.31	73.2
	50-100	23.8	64.9	11.3	0.34	1.39	60.5
	100-200	24.6	63.7	11.7	0.31	1.45	53.4

θ_s= saturated soil water content, *Ks*=saturated hydraulic conductivity, BD= soil bulk density ”

” (Pages 3-4 Lines 38-50 in Appendix A)

Thirdly, the measured SW in the present study in each plantation type was used for model calibration and validation. The SW at each soil depths in each plantation type from DOY 132 to 202 was used to calibrate the HYDRUS-1D. And some soil hydraulic parameters were optimized through the inverse solution module in HYDRUS-1D during the model calibration (Table A2).

Table A2. Optimized soil hydraulic parameters in both pure and mixed plantations through HYDRUS-1D

	Soil depth (cm)	θr (cm^3 cm^{-3})	θs (cm^3 cm^{-3})	Ks (cm day^{-1})	*a*	*n*
H. rhamnoides pure plantation	0-20	0.08	0.36	74.9	0.018	1.6
	20-50	0.08	0.34	71.2	0.018	1.6
	50-100	0.0823	0.31	56.2	0.01	1.45
	100-200	0.0823	0.3	51.5	0.01	1.43
P. tomentosa pure plantation	0-20	0.08	0.36	82.1	0.019	1.62
	20-50	0.08	0.35	73.5	0.018	1.6
	50-100	0.0821	0.31	59.2	0.01	1.51
	100-200	0.0822	0.31	51.6	0.011	1.47

Mixed plantation	0-20	0.08	0.37	79.2	0.018	1.61
	20-50	0.08	0.36	74.2	0.018	1.61
	50-100	0.0822	0.34	60.2	0.011	1.46
	100-200	0.0823	0.3	55.8	0.011	1.45

θ_r= residual soil water content, *Ks*=saturated hydraulic conductivity, θ_s= saturated soil water content, *a* and *n* = parameters of van Genuchten model.

Subsequently, the SW from DOY 203 to 273 in each plantation type was used to validate the model. The root mean square error (RMSE), Nash-Sutcliffe efficiency coefficient (NSE), and determinant coefficient (R^2) based on the observed and simulated SW was used to evaluate the model performance (Bai et al., 2020). The calculated RMSE, NSE, and R^2 indicated that the simulated results were acceptable for three plantation types in this study (Table A3), based on the criterions suggested in Bai et al. (2020) and Wang et al. (2020b). The detailed sentences can be observed in “2 Model calibration and validation, and runoff calculation” section in **“Appendix A”.** (Pages 5-10 Lines 53-96 in Appendix A)

Table A3. The RMSE, NSE, and R^2 between the observed and simulated SW during the HYDRUS-1D validation period (from DOY 203-273)

	Soil depth (cm)	RMSE	NSE	R^2
H. rhamnoides pure plantation	5	0.008	0.65	0.84
	20	0.006	0.58	0.83
	50	0.006	0.7	0.71
	100	0.008	0.56	0.85
	150	0.005	0.59	0.81
	200	0.006	0.52	0.78
P. tomentosa pure plantation	5	0.008	0.67	0.79
	20	0.008	0.62	0.76
	50	0.006	0.72	0.82
	100	0.009	0.59	0.75

	150	0.008	0.57	0.83
	200	0.009	0.61	0.78
Mixed plantation	5	0.009	0.61	0.81
	20	0.01	0.54	0.76
	50	0.008	0.68	0.82
	100	0.008	0.7	0.79
	150	0.006	0.76	0.82
	200	0.008	0.67	0.81

RMSE= root mean square error, NSE = Nash-Sutcliffe efficiency coefficient, R^2= determinant coefficient

The simulated SWs at different soil depths closely matched the variation of these values observed from DOY 203 to 273, the example can be observed in the *H. rhamnoides* pure plantation in Figs. A1 and A2.

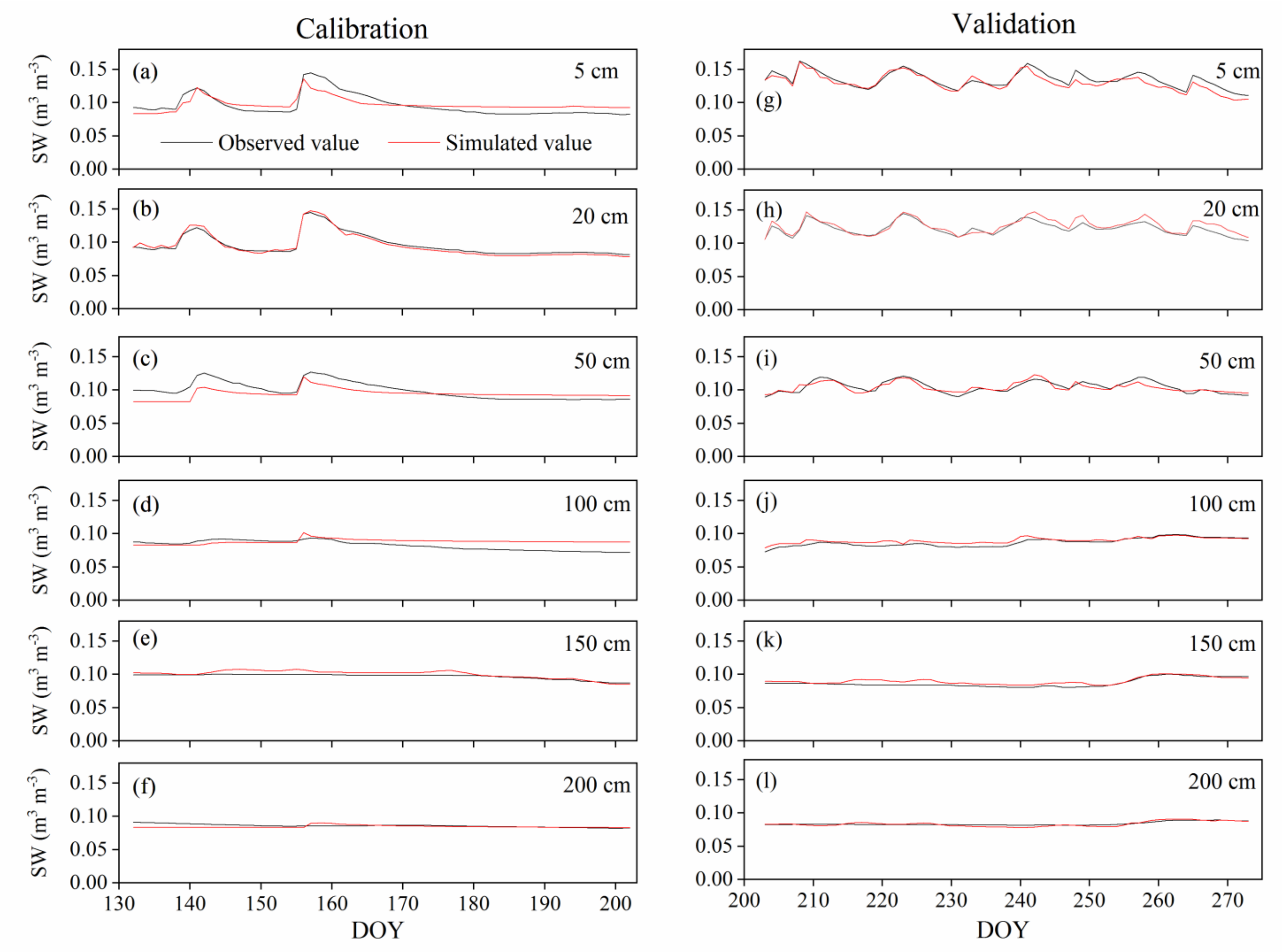


Figure A1. Variation in soil water content (SW) at 5, 50, 50, 100, 150, and 200 cm depths during the HYDRUS-1D (a-f) calibration (from DOY 132-202) and (g-l) validation (from DOY 203-273) period in *H. rhamnoides* pure plantation.

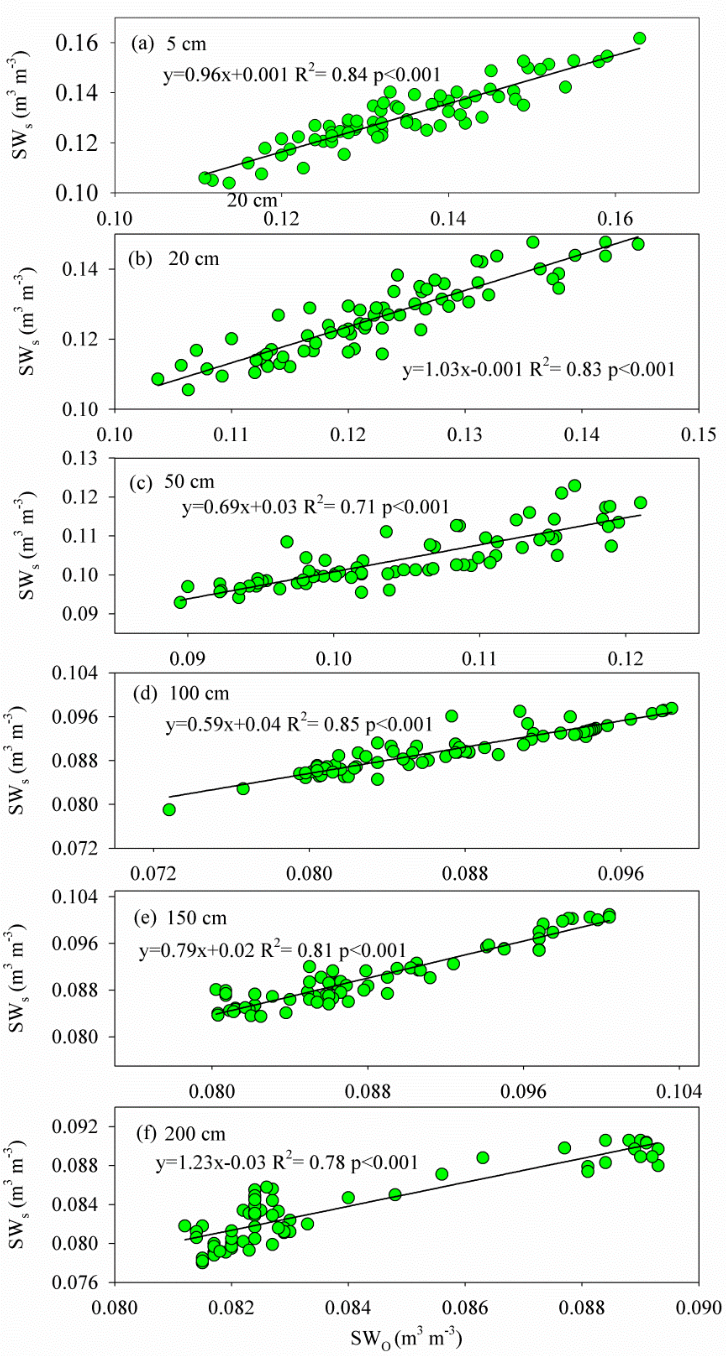


Figure A2. The relationship between observed (SW_O) and simulated (SW_s) soil water content at 5, 50, 50, 100, 150, and 200 cm depths during the HYDRUS-1D validation period (from DOY 203-273) in *H. rhamnoides* pure plantation.

Fourthly, the runoff was calculated through HYDRUS-1D in three plantation types. The result from this model indicated that no runoff was generated during the studied period from DOY 132 to 273. Thus, we expect that no runoff was generated during the time of our selected rainfall events. The detailed sentences can be observed in "2 Model calibration and validation, and runoff calculation" section in **"Appendix A".** (Page 10 Lines 98-101 in Appendix A)

2) In response to the description of plant uptake deep soil water, the relative sentences have been rewritten in "4.2 RRS uptake enhances plant transpiration for coexisting species in mixed plantation" subsection in "**4 Discussion**" section as follows: "Furthermore, similar to other studies in the Loess Plateau (Wang et al., 2020a; Wu et al., 2021), the deep soil layer generally exhibited lower SW than other soil layers in all plantation types in the present study (Fig. 1, Table S3). Jia et al. (2017) and Wang et al. (2020a) attributed the lower SW in deep soil layers to the imbalance between rainwater replenishment and plant uptake of water from this soil layer in the studied region. Silvertown et al. (2015) and Tang et al. (2019) suggested that coexisting plant species generally reduce water uptake from soil layers that exhibit low soil water content to avoid water source competition in these layers and maintain stable coexistence. In the present study, consistent with the second adaptation type, mixed afforestation significantly decreased the water uptake proportion from the deep soil layer for these species (Table S5). Thus, both increased rainwater-recharged soil water uptake and decreased water source competition from the deep soil layer were adopted by these species in the mixed plantation to minimize water sources competition under water limited conditions." (Page 23 Lines 504-514)

This paragraph mainly described the second adaptation type of coexisting plant species to cope with resource competition. Two types of adaptation can be adopted by plants among plant species to cope with resource competition in mixed plantations. The sentence has been mentioned in the previous paragraph: "Generally, two types of adaptation can be adopted by plants to cope with resource competition: increased competition ability or minimized competition interactions (West et al., 2007)." (Page 22 Lines 485-486).

In this paragraph, **Firstly,** we pointed out that the deep soil layer generally exhibited lower SW than other soil layers in all plantation types in the present study (Fig. 1, Table S3). Jia et al. (2017) and Wang et al. (2020a) attributed the lower SW in deep soil layers to the imbalance between rainwater replenishment and plant uptake of water from this layer. This is mainly because, during the dry period in this semiarid region, the SW in shallow and middle soil layers may similar or lower than the value in deep soil layer. For example, during DOY 180-200, the SW at 5 cm and 20 cm was lower than the value at 150cm (red cycle in Figure 1d as follows). Under this water limited conditions, plant generally absorbed more water from deep than from other soil layers. In general, at seasonal or annual timescale, the imbalance between rainwater replenishment and plant uptake of water from deep soil layer result to the lower SW in deep soil layers in the Loess Plateau (Figure 1). Coexisting plant species may reduce their water uptake proportion from deep soil layer and thus reduce water competition at this soil layer, compared with water sources for specific species in pure plantation.

Silvertown et al. (2015) and Tang et al. (2019) suggested that coexisting plant species generally reduce water uptake from soil layers that exhibit low soil water content to avoid water source competition in these layers and maintain stable coexistence. In addition, our result indicated that “mixed afforestation significantly decreased the water uptake proportion from the deep soil layer for these species”. Thus, we point out that “In the present study, consistent with the second adaptation type, mixed afforestation significantly decreased the water uptake proportion from the deep soil layer for these species (Table S5).” (Page 23 Lines 510-512).

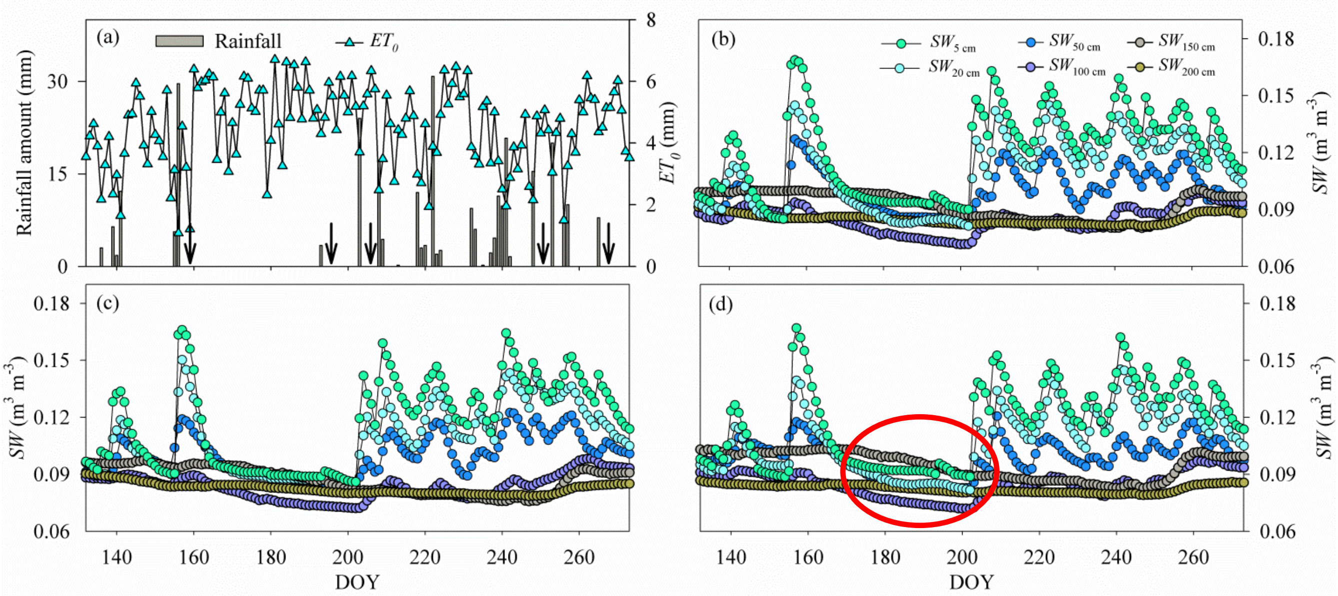


Figure 1. Variation in (a) rainfall amount, reference evapotranspiration (ET_0), and average (mean ± SD) soil water content (SW) in (b) *H. rhamnoides* pure plantation, (c) *P. tomentosa* pure plantation, and (d) mixed plantation from DOY 132 to 273 (11 May to 30 September) (n = 3). Standard deviation bars for SW at each soil layers are not shown to allow clear display of variation of SW for each plantation. Arrows in (a) indicate dates of sample collection at the first day after rainfall events: DOY 157 (6 June), DOY 194 (12 July), DOY 204 (23 July), DOY 249 (6 September), and DOY 265 (22 September).

Secondly, combined with the first adaptation type discussed in the previous paragraph (Page 22 Lines 486-495), we suggested that "Thus, both increased rainwater-recharged soil water uptake and decreased water source competition from the deep soil layer were adopted by these species in the mixed plantation to minimize water sources competition under water limited conditions." (Page 23 Lines 512-514)

3) Based on suggestion by **Reviewer 2,** two hypotheses and these hypotheses verification have been added in the previous revised manuscript. We have been rewritten the verification of these hypotheses in the current revised manuscript.

Two hypotheses have been added in the revised manuscript in "**1 Introduction**" section as follows: "Based on variations of plant water uptake from different soil layers and leaf water potential for these species in Xi et al. (2013) and Tang et al. (2019), we hypothesize that (1) the influence of RRS uptake and leaf water potential on plant transpiration may differ for these species in pure plantations, and (2) these influences may differ for specific species in pure and mixed plantations." (Page 4 Lines 102-106). RRS is the abbreviation for "Rainwater-recharged soil water", which has been mentioned at the first appearance in the first sentence in "**1 Introduction"** section (Page 2 Lines 39-42).

These tow hypotheses have also been verified in "**4 Discussion**" section. In response to the first hypothesis, the sentence has been rewritten in "4.1 RRS uptake enhances plant transpiration for *H. rhamnoides* but not *P. tomentosa* in pure plantations" subsection as follows: "Consistent with the first hypothesis, the influence of RRS uptake and $\Psi_{pd}-\Psi_m$ on SF_R was different for these species in pure plantations." (Page 20 Lines 451-452). The SF_R was significantly influenced by RUP and $\Psi_{pd}-\Psi_m$ for *H. rhamnoides* in the pure plantation, indicating that RRS uptake and leaf physiological adjustment enhanced its plant transpiration (Figs. 6 and 7). However, the SF_R was significantly influenced by $\Psi_{pd}-\Psi_m$ for *P. tomentosa* (Fig. 6), suggesting that its transpiration was mainly constrained by plant physiological characteristics.

In response to the second hypothesis, the relative sentence has been added in "4.2 RRS uptake enhances plant transpiration for coexisting species in mixed plantation" subsection: "The different influence of RUP and $\Psi_{pd}-\Psi_m$ on SF_R for specific species in pure and mixed plantations was consistent with the second hypothesis. The significant influence of RUP and $\Psi_{pd}-\Psi_m$ on SF_R was observed for *P. tomentosa* in mixed plantation (Fig. 6). Meanwhile, for *H. rhamnoides* in mixed plantation compared to specific value in pure plantation, larger and smaller slopes in linear regression were observed between SF_R and RUP, and SF_R and $\Psi_{pd}-\Psi_m$, respectively (Fig. 6)." (Page 22 Lines 495-499).

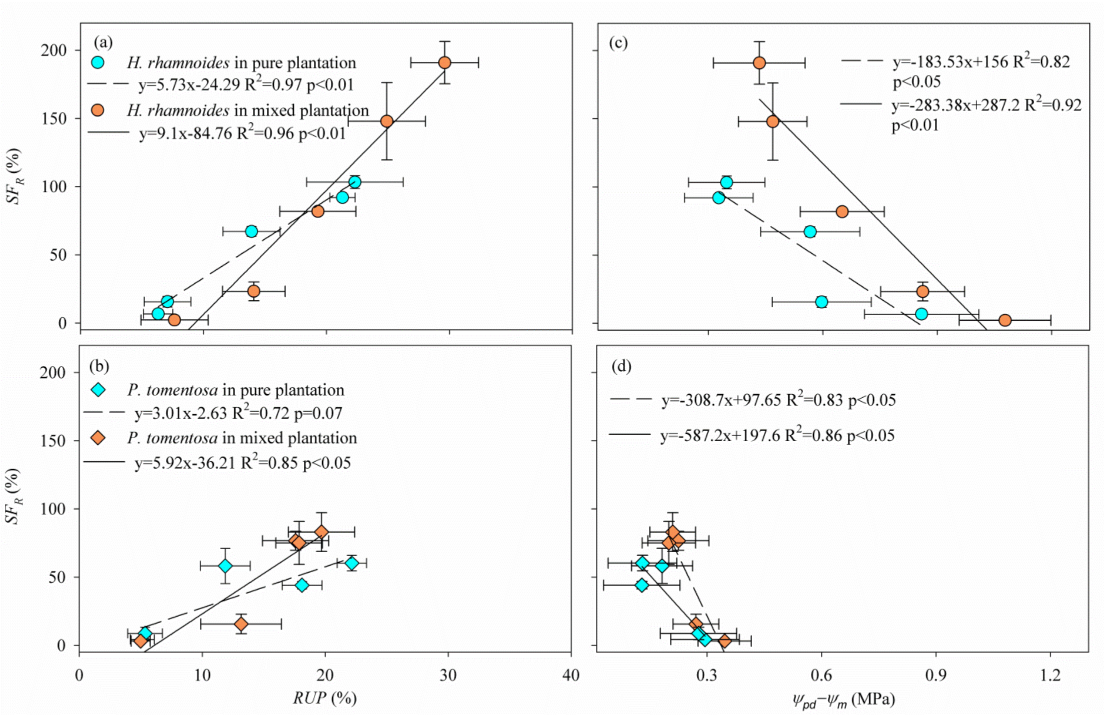


Figure 6. Relationship of average (a, b) rainwater-recharged soil water uptake proportion (RUP) and (c, d) leaf water potential gradient (Ψ_{pd}–Ψ_{m}) with relative response of normalized F_d (SF_R) for *H. rhamnoides* and *P. tomentosa* in both plantation types (n = 3).

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Wang, S. F., An, J., Zhao, X. N., Gao, X. D., Wu, P., Huo, G. P., and Robinson, B. H.: Age- and climate- related water use patterns of apple trees on China's Loess Plateau, J Hydrol, 582, 2020b.

Minor Comments:

1) What is the filtration property?

Response: Rewritten. Thanks for this suggestion, the term “filtration property” is not an exact expression, this term has been rewritten to an exact term as “soil saturated hydraulic conductivity”. This sentence has been written in revised manuscript in “2.1 Study site” subsection in “**2 Materials and methods**” section as follows: “Based on an experiment conducted in July 2018 using the cutting ring (Wu et al., 2016) and constant water head (Reynolds et al., 2002) method, the soil bulk density, total porosity, and saturated hydraulic conductivity at 0–50 cm soil depth were similar in three plantations.” (Page 5 Lines 130-132)

The saturated hydraulic conductivity is a soil property that has a role in the partitioning of rainfall into surface runoff and infiltration. This parameter can be used to describe water movement under saturated conditions in the soils. Soils with small values of hydraulic conductivity generally have low infiltration rates. The detailed information of this index can be observed in Morbidelli et al. (2017) and Jadczyszyn and Niedzwiecki (2005).

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Jadczyszyn, J., and Niedzwiecki, J.: Relation of saturated hydraulic conductivity to soil losses, Pol J Environ Stud, 14, 431-435, 2005.

2) What is the capillary porosity? How is this defined?

Response: Clarified and Rewritten. In response to this suggestion, the "capillary porosity" has been deleted in the revised manuscript to eliminate the possible misleading. This sentence has been rewritten in "2.1 Study site" subsection in "**2 Materials and methods**" section as follows: "Based on an experiment conducted in July 2018 using the cutting ring (Wu et al., 2016) and constant water head (Reynolds et al., 2002) method, the soil bulk density, total porosity, and saturated hydraulic conductivity at 0–50 cm soil depth were similar in three plantations. The average soil bulk density was 1.34 ± 0.04, 1.31 ± 0.05, and 1.31 ± 0.05 g cm^{-3} for pure *H. rhamnoides*, pure *P. tomentosa*, and mixed plantations, respectively, and corresponding soil total porosity was 48.25 ± 0.52, 48.17 ± 0.48, and 48.03 ± 0.63%. The average soil saturated hydraulic conductivity was 0.51 ± 0.15, 0.54 ± 0.13, and 0.53 ± 0.11 mm min^{-1} mm min^{-1} for pure *H. rhamnoides*, pure *P. tomentosa*, and mixed plantations, respectively." (Pages 5-6 Lines 130-137)

Soil total porosity = soil non-capillary porosity + soil capillary porosity. Soil non-capillary porosity consists of large soil pores with diameters larger than 0.1 mm, which would not hold water tightly through capillary forces but would permit the percolation of water and the ready entrance of air (Baver et al., 1939; Yu et al., 2018). Meanwhile, soil capillary porosity consists of soil pores with diameters smaller than 0.1 mm, which would hold water tightly through capillary forces. The detailed methods calculate soil total porosity, soil capillary porosity, and soil non-capillary porosity can be observed in Wu et al. (2016) and Yu et al. (2018).

Reference:

Wu, G. L., Yang, Z., Cui, Z., Liu, Y., Fang, N. F., and Shi, Z. H.: Mixed artificial grasslands with more roots improved mine soil infiltration capacity, J Hydrol, 535, 54-60, 2016.

Yu, B. Q., Xie, C. K., Cai, S. Z., Chen, Y., Lv, Y. P., Mo, Z. L., Liu, T. L., and Yang, Z. W.: Effects of Tree Root Density on Soil Total Porosity and Non-Capillary Porosity Using a Ground-Penetrating Tree Radar Unit in Shanghai, China, Sustainability-Basel, 10, Artn 4640 10.3390/Su10124640, 2018.

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3) but this is not directly an answer to the question of whether runoff took place, is it? This is now referring to other works ?

Response: Rewritten. In response to this meaningful suggestion, we have rewritten these sentences and directly answer whether runoff occurred through HYDRUS-1D model. The detailed sentences can be observed in “2.4 Rainwater, plant stem, soil water, and leaf sample collection and measurement” subsection in “**2 Materials and methods**” section as follows: “In addition, no runoff was generated during the selected rainfall events in three plantations according to the simulated result from the HYDRUS-1D model (Appendix A), which is based on the Richards’ equation to describe soil water dynamics (Šimůnek et al., 2008). This model has been widely used to simulate the runoff and soil water dynamics in the Loess Plateau (Yi and Fan, 2016; Bai et al., 2020; Wang et al., 2020b).” (Page 8 Lines 195-199)

The HYDRUS-1D model was used in the revised manuscript to calculate the runoff in three plantations. This model has been widely used to simulate the runoff and soil water dynamics in the Loess Plateau (Yi and Fan, 2016; Cai et al., 2018; Bai et al., 2020; Wang et al., 2020b). In Appendix A, the detailed information of this model, the basic data sources should be inputs in this model, the calibration and validation of this model, and the runoff result calculated by this model can be observed. More information can be observed in Appendix A in the manuscript and in response to *Major Comments* for Editor.

References:

Yi, C. Q., and Fan, J.: Application of HYDRUS-1D model to provide antecedent soil water contents for analysis of runoff and soil erosion from a slope on the Loess Plateau, Catena, 139, 1-8, 2016.

Cai, Y. H., Wu, P. T., Zhang, L., Zhu, D. L., Wu, S. J., Zhao, X., Chen, J. Y., and Dong, Z.: Prediction of flow characteristics and risk assessment of deep percolation by ceramic emitters in loam, J Hydrol, 566, 901-909, 2018.

Bai, X., Jia, X. X., Jia, Y. H., Shao, M. A., and Hu, W.: Modeling long-term soil water dynamics in response to land-use change in a semi-arid area, J Hydrol, 585, 2020.

Wang, S. F., An, J., Zhao, X. N., Gao, X. D., Wu, P., Huo, G. P., and Robinson, B. H.: Age- and climate- related water use patterns of apple trees on China's Loess Plateau, J Hydrol, 582, 2020b.

4) But this does not have anything to do with the question of whether run-off took place. In that question the reviewers wanted to know whether you can say if the precipitation was really all infiltrating and thus available as soil water to the plants. Here you refer to a method to avoid run-off, but that is a different issue.

Response: Deleted. Thanks for this meaningful suggestion, we deleted these sentences mentioned above in the revised manuscript. These sentences were not related to the topic of this manuscript.

5) I think it would be helpfull if you could add something about the rainfall intensities, as that is a better indicator than rainfall amount, of whether runoff might take place, but this is a very rough estimate if you have just divided the total rainfall by the event duration, as rainfall is seldom distributed evenly over a long period. In the figure you give in this explanation it is clear that the rainfall does not exceed 4.5 mm in 30 minutes, which is 0.15 mm/min? and thus larger than the 0.05 mm/min you mention in this text.

Response: Added and Rewritten. Thanks for this valuable comment, we deleted these sentences that compared the observed runoff results from Huang et al. (2014) and Pan and Shuangguan (2005) in the Loess Plateau. In the revised manuscript, the HYDRUS-1D model was used to calculate the runoff during the time of our selected rainfall events in three plantations. This model has been widely used to simulate the runoff and soil water dynamics in the Loess Plateau (Yi and Fan, 2016; Cai et al., 2018; Bai et al., 2020; Wang et al., 2020b). The relative sentence has been added in “2.4 Rainwater, plant stem, soil water, and leaf sample collection and measurement” subsection in “**2 Materials and methods**” section as follows: “In addition, no runoff was generated during the selected rainfall events in three plantations according to the simulated result from the HYDRUS-1D model (Appendix A), which is based on the Richards’ equation to describe soil water dynamics (Šimůnek et al., 2008). This model has been widely used to simulate the runoff and soil water dynamics in the Loess Plateau (Yi and Fan, 2016; Bai et al., 2020; Wang et al., 2020b).” (Page 8 Lines 195-199)

More information can be observed in Appendix A in the manuscript and in response to *Major Comments* for Editor.

6) expect would be a better word choice here.

Response: Rewritten. The term “expect” was used in the sentence in “2 Model calibration and validation, and runoff calculation” subsection in **Appendix A** as follows: “Thus, we expect that no runoff would be generated during the selected rainfall events.” (Page 10 Lines 100-101 in Appendix A)

7) this is also not really the focus of your paper and is misleading. It undermines your message, by distracting the reader.

Response: Deleted. We deleted this sentence, because this sentence really undermines our message and distracting the reader. Thanks for this meaningful and helpful suggestion again!

8) I don't really understand what you mean to say here. I would think that the plants would then just uptake water from shallower layers, if there is more water there, instead of using more energy to do uptake from deep layers.

Response: Rewritten. In response to this suggestion, these sentences have been rewritten in “4.2 RRS uptake enhances plant transpiration for coexisting species in mixed plantation” subsection in “**4 Discussion**” section as follows: “Furthermore, similar to other studies in the Loess Plateau (Wang et al., 2020a; Wu et al., 2021), the deep soil layer generally exhibited lower SW than other soil layers in all plantation types in the present study (Fig. 1, Table S3). Jia et al. (2017) and Wang et al. (2020a) attributed the lower SW in deep soil layers to the imbalance between rainwater replenishment and plant uptake of water from this soil layer in the studied region. Silvertown et al. (2015) and Tang et al. (2019) suggested that coexisting plant species generally reduce water uptake from soil layers that exhibit low soil water content to avoid water source competition in these layers and maintain stable coexistence. In the present study, consistent with the second adaptation type, mixed afforestation significantly decreased the water uptake proportion from the deep soil layer for these species (Table S5). Thus, both increased rainwater-recharged soil water uptake and decreased water source competition from the deep soil layer were adopted by these species in the mixed plantation to minimize water sources competition under water limited conditions.” (Page 23 Lines 504-514)

This paragraph mainly described the second adaptation type of coexisting plant species to cope with resource competition. Two types of adaptation can be adopted by plants among plant species to cope with resource competition in mixed plantations. The sentence has been mentioned in the previous paragraph: “Generally, two types of adaptation can be adopted by plants to cope with resource competition: increased competition ability or minimized competition interactions (West et al., 2007).” (Page 22 Lines 485-486).

In this paragraph, **Firstly,** we pointed out that the deep soil layer generally exhibited lower SW than other soil layers in all plantation types in the present study (Fig. 1, Table S3). Jia et al. (2017) and Wang et al. (2020a) attributed the lower SW in deep soil layers to the imbalance between rainwater replenishment and plant uptake of water from this layer. This is mainly because, during the dry period in this semiarid region, the SW in shallow and middle soil layers may similar or lower than the value in deep soil layer. Under this water limited conditions, plant generally absorbed more water from deep than from other soil layers. In general, at seasonal or annual timescale, the imbalance between rainwater replenishment and plant uptake of water from deep soil layer result to the lower SW in deep soil layers in the Loess Plateau. Coexisting plant species may reduce their water uptake proportion from deep soil layer and thus reduce water competition at this soil layer, compared with water sources for specific species in pure plantation.

Silvertown et al. (2015) and Tang et al. (2019) suggested that coexisting plant species generally reduce water uptake from soil layers that exhibit low soil water content to avoid water source competition in these layers and maintain stable coexistence. In addition, our result indicated that “mixed afforestation significantly decreased the water uptake proportion from the deep soil layer for these species”. Thus, we point out that “In the present study, consistent with the second adaptation type, mixed afforestation significantly decreased the water uptake proportion from the deep soil layer for these species (Table S5).” (Page 23 Lines 510-512).

Secondly, combined with the first adaptation type discussed in the previous paragraph (Page 22 Lines 486-495), we suggested that “Thus, both increased rainwater-recharged soil water uptake and decreased water source competition from the deep soil layer were adopted by these species in the mixed plantation to minimize water sources competition under water limited conditions.” (Page 23 Lines 512-514)

More information can be observed in response to *Major Comments* for Editor.

References:

Jia, X. X., Shao, M. A., Zhu, Y. J., and Luo, Y.: Soil moisture decline due to afforestation across the Loess Plateau, China, J Hydrol, 546, 113-122, 2017.

Wang, J., Fu, B. J., Wang, L. X., Lu, N., and Li, J. Y.: Water use characteristics of the common tree species in different plantation types in the Loess Plateau of China, Agr Forest Meteorol, 288, ARTN 108020, 10.1016/j.agrformet.2020.108020, 2020a.

Wu, W. J., Li, H. J., Feng, H., Si, B. C., Chen, G. J., Meng, T. F., Li, Y., and Siddique, K. H. M.: Precipitation dominates the transpiration of both the economic forest (Malus pumila) and ecological forest (Robinia pseudoacacia) on the Loess Plateau after about 15 years of water depletion in deep soil, Agr Forest Meteorol, 297, ARTN 108244, 10.1016/j.agrformet.2020.108244, 2021.

Silvertown, J., Araya, Y., and Gowing, D.: Hydrological niches in terrestrial plant communities: a review, J Ecol, 103, 93-108, 10.1111/1365-2745.12332, 2015.

Tang, Y. K., Wu, X., Chen, C., Jia, C., and Chen, Y. M.: Water source partitioning and nitrogen facilitation promote coexistence of nitrogen-fixing and neighbor species in mixed plantations in the semiarid Loess Plateau, Plant Soil, 445, 289-305, 10.1007/s11104-019-04301-9, 2019.

West, A. G., Hultine, K. R., Jackson, T. L., and Ehleringer, J. R.: Differential summer water use by Pinus edulis and Juniperus osteosperma reflects contrasting hydraulic characteristics, Tree Physiol, 27, 1711-1720, 10.1093/treephys/27.12.1711, 2007.

Reviewer 1

Major Comments:

1) Do you have any information about runoff generation of the studied plantation sites? Any runoff after rainfall pulse may influence the result of your manuscript since the contribution of precipitation to plant water uptake is central to your study, although precipitation amount was not the direct independent factor used during the data analysis. So, considered the potential runoff may strengthen and validity your result.

Response: Added and Clarified. In response to this meaningful suggestion, we added the relative sentence in "2.4 Rainwater, plant stem, soil water, and leaf sample collection and measurement" subsection in "**2 Materials and methods**" section as follows: "In addition, no runoff was generated during the selected rainfall events in three plantations according to the simulated result from the HYDRUS-1D model (Appendix A), which is based on the Richards' equation to describe soil water dynamics (Šimůnek et al., 2008). This model has been widely used to simulate the runoff and soil water dynamics in the Loess Plateau (Yi and Fan, 2016; Bai et al., 2020; Wang et al., 2020b)." (Page 8 Lines 195-199).

In the revised manuscript, the HYDRUS-1D model was used to calculate the runoff during the selected rainfall events in three plantations. This model has been widely used to simulate the runoff and soil water dynamics in the Loess Plateau (Yi and Fan, 2016; Bai et al., 2020; Wang et al., 2020b). The detailed information of this model, the basic data sources should be inputs in this model, the calibration and validation of this model, and the runoff result calculated by this model can be observed in **Appendix A** in the revised manuscript.

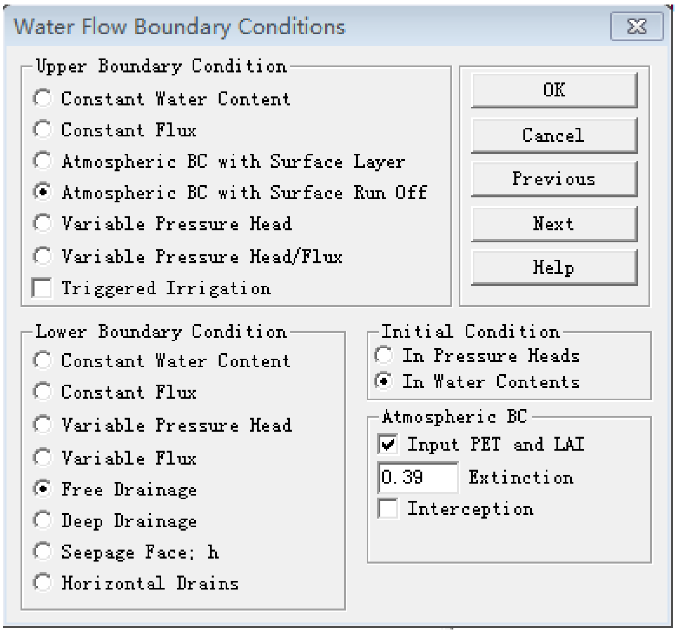
In Appendix A, **firstly**, we described the equation of the HYDRUS-1D model. After that, we pointed that this model has been widely used to simulate the runoff and soil water dynamics in the Loess Plateau (Yi and Fan, 2016; Bai et al., 2020; Wang et al., 2020b). The relative sentences can be observed as follows: "

The HYDRUS-1D model is based on the Richards' equation (Richards, 1931) to describe soil water dynamics (Šimůnek et al., 2008; Šimůnek et al., 2013):

$$\partial\theta/\partial t=\partial/\partial z\left(K(h,z)((\partial h/\partial z)+1)\right)-S_r(z,t) \tag{1}$$

where θ, t, h, and z are the soil moisture content (SW, cm^3 cm^{-3}), simulation time (day), pressure head (cm), and vertical coordinate (cm), respectively. $K(h, z)$ and S_r (z, t) are the unsaturated hydraulic conductivity (cm day^{-1}) (Mualem, 1976; van Genuchten, 1980) and root water uptake (cm^3 cm^{-3} day^{-1}), respectively.

This model has been widely used to simulate soil water hydrological processes with HYDRUS-1D software (Šimůnek et al., 2013), such as soil water content dynamics and runoff in the Loess Plateau (Yi and Fan, 2016; Bai et al., 2020; Wang et al., 2020b). The model was used to calculate the runoff for each plantation type in this study, after calibration and validation this model using the observed SW. Based on suggestions in Yi and Fan (2016) and Bai et al. (2020), the atmospheric boundary condition with surface runoff and free drainage were selected as upper and lower boundary condition, respectively, to calibrate and validate this model and calculate runoff (Fig. A1).



Water Flow Boundary Conditions

Upper Boundary Condition
○ Constant Water Content
○ Constant Flux
○ Atmospheric BC with Surface Layer
● Atmospheric BC with Surface Run Off
○ Variable Pressure Head
○ Variable Pressure Head/Flux
☐ Triggered Irrigation

Lower Boundary Condition
○ Constant Water Content
○ Constant Flux
○ Variable Pressure Head
○ Variable Flux
● Free Drainage
○ Deep Drainage
○ Seepage Face; h
○ Horizontal Drains

Initial Condition
○ In Pressure Heads
● In Water Contents

Atmospheric BC
☑ Input PET and LAI
0.39 Extinction
☐ Interception

Figure A1. The upper and lower boundary conditions selection in HYDRUS-1D software (Version 4.15).

” (Pages 1-2 Lines 2-18 in Appendix A)

Secondly, the basic data sources should be inputs in this model were clearly descripted. These data sources included the observed meteorological, plant, and soil hydraulic parameters.

For meteorological parameters, the relative sentences can be observed in "**1.1 Meteorological parameters" subsection in "Appendix A"** as follows: "The meteorological parameters required for HYDRUS-1D include relative humidity, wind speed (W_S), air temperature, rainfall amount, and reference evapotranspiration (ET_0). Daily relative humidity, maximum, minimum and average air temperatures, W_S, and rainfall amount were measured by a weather station approximately 500 m from the research plots. The ET_0 (cm day^{-1}) was calculated through method described by Allen et al. (1998). The detailed information can be observed in "2.2 Environmental parameter measurements and ET_0 calculation" subsection in the manuscript." (Pages 2-3 Lines 24-29 in Appendix A)

For plant parameters, the relative sentences can be observed in "**1.2 Plant parameters" subsection in "Appendix A"** as follows: "The plant parameters required for HYDRUS-1D include plant height, root depth, and potential transpiration rate. Plant height and root depth in each plantation type can be observed in Table S1 and Figure S4 in the manuscript, respectively. The leaf area index (LAI) was measured monthly, from May to September, for each plantation type using a LAI-2200 (LiCor Inc., Lincoln, USA). The potential transpiration rate (cm day^{-1}) was calculated using the Beer equation (Ritchie, 1972) based on the measured LAI and extinction coefficient value (0.39) suggested in Šimůnek et al. (2013)." (Page 3 Lines 31-36 in Appendix A)

For soil hydraulic parameters, the relative sentences can be observed in "**1.3 Soil hydraulic parameters" subsection in "Appendix A"** as follows: "The saturated soil water content (θs) and hydraulic conductivity (Ks), van Genuchten model parameters (α and n), and residual soil water content (θr) were required parameters for HYDRUS-1D. The Ks, θs, and soil bulk density (BD) at soil depth intervals of 0-20, 20-50, 50-100, and 100-200 cm were measured in July 2018 using the cutting ring (Wu et al., 2016) and constant water head (Reynolds et al., 2002) method in each plantation type. The soil particle composition was determined using a Mastersize 2000 (Malvern Instruments Ltd., UK). Additionally, the slopes for these three plantation types were required for HYDRUS-1D. The detailed information can be observed in "2.1 Study site" subsection in the manuscript. The measured soil hydraulic parameters for the three plantation types are shown in Table A1. The Rosetta pedotransfer function was used to calculate θr, α, and n (Jana and Mohanty, 2012; Bai et al., 2020).

Table A1. Measured soil hydraulic parameters and particle composition in both pure and mixed plantations

	Soil depth (cm)	Soil particle composition			Soil hydraulic parameter		
		Sand (%)	Silt (%)	Clay (%)	θ_s (cm^3 cm^{-3})	BD (g cm^{-3})	Ks (cm day^{-1})
H. rhamnoides pure plantation	0-20	26.4	63.5	10.1	0.37	1.28	75.7
	20-50	22.2	61.6	16.2	0.34	1.4	70.3
	50-100	23.5	63.1	13.4	0.32	1.44	55.4
	100-200	24.7	63.8	11.5	0.29	1.48	50.6
P. tomentosa pure plantation	0-20	25.8	62.2	12	0.35	1.21	82.4
	20-50	23.7	62.5	13.8	0.35	1.33	73.7
	50-100	22.2	61.5	16.3	0.31	1.42	58.9
	100-200	24.9	64.8	10.3	0.3	1.45	52.6
Mixed plantation	0-20	25.5	63.8	10.7	0.36	1.25	78.5
	20-50	24.3	62.7	13	0.35	1.31	73.2
	50-100	23.8	64.9	11.3	0.34	1.39	60.5
	100-200	24.6	63.7	11.7	0.31	1.45	53.4

θ_s= saturated soil water content, Ks=saturated hydraulic conductivity, BD= soil bulk density ”

” (Pages 3-4 Lines 38-50 in Appendix A)

Thirdly, the measured SW in the present study in each plantation type was used for model calibration and validation. The SW at each soil depths in each plantation type from DOY 132 to 202 was used to calibrate the HYDRUS-1D. And some soil hydraulic parameters were optimized through the inverse solution module in HYDRUS-1D during the model calibration (Table A2).

Table A2. Optimized soil hydraulic parameters in both pure and mixed plantations through HYDRUS-1D

	Soil depth (cm)	θr (cm^3 cm^{-3})	θs (cm^3 cm^{-3})	Ks (cm day^{-1})	*a*	*n*
H. rhamnoides pure plantation	0-20	0.08	0.36	74.9	0.018	1.6
	20-50	0.08	0.34	71.2	0.018	1.6
	50-100	0.0823	0.31	56.2	0.01	1.45
	100-200	0.0823	0.3	51.5	0.01	1.43
P. tomentosa pure plantation	0-20	0.08	0.36	82.1	0.019	1.62
	20-50	0.08	0.35	73.5	0.018	1.6
	50-100	0.0821	0.31	59.2	0.01	1.51
	100-200	0.0822	0.31	51.6	0.011	1.47
Mixed plantation	0-20	0.08	0.37	79.2	0.018	1.61
	20-50	0.08	0.36	74.2	0.018	1.61
	50-100	0.0822	0.34	60.2	0.011	1.46
	100-200	0.0823	0.3	55.8	0.011	1.45

θ_r= residual soil water content, *Ks*=saturated hydraulic conductivity, θ_s= saturated soil water content, *a* and *n* = parameters of van Genuchten model.

Subsequently, the SW from DOY 203 to 273 in each plantation type was used to validate the model. The root mean square error (RMSE), Nash-Sutcliffe efficiency coefficient (NSE), and determinant coefficient (R^2) based on the observed and simulated SW was used to evaluate the model performance (Bai et al., 2020). The calculated RMSE, NSE, and R^2 indicated that the simulated results were acceptable for three plantation types in this study (Table A3), based on the criterions suggested in Bai et al. (2020) and Wang et al. (2020b). The detailed sentences can be observed in “2 Model calibration and validation, and runoff calculation” section in **“Appendix A”.** (Pages 5-10 Lines 53-96 in Appendix A)

Table A3. The RMSE, NSE, and R^2 between the observed and simulated SW during the HYDRUS-1D validation period (from DOY 203-273)

	Soil depth (cm)	RMSE	NSE	R^2
H. rhamnoides pure plantation	5	0.008	0.65	0.84
	20	0.006	0.58	0.83
	50	0.006	0.7	0.71
	100	0.008	0.56	0.85
	150	0.005	0.59	0.81
	200	0.006	0.52	0.78
P. tomentosa pure plantation	5	0.008	0.67	0.79
	20	0.008	0.62	0.76
	50	0.006	0.72	0.82
	100	0.009	0.59	0.75
	150	0.008	0.57	0.83
	200	0.009	0.61	0.78
Mixed plantation	5	0.009	0.61	0.81
	20	0.01	0.54	0.76
	50	0.008	0.68	0.82
	100	0.008	0.7	0.79
	150	0.006	0.76	0.82
	200	0.008	0.67	0.81

RMSE= root mean square error, NSE = Nash-Sutcliffe efficiency coefficient, R^2= determinant coefficient

The simulated SWs at different soil depths closely matched the variation of these values observed from DOY 203 to 273, the example can be observed in the *H. rhamnoides* pure plantation in Figs. A1 and A2.

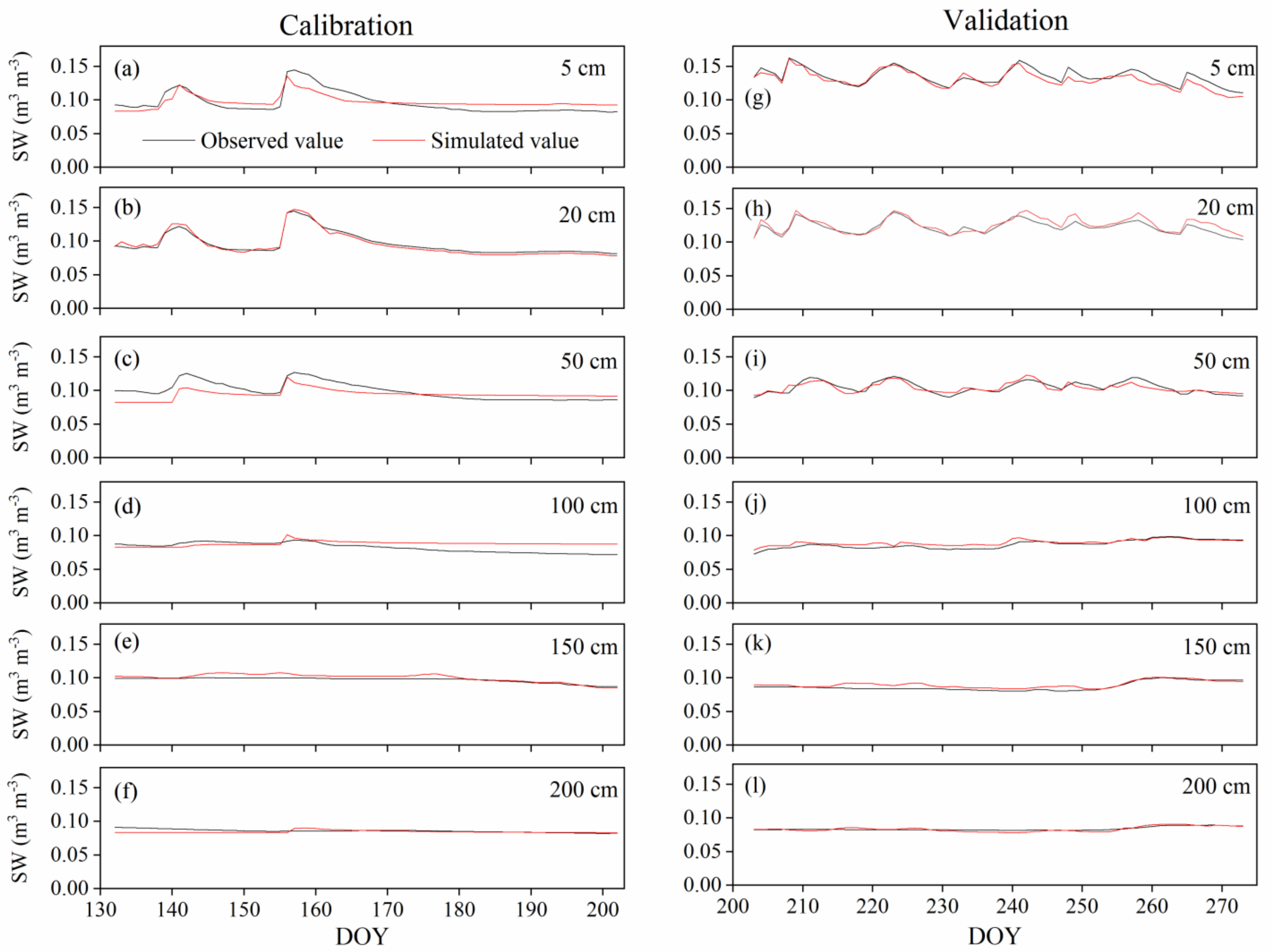


Figure A1. Variation in soil water content (SW) at 5, 50, 50, 100, 150, and 200 cm depths during the HYDRUS-1D (a-f) calibration (from DOY 132-202) and (g-l) validation (from DOY 203-273) period in *H. rhamnoides* pure plantation.

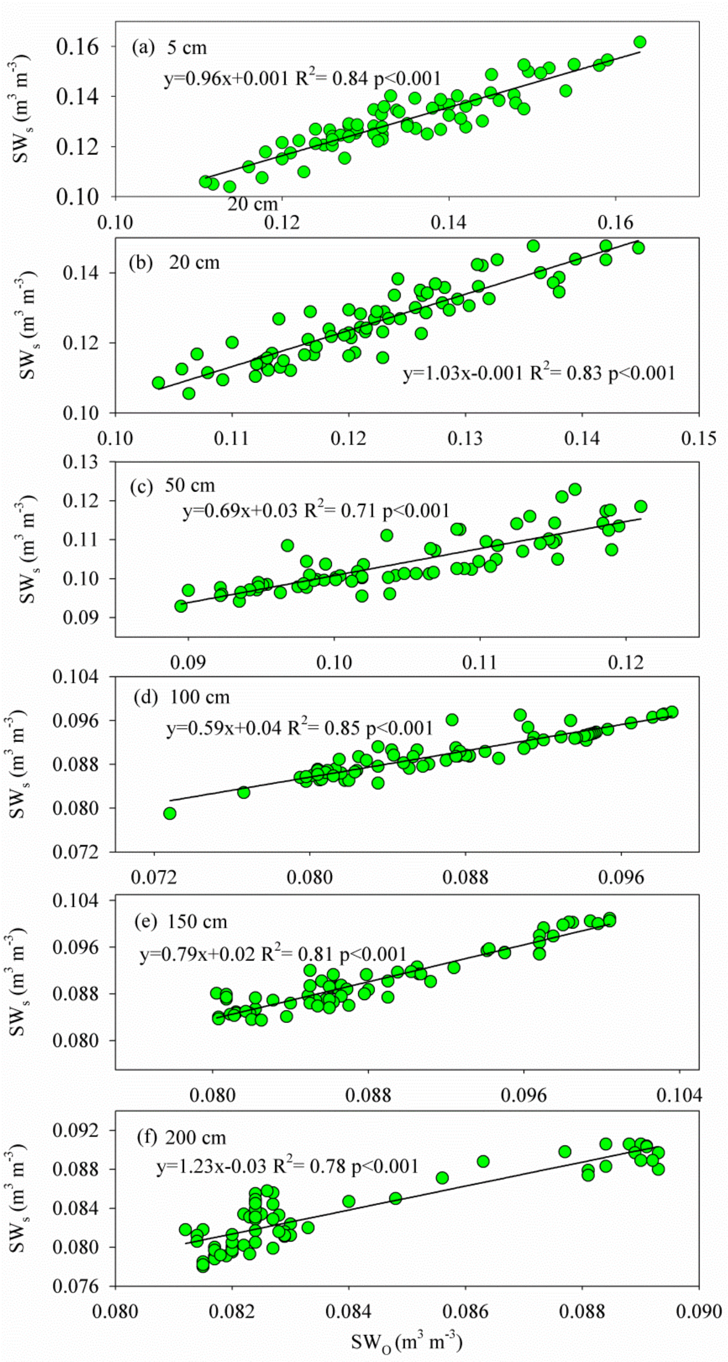


Figure A2. The relationship between observed (SW_O) and simulated (SW_S) soil water content at 5, 50, 50, 100, 150, and 200 cm depths during the HYDRUS-1D validation period (from DOY 203-273) in *H. rhamnoides* pure plantation.

Fourthly, the runoff was calculated through HYDRUS-1D in three plantation types. The result from this model indicated that no runoff was generated during the studied period from DOY 132 to 273. Thus, we expect that no runoff was generated during the time of our selected rainfall events. The detailed sentences can be observed in "2 Model calibration and validation, and runoff calculation" section in

“Appendix A”. (Page 10 Lines 98-101 in Appendix A)

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Allen, R.G., Periera, L.S., Raes, D., and Smith, M.: Crop evapotranspiration: Guidelines for Computing Crop Requirements, Irrigation and Drainage paper NO.56, FAO, Rome, Italy, 300, 1998.

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van Genuchten, M.T., 1980. A closed-form equation for predicting the hydraulic conductivity of unsaturated soils. Soil Sci. Soc. Am. J. 44, 892–898. https://doi.org/10.2136/sssaj1980.03615995004400050002x.

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Bai, X., Jia, X. X., Jia, Y. H., Shao, M. A., and Hu, W.: Modeling long-term soil water dynamics in response to land-use change in a semi-arid area, J Hydrol, 585, 2020.

Wang, S. F., An, J., Zhao, X. N., Gao, X. D., Wu, P., Huo, G. P., and Robinson, B. H.: Age- and climate- related water use patterns of apple trees on China's Loess Plateau, J Hydrol, 582, 2020b.

2) Throughout the manuscript, there are also some instances where the term seems inappropriately use (e.g. only). I would suggest going through the entire paper and refining the language to more accurately reflect the result.

Response: Rewritten and clarified. Thanks for your suggestion, the entire manuscript has been reviewed and the relative terms have been rewritten in the revised version.

For example, based on the suggestion by the other reviewer, the term “plant water consumption” and “rainwater uptake” has been revised to “plant transpiration” and “rainwater-recharged soil water”, respectively, in the revised manuscript. The RRS was used as the abbreviation for “rainwater-recharged soil water” in the revised manuscript. And the **Title** of the revised manuscript has also been rewritten as “Differential response of plant transpiration to uptake of rainwater-recharged soil water for dominant tree species in the semiarid Loess Plateau” (Page 1 Lines 1-2).

For example, the “only” has also been deleted in the revised manuscript in “**Abstract**” section as follows: “In pure plantations, the relative response of daily normalized sap flow (SF_R) was significantly affected by RRS uptake proportion (RUP) and $\Psi_{pd}-\Psi_m$ for *H. rhamnoides*, and was significantly influenced by $\Psi_{pd}-\Psi_m$ for *P. tomentosa* ($P < 0.05$).” (Page 1 Lines 20-22)

3) Potential/Reference Evapotranspiration is a key parameter indicator that reflect atmospheric evaporative demand, and also support some part of you conclusion. However, why the Reference evapotranspiration (ET0) was used in the study, because there are some other indicator also reflect the evaporative demand.

Response: Clarified and rewritten. In response to this meaningful suggestion, the advantage of Reference evapotranspiration (ET_0) has been added in “2.2 Environmental parameter measurements and ET_0 calculation” subsection in “**2 Materials and methods**” section as follows: “ET_0, considering both aerodynamic characteristics and energy balance, was used to indicate atmospheric evaporative demand (Allen et al., 1998):” (Page 6 Lines 153-154).

Indeed, there are several Equations that calculated the potential or reference evapotranspiration. The ET_0 equation in the present study is used as the standard method by the FAO (Food and Agriculture Organization of the United Nations), and has been widely used for evaluate other ET_0 equations (Xiang et al., 2020). The advantage of the Equation that we used considered both aerodynamic aspects and energy balance, because evapotranspiration is a process that liquid water is converted vapor phase and then the vapor moves. The detailed information can be observed in a review of difference of reference crop evapotranspiration in Xiang et al. (2020).

References:

Allen, R.G., Periera, L.S., Raes, D., and Smith, M.: Crop evapotranspiration: Guidelines for Computing Crop Requirements, Irrigation and Drainage paper NO.56, FAO, Rome, Italy, 300, 1998.
Xiang, K. Y., Li, Y., Horton, R., and Feng, H.: Similarity and difference of potential evapotranspiration and reference crop evapotranspiration - a review, Agr Water Manage, 232, 10.1016/J.Agwat.2020.106043, 2020.

4) This manuscript should be looked over by a language editing service and/or a native English speaker - there are some grammatically incorrect and/or awkward phrasings.

Response: Rewritten. Thanks for your suggestion; the entire revised manuscript has been reviewed and the language has been refined by *International Science Editing*.

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To whom it may concern,

The paper "Differential response of plant transpiration to uptake of rainwater-recharged soil water for dominant tree species in the semiarid Loess Plateau" by Yakun Tang was edited by International Science Editing. We were asked not to edit the references. Please contact us if you would like to view the edited paper.

Kindest regards,

David Cushley.

If the English is still not meet the standard, please give me another chance, I will revised the language by another scientific editing service company again.

Minor Comments:

1) Lines 22 "only" is too arbitrary

Response: Deleted. This sentence has been rewritten in "**Abstract**" section as follows: "In pure plantations, the relative response of daily normalized sap flow (SF_R) was significantly affected by RRS uptake proportion (RUP) and $\Psi_{pd}-\Psi_m$ for *H. rhamnoides*, and was significantly influenced by $\Psi_{pd}-\Psi_m$ for *P. tomentosa* ($P < 0.05$).” (Page 1 Lines 20-22).

2) Lines 30-32 “Regardless of sensitivity to rainfall pulses” ? this short sentence should be rewritten.

Response: Rewritten. Thanks for this meaningful suggestion**,** this sentence has been rewritten in “**Abstract**” section as follows: “These results indicate that mixed afforestation enhanced the influence of RRS uptake to plant transpiration for these different rainfall pulse sensitive plants.” (Page 2 Lines 30-31).

3) Lines 54-57 The “water uptake” should also be clearly described.

Response: Rewritten. In response to this meaningful suggestion, the sentence has been rewritten in “**1 Introduction**”as follows: “The controversial rainfall pulse response between RRS uptake and plant transpiration may be mainly attributed to an inconsistent influence of plant leaf physiological characteristics (West et al., 2007), root morphology adjustment (Wang et al., 2020a), or environmental conditions (Tfwala et al., 2019) on these two water processes.” (Pages 2-3 Lines 53-56).

4) Lines 69-71 the author should be clarified this sentence for pure or coexisting species? Because the similar meaning and sentence can be observed at Lines 57-60.

Response: Revised. According to this suggestion, this sentence has been revised in “**1 Introduction**” section as follows: “Rainfall pulses have been observed to relieve or eliminate water competition among coexisting species and thus maintain or increase plant transpiration in some water limited regions (Wang et al., 2020a; Tfwala et al., 2019).” (Page 3 Lines 68-70)

Indeed, this sentence should be clarified the influence of rainfall pulses on water competition among coexisting species.

5) Lines 131-132 Please clarify why the Reference evapotranspiration (ET0) was used in the study, as a large number of indicators can reflect atmospheric evaporative demand.

Response: Clarified and rewritten. In response to this meaningful suggestion, the advantage of Reference evapotranspiration (ET_0) has been added in "2.2 Environmental parameter measurements and ET_0 calculation" subsection in "**2 Materials and methods**" section as follows: "ET_0, considering both aerodynamic characteristics and energy balance, was used to indicate atmospheric evaporative demand (Allen et al., 1998):" (Page 6 Lines 153-154). The detailed explanation can be observed the response to *Major Comments 3)*.

6) Lines 213-214 This sentence is nonsense and should be deleted.

Response: Deleted and Rewritten. In response to this suggestion, the sentence in the previous manuscript has been deleted and rewritten in the revised manuscript in "2.6.2 Calculation of RRS uptake proportion and water sources from different soil layers" subsection in "**2 Materials and methods**" section as follows: "In addition to RUP, the water uptake proportions from different soil layers were calculated on the first day after a rainfall event using the MixSIR program, to complement the analysis of plant water source variations in response to rainfall pulses. The RUP method only calculated the proportion of recent rainwater in the plant stem and did not include soil water before the recent rainfall event (Gebauer and Ehleringer, 2000; Cheng et al., 2006). The water taken up from different soil layers by the plant is a mixture of soil water before the recent rainfall event and the recent rainwater." (Page 11 Lines 270-275)

References:

Cheng, X. L., An, S. Q., Li, B., Chen, J. Q., Lin, G. H., Liu, Y. H., Luo, Y. Q., and Liu, S. R.: Summer rain pulse size and rainwater uptake by three dominant desert plants in a desertified grassland ecosystem in northwestern China, Plant Ecol, 184, 1-12, 2006.

Gebauer, R. L. E., and Ehleringer, J. R.: Water and nitrogen uptake patterns following moisture pulses in a cold desert community, Ecology, 81, 1415-1424, 2000.

7) Line 306 There are 7 Figures in the paper and the Tables 1-4 are the statistical analysis. These Tables are unnecessary list in the paper and its better remove to Supplementary file.

Response: Rewritten. Thanks for this suggestion, all the Tables have been removed to Supplementary file. The Tables 1-4 have been renamed to Tables S 4-6, respectively, and the origin Tables 1-2 has been combined into Table S4. The detailed Table S can be observed in the *Supplementary file* in the revised manuscript.

8) Line 415 Is synchronization correct in this sentence ? It's not correct, you should check it.

Response: Rewritten. Indeed, the word "synchronization" is not correct in this sentence. The sentence has been rewritten in "4.1 RRS uptake enhances plant transpiration for *H. rhamnoides* but not *P. tomentosa* in pure plantations" subsection in "**4 Discussion**" section as follows: "The asynchronization between RRS uptake and plant transpiration for *J. osteosperma* was mainly attributed to the uptake of RRS by plants being unable to reverse the cavitation in its roots and stems (Grossiord et al., 2017; West et al., 2007)." (Page 19 Lines 436-439).

9) Lines 478-480 Table S3 does not indicated the relationship between rainfall amount and water source proportion from deep soil layer.

Response: Deleted and rewritten. Thanks for this meaningful suggestion. These sentences have been rewritten in "4.2 RRS uptake enhances plant transpiration for coexisting species in mixed plantation" subsection in "**4 Discussion**" section as follows: "Furthermore, similar to other studies in the Loess Plateau (Wang et al., 2020a; Wu et al., 2021), the deep soil layer generally exhibited lower SW than other soil layers in all plantation types in the present study (Fig. 1, Table S3). Jia et al. (2017) and Wang et al. (2020a) attributed the lower SW in deep soil layers to the imbalance between rainwater replenishment and plant uptake of water from this soil layer in the studied region. Silvertown et al. (2015) and Tang et al. (2019) suggested that coexisting plant species generally reduce water uptake from soil layers that exhibit low soil water content to avoid water source competition in these layers and maintain stable coexistence. In the present study, consistent with the second adaptation type, mixed afforestation significantly decreased the water uptake proportion from the deep soil layer for these species (Table S5). Thus, both increased rainwater-recharged soil water uptake and decreased water source competition from the deep soil layer were adopted by these species in the mixed plantation to minimize water sources competition under water limited conditions.” (Page 23 Lines 504-514)

This paragraph mainly described the second adaptation type of coexisting plant species to cope with resource competition. Two types of adaptation can be adopted by plants among plant species to cope with resource competition in mixed plantations. The sentence has been mentioned in the previous paragraph: “Generally, two types of adaptation can be adopted by plants to cope with resource competition: increased competition ability or minimized competition interactions (West et al., 2007).” (Page 22 Lines 485-486).

In this paragraph, **Firstly,** we pointed out that the deep soil layer generally exhibited lower SW than other soil layers in all plantation types in the present study (Fig. 1, Table S3). Jia et al. (2017) and Wang et al. (2020a) attributed the lower SW in deep soil layers to the imbalance between rainwater replenishment and plant uptake of water from this layer. This is mainly because, during the dry period in this semiarid region, the SW in shallow and middle soil layers may similar or lower than the value in deep soil layer. For example, during DOY 180-200, the SW at 5 cm and 20 cm was lower than the value at 150cm (red cycle in Figure 1d as follows). Under this water limited conditions, plant generally absorbed more water from deep than from other soil layers. In general, at seasonal or annual timescale, the imbalance between rainwater replenishment and plant uptake of water from deep soil layer result to the lower SW in deep soil layers in the Loess Plateau (Figure 1). Coexisting plant species may reduce their water uptake proportion from deep soil layer and thus reduce water competition at this soil layer, compared with water sources for specific species in pure plantation.

Silvertown et al. (2015) and Tang et al. (2019) suggested that coexisting plant species generally reduce water uptake from soil layers that exhibit low soil water content to avoid water source competition in these layers and maintain stable coexistence. In addition, our result indicated that “mixed afforestation significantly decreased the water uptake proportion from the deep soil layer for these species”. Thus, we point out that “In the present study, consistent with the second adaptation type, mixed afforestation significantly decreased the water uptake proportion from the deep soil layer for these species (Table S5).” (Page 23 Lines 510-512).

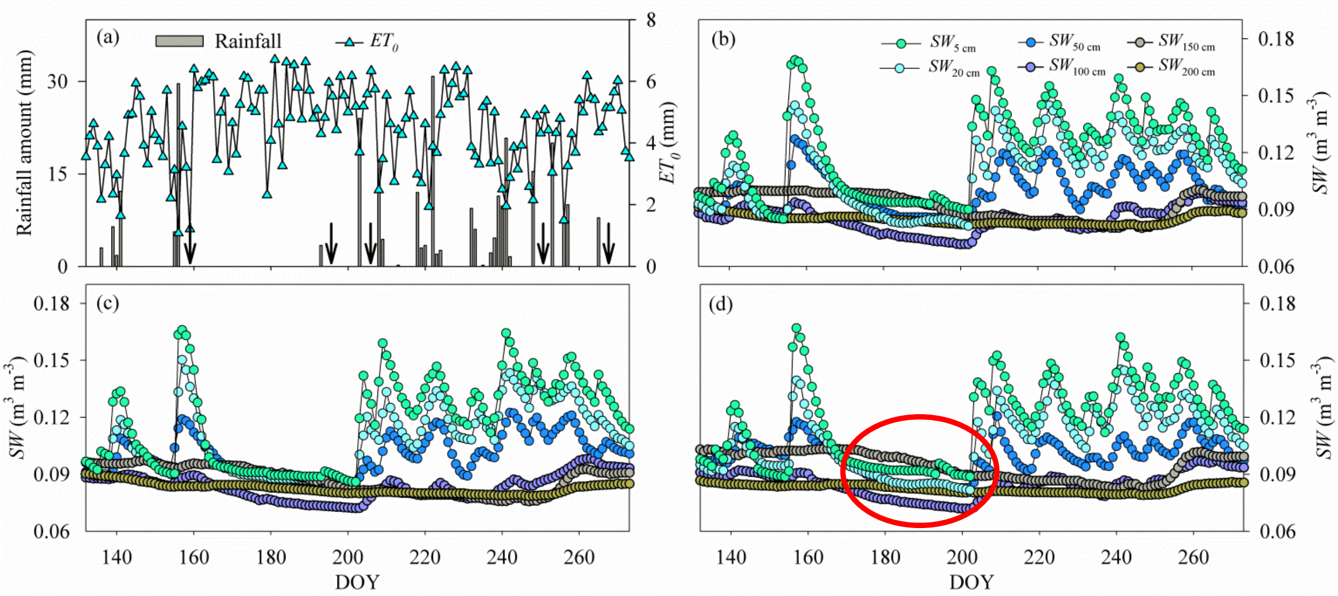


Figure 1. Variation in (a) rainfall amount, reference evapotranspiration (ET_0), and average (mean ± SD) soil water content (SW) in (b) *H. rhamnoides* pure plantation, (c) *P. tomentosa* pure plantation, and (d) mixed plantation from DOY 132 to 273 (11 May to 30 September) (n = 3). Standard deviation bars for SW at each soil layers are not shown to allow clear display of variation of SW for each plantation. Arrows in (a) indicate dates of sample collection at the first day after rainfall events: DOY 157 (6 June), DOY 194 (12 July), DOY 204 (23 July), DOY 249 (6 September), and DOY 265 (22 September).

Secondly, combined with the first adaptation type discussed in the previous paragraph (Page 22 Lines 486-495), we suggested that "Thus, both increased rainwater-recharged soil water uptake and decreased water source competition from the deep soil layer were adopted by these species in the mixed plantation to minimize water sources competition under water limited conditions." (Page 23 Lines 512-514)

References:

Jia, X. X., Shao, M. A., Zhu, Y. J., and Luo, Y.: Soil moisture decline due to afforestation across the Loess Plateau, China, J Hydrol, 546, 113-122, 2017.

Wang, J., Fu, B. J., Wang, L. X., Lu, N., and Li, J. Y.: Water use characteristics of the common tree species in different plantation types in the Loess Plateau of China, Agr Forest Meteorol, 288, ARTN 108020, 10.1016/j.agrformet.2020.108020, 2020a.

Wu, W. J., Li, H. J., Feng, H., Si, B. C., Chen, G. J., Meng, T. F., Li, Y., and Siddique, K. H. M.: Precipitation dominates the transpiration of both the economic forest (Malus pumila) and ecological forest (Robinia pseudoacacia) on the Loess Plateau after about 15 years of water depletion in deep soil, Agr Forest Meteorol, 297, ARTN 108244, 10.1016/j.agrformet.2020.108244, 2021.

Silvertown, J., Araya, Y., and Gowing, D.: Hydrological niches in terrestrial plant communities: a review, J Ecol, 103, 93-108, 10.1111/1365-2745.12332, 2015.

Tang, Y. K., Wu, X., Chen, C., Jia, C., and Chen, Y. M.: Water source partitioning and nitrogen facilitation promote coexistence of nitrogen-fixing and neighbor species in mixed plantations in the semiarid Loess Plateau, Plant Soil, 445, 289-305, 10.1007/s11104-019-04301-9, 2019.

West, A. G., Hultine, K. R., Jackson, T. L., and Ehleringer, J. R.: Differential summer water use by Pinus edulis and Juniperus osteosperma reflects contrasting hydraulic characteristics, Tree Physiol, 27, 1711-1720, 10.1093/treephys/27.12.1711, 2007.

Reviewer 2

Major Comments:

1. Personally, I find the terms 'rainwater uptake' and 'water consumption' (both central to this manuscript) rather ambiguous. I would recommend using 'transpiration' instead of 'water consumption. On the other hand, the term rainwater uptake can be confusing, as it seems to suggest that these trees take up water directly from rainfall. Some trees can indeed take up rainwater through their leaves, but this is not the case for the species included in this study. In my opinion, it would be better to refer instead to the 'uptake of recently recharged soil water' or similar (uptake of soil water that has been recharged from a recent rainfall event).

Response: Suggestions accepted. Thanks for this meaningful suggestion, the terms of "water consumption" and "rainwater uptake" have been changed to "transpiration" and "uptake of rainwater-recharged soil water", respectively, throughout the revised manuscript. For example, the manuscript **Title** has been rewritten as "Differential response of plant transpiration to uptake of rainwater-recharged soil water for dominant tree species in the semiarid Loess Plateau" (Page 1 Lines 1-2).

In addition, the "RRS", abbreviation of "rainwater-recharged soil water", was used in this study for convenient reading and understanding. This abbreviation has been added at the first sentence in "**Abstract**" section as "Whether uptake of rainwater-recharged soil water (RRS) can increase plant transpiration in response to rainfall pulses requires investigation to evaluate the plant adaptability, especially in water limited regions where rainwater is the only replenishable soil water source." (Page 1 Lines 14-16). Furthermore, this abbreviation has also been added at the first sentence in "**Introduction**" section as "Rainwater-recharged soil water (RRS) uptake by plants and plant transpiration in response to rainfall pulses drive the survival of plant species and ecosystem ecohydrological processes, especially in arid and semiarid regions where rainwater is the only replenishable soil water source (Berkelhammer et al., 2020; Gebauer and Ehleringer, 2000; West et al., 2012)." (Page 2 Lines 39-42).

The illustration to "rainwater-recharged soil water (RRS)" has also been added in the "**1 Introduction**" section as follows: "Generally, RRS uptake after a rainfall pulse refers to the root uptake of soil water that was recharged by recent rainwater, and can be quantified through water stable isotopes (Cheng et al., 2006; Meier et al., 2018).” (Page 2 Lines 42-44)

Furthermore, the abbreviation of “rainwater recharged soil water” is used for “RRS” but not “RRSW”, mainly because the “RRSW” has been used as the abbreviation of “resistance rivet spot welding” in other published articles based on research in *Web of Science*.

2. It would be very helpful if the authors could provide some additional information on the two studied tree species. The authors write (L.82-84): ‘Hippophae rhamnoides and Populus tomentosa are typical dominant tree species, with high survival rate and drought tolerance, and occupy nearly 30% of the plantation area in this region (Liu et al., 2017; Tang et al., 2019)’. Could you give some species-specific information on e.g. their phenology or root system? How do the species differ, and are there any reasons to believe that they might respond differently to rain pulses in terms of transpiration and water source partitioning? Do you have any hypotheses? In addition, I would suggest the authors check the scientific names of the species. According to the World Flora Online, Hippophae rhamnoidesis not an accepted name but a synonym of Elaeagnus rhamnoides (L.) A.Nelson.

Response: Added and Corrected. In response to these suggestions, the relative sentences of species-specific information, two hypotheses, and the correct scientific names of the species have been added and corrected in the revised manuscript.

1) in response to plant phenology and species-specific differ for these two studied plantation species, the relative sentences have been rewritten in “**1 Introduction**” section as follows: “*Hippophae rhamnoides* subsp. *sinensis* and *Populus tomentosa* are typical deciduous broadleaved tree species, with similar leaf expansion (April) and falling (November) periods, and occupy nearly 30% of the plantation area in this region (Liu et al., 2017; Tang et al., 2019). Our previous study indicated that *H. rhamnoides* generally took up soil water from 0−40 cm or > 100 cm soil depths and adopted large leaf water potential variation to cope with varied soil water conditions in this region (Tang et al., 2019). Meanwhile, *P. tomentosa* generally took up soil water from > 100 cm soil depth throughout the growing season in varied soil water conditions (Xi et al., 2013). In addition, mixed plantations of these two species were widely promoted by local government due to the higher soil and water conservation capacity than pure plantations in the original afforestation stage (Tang et al., 2019; Wang et al., 2020a). Tang et al. (2019) also suggested that mixed afforestation with *Ulmus pumila*, a deciduous broadleaved tree species with similar leaf growth phenology to *H. rhamnoides*, increased the water source from 0−40 cm soil depth and enlarged the leaf water potential variation for *H. rhamnoides* compared with these values for this species in pure plantation." (Pages 3-4 Lines 81-93).

In previous studies, the water sources from soil depths were different between the two studied plantation species (Xi et al., 2013; Tang et al., 2019), with *H. rhamnoides* generally shifted its main water sources depending on soil water conditions, however, *P. tomentosa* generally absorbed relative stable deep soil water throughout the growing season in varied soil water conditions. These two plantation species exhibited similar leaf growth phenology such as leaf expansion (April) and falling (November) time. In addition, mixed with other plant species may altered the water sources and leaf water potential for *H. rhamnoides* or *P. tomentosa*. These different soil water uptake patterns for these two species in pure plantation, as well as the possibility of altered plant water sources and leaf water potential in mixed plantation, may affect the influence of rainwater-recharged soil water (RRS) uptake and leaf water potential on plant transpiration after rainfall pulses. And these affect may also different in pure and mixed plantations. Thus, two hypotheses and these hypotheses verification have been added in the previous revised manuscript.

2) In response to two hypotheses, these hypotheses have been added in the revised manuscript in "**1 Introduction**" section as follows: "Based on variations of plant water uptake from different soil layers and leaf water potential for these species in Xi et al. (2013) and Tang et al. (2019), we hypothesize that (1) the influence of RRS uptake and leaf water potential on plant transpiration may differ for these species in pure plantations, and (2) these influences may differ for specific species in pure and mixed plantations." (Page 4 Lines 102-106).

The first hypothesis is mainly based on previous studies in Xi et al. (2013) and Tang et al. (2019), where the majority of plant water sources from soil depths were different for these plantation species in pure plantation. The leaf water potential may also different in varied soil water conditions for these two plant species. Thus, we hypothesis that the influence of RRS uptake and leaf water potential on plant transpiration may be different for these species.

The second hypothesis is mainly based on our previous studies indicated that mixed afforestation between *H. rhamnoides* and *Ulmus pumila* altered both the majority of plant water sources from different soil layers and the leaf water potential for *H. rhamnoides*, compared with these values for this species in pure plantation (Tang et al., 2019). Thus, we hypothesis that mixed afforestation may alter the influence of RRS uptake and leaf water potential on plant transpiration for specific plant species, compared with these influences in pure plantation.

These tow hypotheses have also been verified in "**4 Discussion**" section. In response to the first hypothesis, the sentence has been rewritten in "4.1 RRS uptake enhances plant transpiration for *H. rhamnoides* but not *P. tomentosa* in pure plantations" subsection as follows: "Consistent with the first hypothesis, the influence of RRS uptake and Ψ_{pd}–Ψ_m on SF_R was different for these species in pure plantations." (Page 20 Lines 451-452). The SF_R was significantly influenced by RUP and Ψ_{pd}–Ψ_m for *H. rhamnoides* in the pure plantation, indicating that RRS uptake and leaf physiological adjustment enhanced its plant transpiration (Figs. 6 and 7). However, the SF_R was significantly influenced by Ψ_{pd}–Ψ_m for *P. tomentosa* (Fig. 6), suggesting that its transpiration was mainly constrained by plant physiological characteristics.

In response to the second hypothesis, the relative sentence has been added in "4.2 RRS uptake enhances plant transpiration for coexisting species in mixed plantation" subsection: "The different influence of RUP and Ψ_{pd}–Ψ_m on SF_R for specific species in pure and mixed plantations was consistent with the second hypothesis. The significant influence of RUP and Ψ_{pd}–Ψ_m on SF_R was observed for *P. tomentosa* in mixed plantation (Fig. 6). Meanwhile, for *H. rhamnoides* in mixed plantation compared to specific value in pure plantation, larger and smaller slopes in linear regression were observed between SF_R and RUP, and SF_R and Ψ_{pd}–Ψ_m, respectively (Fig. 6)." (Page 22 Lines 495-499).

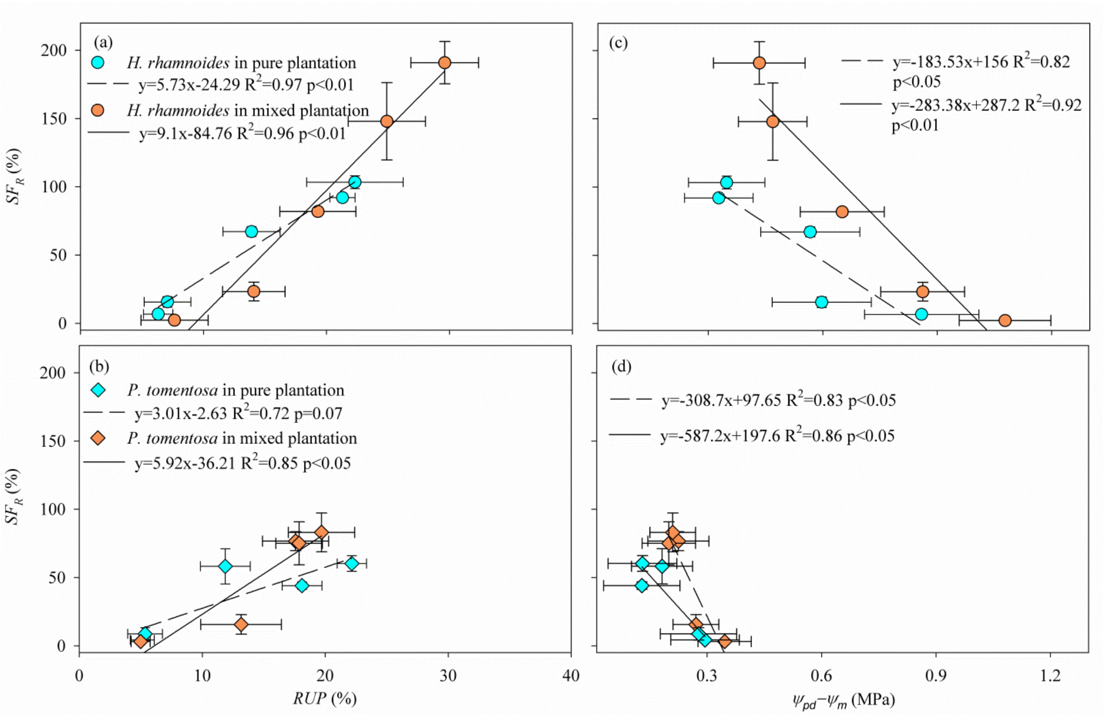


Figure 6. Relationship of average (a, b) rainwater-recharged soil water uptake proportion (RUP) and (c, d) leaf water potential gradient (Ψ_{pd}–Ψ_m) with relative response of normalized F_d (SF_R) for *H. rhamnoides* and *P. tomentosa* in both plantation types (n = 3).

3) In response to plant root distribution of these species, the plant root distribution has been conducted in our present study. The method to investigate the plant root distribution was in the "2.5 Plant fine root investigation" subsection in "**2 Materials and methods**" section as follows: "In August 2018, 4 soil cores were dug around each selected standard individual for plant stem and soil water collection, through a soil drill with diameter 20 cm to investigate plant fine roots. The collected soil depths were 0–10, 10–20, 20–30, 30–50, 50–70, 70–100, 100–130, 130–150, 150–200 cm, with approximately 0.5 m around the stem of each species standard individual. The sum of root samples for 4 soil cores at each soil depth for each selected standard individual was used for fine root distribution analysis, giving 324 fine root samples. WinRHIZO (Regent Instruments Inc., Quebec, Canada) was used to determine the fine root (diameter < 2 mm) surface area at each soil depth. The average fine root surface area for specific species at each soil depth was calculated in each plot for further analysis." (Page 9 Lines 225-232).

The results can be observed as in **Figure S4** as follows. These fine root surface area distribution was mainly used to illustrate the plant water sources of these two species in pure and mixed plantations in "**3 Results**" and "**4 Discussion**" section.

The relative sentences can be observed in "3.1 Variation in environmental parameters and plant fine root vertical distribution" subsection in "**3 Results**" section as follows: "The *H. rhamnoides* and *P. tomentosa* in pure plantations exhibited different fine root vertical distributions, with more than 40% of fine roots observed in shallow and deep soil layers, respectively (Fig. S4). In the mixed plantation, approximately 40% of *H. rhamnoides* fine roots were in the shallow soil layer. Meanwhile, no significant differences in fine root proportion were observed for *H. rhamnoides* for each soil layer in pure and mixed plantations ($P > 0.05$). The fine root proportion of *P. tomentosa* in the shallow soil layer was significantly increased from 21.94% in pure plantation to 31.28% in the mixed plantation ($P < 0.05$)." (Pages 12-13 Lines 321-327).

In "4.1 RRS uptake enhances plant transpiration for *H. rhamnoides* but not *P. tomentosa* in pure plantations" subsection in **"4 Discussion"** section as follows: "This may be mainly due to the greater proportions of fine root surface area distributed in the shallow soil layer for *H. rhamnoides* (40.85 ± 3.14%) compared to *P. tomentosa* (21.94 ± 2.3%) (Fig. S4)." (Page 19 Lines 428-430).

Also, in "4.2 RRS uptake enhances plant transpiration for coexisting species in mixed plantation" subsection in **"4 Discussion"** section as follows: "Mixed afforestation significant increased Ψ_{pd} for *P. tomentosa*, possibly due to the advantage of access to soil moisture recharged by rainwater through an increased root surface area in the shallow soil layer for this species in the mixed plantation (Fig. S4)." (Page 22 Lines 490-492).

Thus, the description of root distribution for these two species was not emphasized in "**1 Introduction**" section.

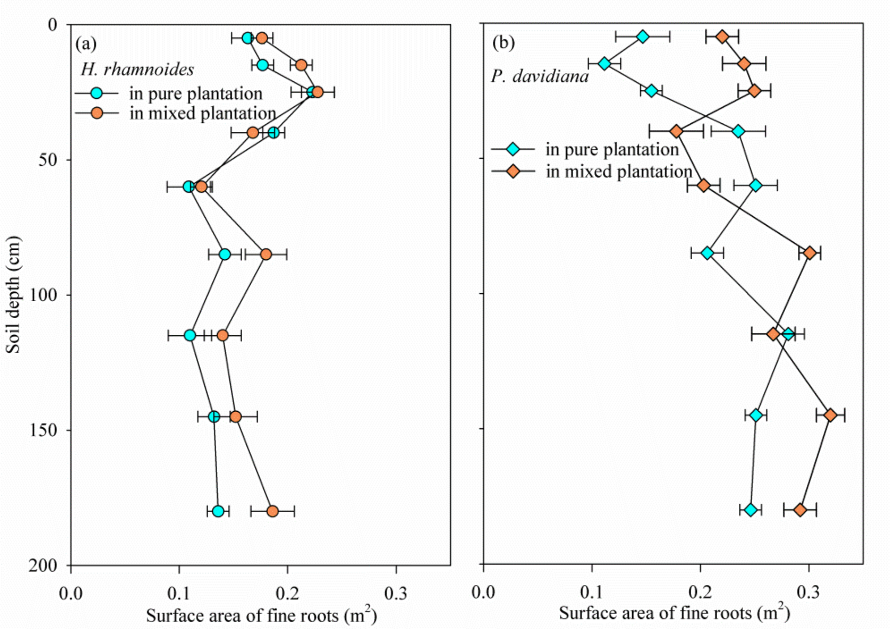
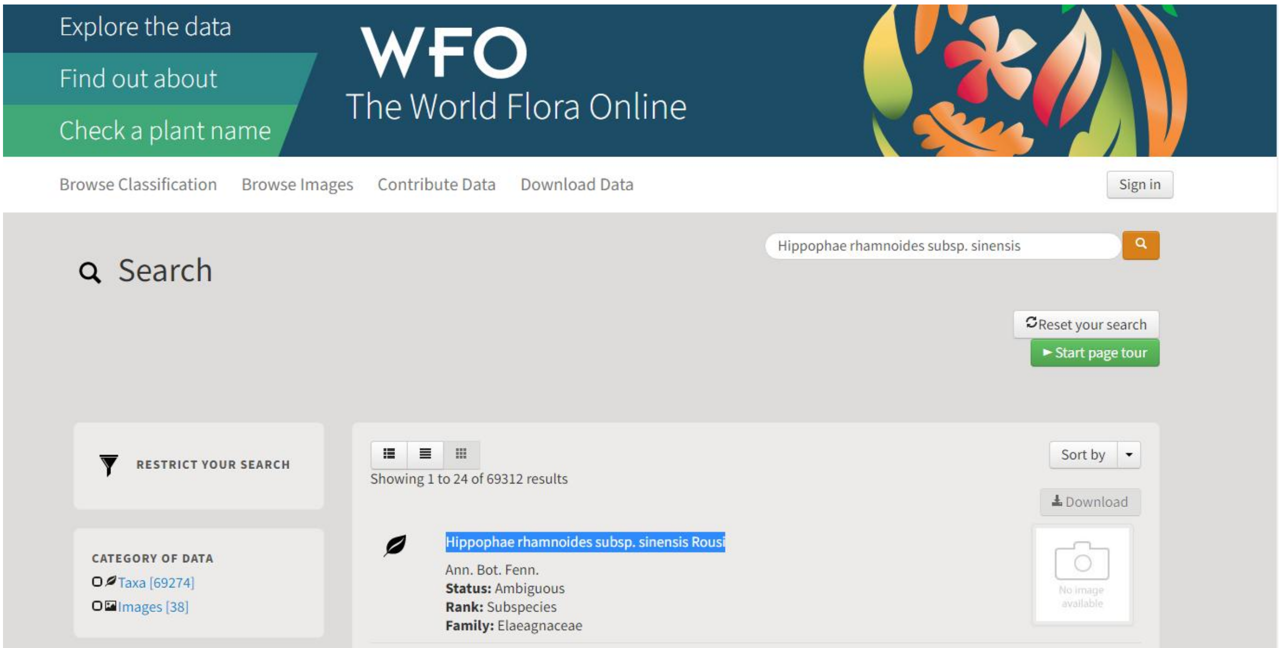


Figure S4. Variation in average (mean ± SD) surface area of fine root at different soil depths for *H. rhamnoides* and *P. tomentosa* in pure (a) and mixed (b) plantations. Error bars indicate the standard deviation (n = 3).

4) Thanks for this careful examination; the Latin name of previous "*Hippophae rhamnoidesis*" has been corrected to "*Hippophae rhamnoides* subsp. *sinensis*" at the first appearance in "**Abstract**" and "**1 Introduction**" section, respectively, in the revised manuscript. Then, the acronym name "*H. rhamnoides*" was used throughout the manuscript.

The revised name of *Hippophae rhamnoides* subsp. *sinensis* can be observed in Huang et al. (2018), and also in *World Flora Online* as follows:



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Hippophae rhamnoides subsp. sinensis Rousi
Ann. Bot. Fenn.
Status: Ambiguous
Rank: Subspecies
Family: Elaeagnaceae

References:

Huang, J. H., Li, G. Q., Li, J., Zhang, X. Q., Yan, M. J., and Du, S.: Projecting the Range Shifts in Climatically Suitable Habitat for Chinese Sea Buckthorn under Climate Change Scenarios, Forests, 9, 2018.

Tang, Y. K., Wu, X., Chen, C., Jia, C., and Chen, Y. M.: Water source partitioning and nitrogen facilitation promote coexistence of nitrogen-fixing and neighbor species in mixed plantations in the semiarid Loess Plateau, Plant Soil, 445, 289-305, 10.1007/s11104-019-04301-9, 2019.

Xi, B. Y., Wang, Y., Jia, L. M., Bloomberg, M., Li, G. D., and Di, N.: Characteristics of fine root system and water uptake in a triploid Populus tomentosa plantation in the North China Plain: Implications for irrigation water management, Agr Water Manage, 117, 83-92, 2013.

3. The authors have done extensive field and lab work, which is extremely valuable. However, I find the material and method section a bit hard to follow given not only the number of measurements but also the use of multiple approaches to address the same question (for example RUP – rainwater uptake proportion - vs MixSIR, or MIXSir with 7 soil depth intervals vs. MIXSir with 3 soil layers). This affects as well the interpretation of the results. Therefore, I would suggest the authors clarify the different steps in the methodology better, whether the chosen approaches are complementary, and how.

Response: Suggestions accepted. Thanks for these helpful suggestions. The sample number of measurements and the complementary between RUP calculation and MixSIR method have been added in "**2 Materials and methods**" section in the revised manuscript.

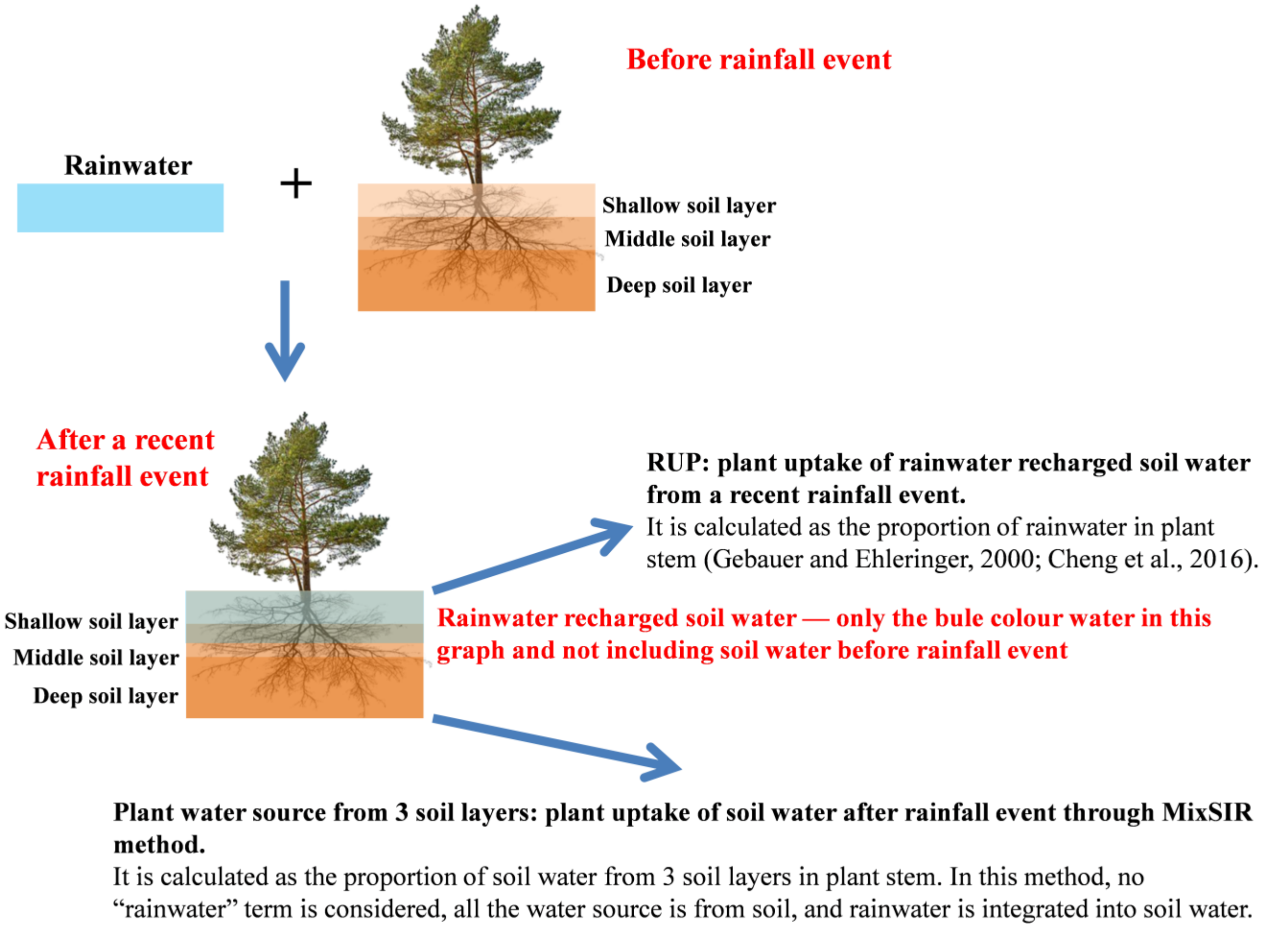
1) The sample numbers for collected plant stems and soil water have been added in the revised manuscript in “2.4 Rainwater, plant stem, soil water, and leaf sample collection and measurement” subsection in “**2 Materials and methods**” section as follows: “At each of successive three days after every selected rainfall event, one suberized stem after removing the bark was collected at midday (11:30–13:30) for each standard individual. Meanwhile, approximately 0.5 m around the stem of each standard individual in the pure plantations and at the middle between two species in the mixed plantation, one soil core at seven depths (0–10, 10–20, 20–30, 30–50, 50–100, 100–150, and 150–200 cm) was collected through soil drilling. The suberized stem and collected soil samples were placed into glass bottles. These bottles were sealed with parafilm and stored at –15 ℃. On the same day as plant stem and soil sample collections, one leaf was selected from each sap flow monitored individual for leaf water potential measurement. The Ψ_{pd} and Ψ_m were measured by a PMS1515D analyzer (PMS Instrument, Corvallis Inc., OR, USA) at predawn (4:30–5:30) and midday (11:20–12:40), respectively.

All the plant stem, soil, and leaf samples collected on the first day after a rainfall pulse were used for analysis, with the detailed given in section “2.6 Statistical analysis”. There were 180 stem and 945 soil samples for water extraction, and 180 leaf samples for Ψ_{pd} and Ψ_m measurement, respectively.” (Page 8 Lines 200-212)

Taken plant stem samples as an example: For *H. rhamnoides* in pure plantation: 1 stem for each individual in each plot×3 individual in each plot×3 plots for this plantation ×5 rainfall events= 45 stems. Thus, the total plant stems were: 45 for *H. rhamnoides* in pure plantation+45 for *H. rhamnoides* in mixed plantation+45 for *P. tomentosa* in pure plantation+45 for *P. tomentosa* in mixed plantation=180 plant stems.

2) The complementary between RUP and MixSIR method have been added in the revised manuscript in “2.6.2 Calculation of RRS uptake proportion and water sources from different soil layers” subsection in “**2 Materials and methods**” section as follows: “In addition to RUP, the water uptake proportions from different soil layers were calculated on the first day after a rainfall event using the MixSIR program, to complement the analysis of plant water source variations in response to rainfall pulses. The RUP method only calculated the proportion of recent rainwater in the plant stem and did not include soil water before the recent rainfall event (Gebauer and Ehleringer, 2000; Cheng et al., 2006). The water taken up from different soil layers by the plant is a mixture of soil water before the recent rainfall event and the recent rainwater." (Page 11 Lines 270-275).

The RUP is the core analysis in the present study, which is calculated as the proportion of rainwater in plant stem (Gebauer and Ehleringer, 2000; Cheng et al., 2006), and indicated the uptake of rainwater-recharged soil water proportion (RUP) by plant from a recent rainfall event. The water uptake proportion from different soil layers is calculated through MixSIR method, and is used to complement analysis the plant water sources variation after rainfall pulses for *H. rhamnoides* or *P. tomentosa*. The difference of these two methods can be observed in **Figure explain 1** as follows. The soil water after a recent rainfall event is the mixture of soil water before recent rainfall event and recent rainwater (**Figure explain 1**). The basic difference between RUP and results from MixSIR method is the former method only calculated the proportion of rainwater (rainwater-recharged soil water) in plant stem after a recent rainfall event and not including soil water before rainfall event.



RUP: plant uptake of rainwater recharged soil water from a recent rainfall event.
It is calculated as the proportion of rainwater in plant stem (Gebauer and Ehleringer, 2000; Cheng et al., 2016).

Plant water source from 3 soil layers: plant uptake of soil water after rainfall event through MixSIR method.
It is calculated as the proportion of soil water from 3 soil layers in plant stem. In this method, no "rainwater" term is considered, all the water source is from soil, and rainwater is integrated into soil water.

Figure explain 1 The schematic of plant uptake of rainwater-recharged soil water from a recent rainfall event and plant water source from 3 soil layers after rainfall event.

In the present study, the RUP and water sources from 3 soil layers was also used to illustrate the mixed afforestation effect of these two species on plant water sources after rainfall pulses. The results indicated that mixed afforestation significantly increased the RUP for these two plant species, and significantly decreased the water uptake proportion from deep soil layer ($P < 0.05$).

The RUP and water sources from 3 soil layers were used to illustrate the two types of plant adaptation to cope with resource competition: (1) increase competition to rainwater-recharged soil water (RRS) from a recent rainfall event; and (2) minimize competition to deeps soil water, which is excessive consumption by plant and rainwater is the only replenish source to deep soil water.

The detailed discussion of the first adaptation types can be observed in “4.2 RRS uptake enhances plant transpiration for coexisting species in mixed plantation” subsection in “**4 Discussion**” section as follows: “Generally, two types of adaptation can be adopted by plants to cope with resource competition: increased competition ability or minimized competition interactions (West et al., 2007). Consistent with the first adaptation type, mixed afforestation enhanced the RUP for *H. rhamnoides* and *P. tomentosa* (Figs. 3 and 7, Table S4).” (Page 22 Lines 485-488).

The detailed discussion of the second adaptation types can be observed in same subsection as follows: “Furthermore, similar to other studies in the Loess Plateau (Wang et al., 2020a; Wu et al., 2021), the deep soil layer generally exhibited lower SW than other soil layers in all plantation types in the present study (Fig. 1, Table S3). Jia et al. (2017) and Wang et al. (2020a) attributed the lower SW in deep soil layers to the imbalance between rainwater replenishment and plant uptake of water from this soil layer in the studied region. Silvertown et al. (2015) and Tang et al. (2019) suggested that coexisting plant species generally reduce water uptake from soil layers that exhibit low soil water content to avoid water source competition in these layers and maintain stable coexistence. In the present study, consistent with the second adaptation type, mixed afforestation significantly decreased the water uptake proportion from the deep soil layer for these species (Table S5).” (Page 23 Lines 504-512).

Thus, in the present study, the plant water sources from different soil layers based on MixSIR method is the complement analysis for RUP calculation. These two methods together were used to discuss the two types of plant adaptation to cope with resource competition.

3) The detailed method of how to calculate water uptake proportions from different soil layers through MixSIR method has been rewritten in "2.6.2 Calculation of RRS uptake proportion and water sources from different soil layers" subsection in "**2 Materials and methods**" section as follows: "Firstly, the seven soil depths (0–10, 10–20, 20–30, 30–50, 50–100, 100–150, and 150–200 cm) were combined into three soil layers (shallow, middle, and deep) based on the variation of soil water $\delta^{18}O$ and δD and SW, to facilitate water source comparison (Wang et al., 2020a; Zhao et al., 2021). The shallow (0–30 cm) soil layer was vulnerable to rainfall, which exhibited high soil water $\delta^{18}O$ and δD values and large water isotope and SW variations (Table S3, Fig. S3). The middle (30–100 cm) soil layer was less vulnerable to rainfall, with moderate soil water isotope values and water isotope and SW variations. The deep (100–200 cm) soil layer was relative stable, with lower soil water isotope values and smaller water isotope and SW variations compared with shallow and middle soil layers. In addition, based on one-way ANOVA followed by post hoc Tukey's test, significant difference ($P < 0.05$) was observed in soil water $\delta^{18}O$ and δD among three soil layers in each plot. Then, the water uptake proportions from three soil layers were calculated using the MixSIR program (Moore and Semmens, 2008), with model input parameters being the average $\delta^{18}O$ and δD values in plant stem water and soil water at each soil layer in each plot." (Pages 11 Lines 276-288)

In the present study, seven soil depths were combined into three soil layers to facilitate water source comparison. These soil depths were combined based on the variation of soil water $\delta^{18}O$ and δD and SW. The similar soil depths combination can also be observed in previous studies in the semiarid Loess Plateau (such as Wang et al., 2020a; Zhao et al., 2021), to facilitate water source comparison. In the present study, the shallow (0–30 cm) soil layer was vulnerable to rainfall, which exhibited high soil water $\delta^{18}O$ and δD values and large water isotope and SW variations. The middle (30–100 cm) soil layer was less vulnerable to rainfall, with moderate soil water isotope values and water isotope and SW variations. The deep (100–200 cm) soil layer was relative stable, with lower soil water isotope values and smaller water isotope and SW variations compared with shallow and middle soil layers.

Then, the water uptake proportions from three soil layers were calculated using the MixSIR program (Moore and Semmens, 2008), with model input parameters being the average δ^{18}O and δD values in plant stem water and soil water at each soil layer in each plot.

Table S3 The average (mean ± SD) and coefficients of variation (CVs, SD/mean) of soil water δ^{18}O and δD on the first day after 5 selected rainfall events, and daily soil water content (SW) from DOY 132 to 273 (11 May to 30 September) in *H. rhamnoides* pure plantation, *P. tomentosa* pure plantation, and *H. rhamnoides*–*P. tomentosa* mixed plantation.

	Soil depth	soil water δ^{18}O (‰)		soil water δD (‰)		SW (m^3 m^{-3})	
		average	CV	average	CV	average	CV
H. rhamnoides pure plantation	0–30 cm	-5.61±1.57	27.99	-41.53±11.68	28.12	0.11±0.02	18.7
	30–100 cm	-7.14±0.92	12.89	-52.37±6.47	12.35	0.1±0.01	10.34
	100–200 cm	-9.3±0.69	7.42	-68.66±3.53	5.14	0.088±0.005	5.68
P. tomentosa pure plantation	0–30 cm	-5.43±1.69	31.12	-42.08±11.91	28.3	0.12±0.02	16.67
	30–100 cm	-7.49±0.73	9.75	-51.34±4.56	8.88	0.09±0.009	10.03
	100–200 cm	-9.39±0.34	3.62	-67.36±3.79	5.63	0.085±0.005	5.88
Mixed plantation	0–30 cm	-5.68±1.73	30.46	-41.67±10.67	25.61	0.11±0.019	17.28
	30–100 cm	-6.57±1.08	16.44	-47.8±5.78	12.09	0.09±0.008	9.01
	100–200 cm	-9.07±0.5	5.51	-64.47±2.45	3.8	0.089±0.005	5.62

There are 45, 30, and 30 data for calculated the average water δ^{18}O and δD of shallow, middle, and deep soil layer in each plantation, respectively. The absolute value was used for CVs of soil water δ^{18}O and δD calculation.

To be noticed, although the δ^{18}O and δD values of soil water was more positive in middle (30-100 cm) than in shallow (0-30 cm) soil layer after 24 mm (**red cycle in Figure S7 as follows**), the average δ^{18}O and δD after 5 rainfall events were more negative in middle than in shallow soil layer during the study period (Table S3).

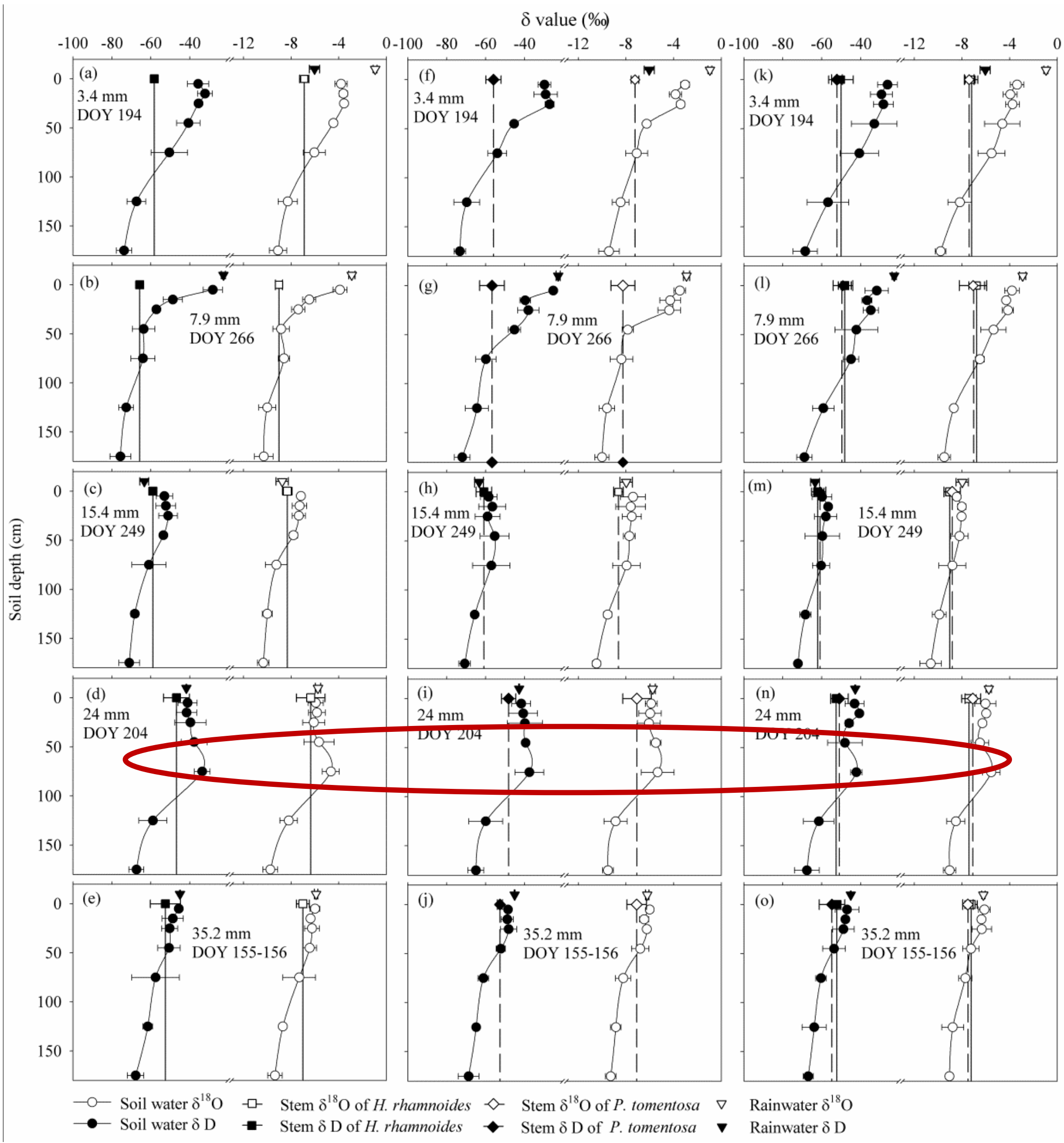


Figure S7. Variation in average (mean ± SD) δ^{18}O and δD of rainwater, stem water, and soil water at seven soil depths for *H. rhamnoides* in (a–e) pure and (k–o) mixed plantations and for *P. tomentosa* in (f–j) pure and (k–o) mixed plantations after five rainfall events. Error bars indicate the standard deviation (n = 3). The date of each five selected rainfall events is followed the corresponding rainfall amount value. The average rainwater δ^{18}O and δD for each rainfall event is calculated with 3 rainwater subsamples, which was divided from one rainwater sample.

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Gebauer, R. L. E., and Ehleringer, J. R.: Water and nitrogen uptake patterns following moisture pulses in a cold desert community, Ecology, 81, 1415-1424, 2000.

West, A. G., Hultine, K. R., Jackson, T. L., and Ehleringer, J. R.: Differential summer water use by Pinus edulis and

Juniperus osteosperma reflects contrasting hydraulic characteristics, Tree Physiol, 27, 1711-1720, 10.1093/treephys/27.12.1711, 2007.

Wang, J., Fu, B. J., Wang, L. X., Lu, N., and Li, J. Y.: Water use characteristics of the common tree species in different plantation types in the Loess Plateau of China, Agr Forest Meteorol, 288, ARTN 108020, 10.1016/j.agrformet.2020.108020, 2020a.

Wu, W. J., Li, H. J., Feng, H., Si, B. C., Chen, G. J., Meng, T. F., Li, Y., and Siddique, K. H. M.: Precipitation dominates the transpiration of both the economic forest (Malus pumila) and ecological forest (Robinia pseudoacacia) on the Loess Plateau after about 15 years of water depletion in deep soil, Agr Forest Meteorol, 297, ARTN 108244, 10.1016/j.agrformet.2020.108244, 2021.

Jia, X. X., Zhao, C. L., Wang, Y. Q., Zhu, Y. J., Wei, X. R., and Shao, M. A.: Traditional dry soil layer index method overestimates soil desiccation severity following conversion of cropland into forest and grassland on China's Loess Plateau, Agr Ecosyst Environ, 291, Artn 106794, 10.1016/J.Agee.2019.106794, 2020.

Silvertown, J., Araya, Y., and Gowing, D.: Hydrological niches in terrestrial plant communities: a review, J Ecol, 103, 93-108, 10.1111/1365-2745.12332, 2015.

Tang, Y. K., Wu, X., Chen, C., Jia, C., and Chen, Y. M.: Water source partitioning and nitrogen facilitation promote coexistence of nitrogen-fixing and neighbor species in mixed plantations in the semiarid Loess Plateau, Plant Soil, 445, 289-305, 10.1007/s11104-019-04301-9, 2019.

Zhao, Y., Wang, L., Knighton, J., Evaristo, J., and Wassen, M.: Contrasting adaptive strategies by Caragana korshinskii and Salix psammophila in a semiarid revegetated ecosystem, Agr Forest Meteorol, 300, ARTN 108323,10.1016/j.agrformet.2021.108323, 2021.

4. Where are the plantations where you conducted the measurements located? It would be good if you could provide a map to illustrate this. Also, what is the slope? Are there any terraces or other soil and water conservation measures? Are soil properties and land-use history similar across all nine plots included in the study? Do you have any information on the physical characteristics of the soils?

Response: Suggestions accepted. In response to these meaningful basic information suggestions, the detailed information for location, the slope and soil water conservation measures, the soil properties and land-use history of three plantations have been added in the revised manuscript.

1) According to plots location, the plantation sites on the Loess Plateau of China has been added in “2.1 Study site” subsection in “**2 Materials and methods**” as follows: “The study was conducted in the Ansai Ecological Station in the semiarid Loess Plateau (36.55 °N, 109.16 °E, 1221 m above sea level), Northern China (Fig. S1).” (Page 5 Lines 110-111)

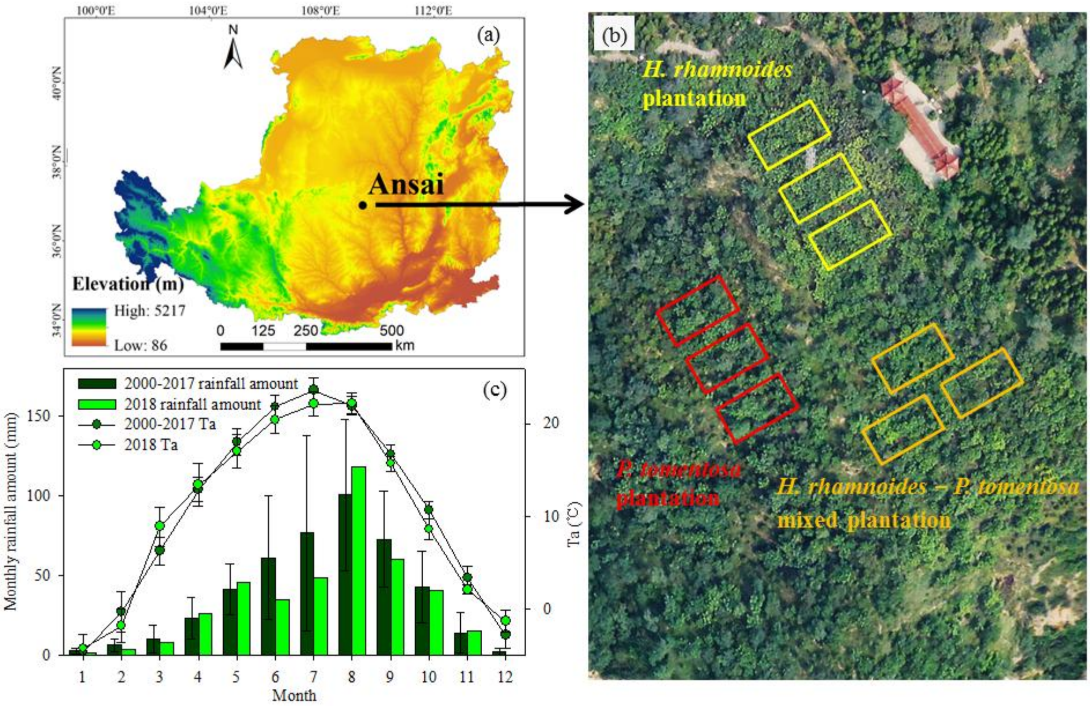
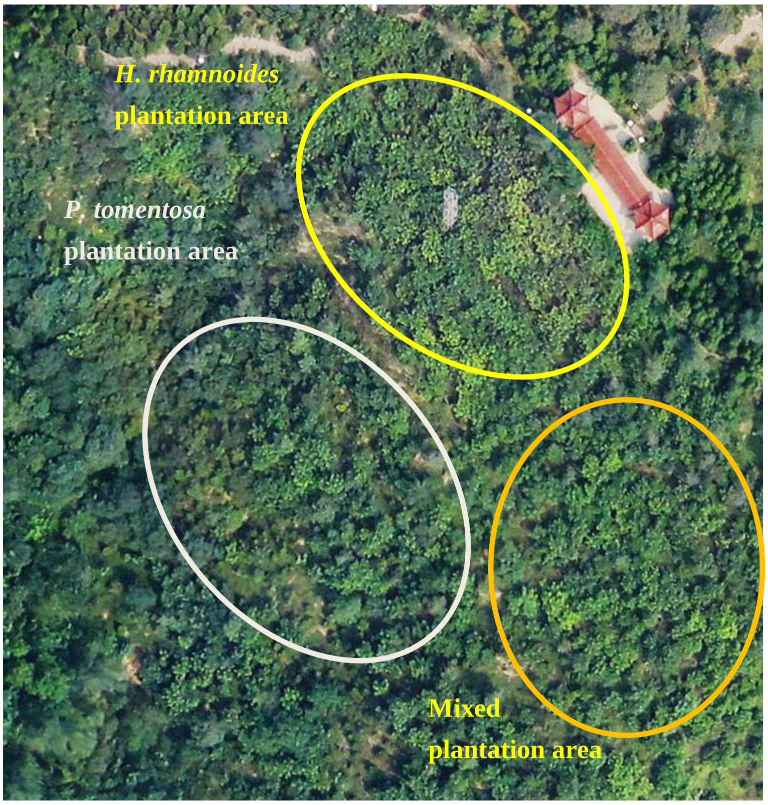


Figure S1. The geographic location of (a) study area and (b) plantation sites in the Loess Plateau of China, and (c) monthly average (mean ± SD) rainfall amount and air temperature (Ta) during 2000-2017, and monthly rainfall amount and average Ta in 2018**.** Plantation types including *H. rhamnoides* pure plantation, *P. tomentosa* pure plantation, and Mixed plantation. Three adjacent plots were selected (16 m × 10 m) for each plantation type, and the schematic diagram of these plantation types is in (b). The China basic map can be obtained from http://map.geoq.cn/arcgis/rest/services/ChinaOnlineCommunityENG/MapServer.

The size of each three adjacent plots (16 m × 10 m) is the schematic diagram in (b) in Fig. S1. The plantation areas of these types are larger than these selected plots in Fig S1. The plantation areas can be observed in different cycles as follows:



2) According to plantation slope, land-use history, and soil and water conservation measures, the relative sentences have been added in “2.1 Study site” subsection in “**2 Materials and methods**” as follows: “Three adjacent plantations were chosen for the study: pure *H. rhamnoides* plantation, pure *P. tomentosa* plantation, and *H. rhamnoides*–*P. tomentosa* mixed plantation (Fig. S1), with corresponding plantation slope of 5.2, 4.5, and 5.5°. All plantations were planted on abandoned grassland in 2004, where *Bothriochloa ischaemum* was the dominant herbaceous species at that time. Three adjacent plots were selected (16 m × 10 m) for each plantation type, and no soil and water conservation measure was conducted in the plantations.” (Page 5 Lines 115-120)

3) According to soil physical properties, the relative sentences have been added in “2.1 Study site” subsection in “**2 Materials and methods**” section as follows: “Based on an experiment conducted in July 2018 using the cutting ring (Wu et al., 2016) and constant water head (Reynolds et al., 2002) method, the soil bulk density, total porosity, and saturated hydraulic conductivity at 0–50 cm soil depth were similar in three plantations. The average soil bulk density was 1.34 ± 0.04, 1.31 ± 0.05, and 1.31 ±

0.05 g cm^{-3} for pure *H. rhamnoides*, pure *P. tomentosa*, and mixed plantations, respectively, and corresponding soil total porosity was 48.25 ± 0.52, 48.17 ± 0.48, and 48.03 ± 0.63%. The average soil saturated hydraulic conductivity was 0.51 ± 0.15, 0.54 ± 0.13, and 0.53 ± 0.11 mm min^{-1} for pure *H. rhamnoides*, pure *P. tomentosa*, and mixed plantations, respectively. The soil is characterized as a silt loam soil according to United States Department of Agriculture soil taxonomy, with average sand (2–0.05 mm), silt (0.05–0.002 mm), and clay (<0.002 mm) compositions were 24.7 ± 1.6, 62.7 ± 0.8, and 12.6 ± 1.8%, respectively, for three plantation types at 0–50 cm soil depth. These compositions were determined using a Mastersize 2000 (Malvern Instruments Ltd., UK).” (Pages 5-6 Lines 130-141).

The method to determine the soil texture can be observed in red arrows in **Figure explain 2** as follows:

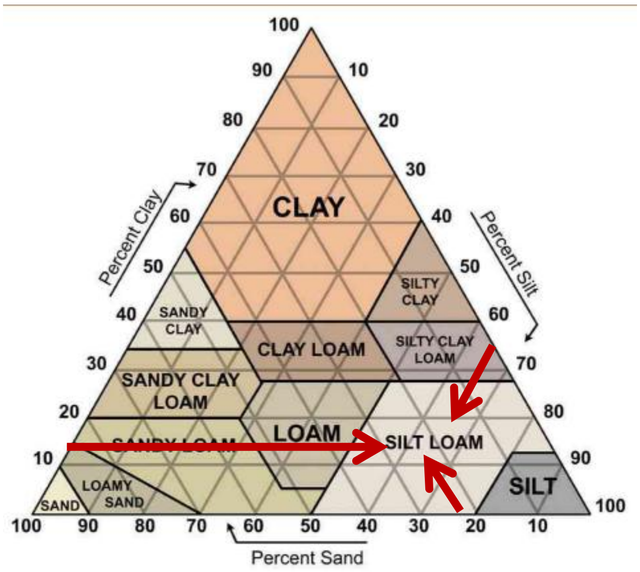


Figure explain 2 The soil texture criterion based on the percent of sand (2-0.05 mm), silt (0.05-0.002 mm), and clay (<0.002 mm) in United States Department of Agriculture soil taxonomy. The red arrow lines represent the percent of sand, silt, and clay of our studied soil.

References:

Reynolds, W.D., Elrick, D.E., Youngs, E.G., Booltink, H.W.G., and Bouma, J.: Saturated and field-saturated water flow parameters, in: Methods of soil analysis, edited by: Dane, J.H., Topp, G.C., Soil Science Society of America, Madison, Wisconsin, USA, 797-878, 2002.

Wu, G. L., Yang, Z., Cui, Z., Liu, Y., Fang, N. F., and Shi, Z. H.: Mixed artificial grasslands with more roots improved mine soil infiltration capacity, J Hydrol, 535, 54-60, 2016.

5. The authors selected 5 distinct rainfall events of varying magnitude (ranging from 3.4 mm to 35.2 mm) *to study the response of the tree species (in both pure and mixed stands) and how this varies according to the magnitude of the event. As stated in L. 168-169, 'These rainfall events were selected with an interpulse period longer than 7 days to eliminate the potential influence of the previous rainfall event.'. However, I have serious doubts about this approach and the validity of the results from this specific analysis (e.g., L. 478-482: 'The increasing rainfall amount significantly decreased water source proportion from deep soil layer (P<0.05) for H. 480 rhamnoides and P. tomentosa in the mixed plantation (Table S3), with the corresponding values decreasing from 43.13 ±13.74% and 47.07 ±5.39% (both after 3.4 mm), respectively, to 21.54 ±8.9% (after 35.2 mm) and 28.66 ±12.26% (after 24 mm) (Fig 4)'). Unfortunately, the selected rainfall events not only differ in magnitude, but also in terms of antecedent conditions. For example, the 3.5 mm event (DOY 194) is the lowest rainfall event but also that following the most prolonged dry period (>30 days dry period from DOY 157 to 194). It is evident that when topsoil moisture content is low following a dry period, plants will tap into deeper, more reliable water sources. This is not so much related to a single rainfall event and its magnitude, but mostly to the antecedent conditions (prolonged dry period).*

Response: Rewritten. In response to this meaningful and valuable question, these sentences in previous version have been deleted, and relative sentences have been rewritten in the revised manuscript in "4.2 RRS uptake enhances plant transpiration for coexisting species in mixed plantation" subsection in "**4 Discussion**" section as follows: "Furthermore, similar to other studies in the Loess Plateau (Wang et al., 2020a; Wu et al., 2021), the deep soil layer generally exhibited lower SW than other soil layers in all plantation types in the present study (Fig. 1, Table S3). Jia et al. (2017) and Wang et al. (2020a) attributed the lower SW in deep soil layers to the imbalance between rainwater replenishment and plant uptake of water from this soil layer in the studied region. Silvertown et al. (2015) and Tang et al. (2019) suggested that coexisting plant species generally reduce water uptake from soil layers that exhibit low soil water content to avoid water source competition in these layers and maintain stable coexistence. In the present study, consistent with the second adaptation type, mixed afforestation significantly decreased the water uptake proportion from the deep soil layer for these species (Table S5). Thus, both increased rainwater-recharged soil water uptake and decreased water source competition from the deep soil layer were adopted by these species in the mixed plantation to minimize water sources competition under water limited conditions.” (Page 23 Lines 504-514)

This paragraph mainly described the second adaptation type of coexisting plant species to cope with resource competition. Two types of adaptation can be adopted by plants among plant species to cope with resource competition in mixed plantations. The sentence has been mentioned in the previous paragraph: “Generally, two types of adaptation can be adopted by plants to cope with resource competition: increased competition ability or minimized competition interactions (West et al., 2007).” (Page 22 Lines 485-486).

In this paragraph, **Firstly,** we pointed out that the deep soil layer generally exhibited lower SW than other soil layers in all plantation types in the present study (Fig. 1, Table S3). Jia et al. (2017) and Wang et al. (2020a) attributed the lower SW in deep soil layers to the imbalance between rainwater replenishment and plant uptake of water from this layer. This is mainly because, during the dry period in this semiarid region, the SW in shallow and middle soil layers may similar or lower than the value in deep soil layer. For example, during DOY 180-200, the SW at 5 cm and 20 cm was lower than the value at 150cm (red cycle in Figure 1d as follows). Under this water limited conditions, plant generally absorbed more water from deep than from other soil layers. In general, at seasonal or annual timescale, the imbalance between rainwater replenishment and plant uptake of water from deep soil layer result to the lower SW in deep soil layers in the Loess Plateau (Figure 1). Coexisting plant species may reduce their water uptake proportion from deep soil layer and thus reduce water competition at this soil layer, compared with water sources for specific species in pure plantation.

Silvertown et al. (2015) and Tang et al. (2019) suggested that coexisting plant species generally reduce water uptake from soil layers that exhibit low soil water content to avoid water source competition in these layers and maintain stable coexistence. In addition, our result indicated that “mixed afforestation significantly decreased the water uptake proportion from the deep soil layer for these species”. Thus, we point out that “In the present study, consistent with the second adaptation type, mixed afforestation significantly decreased the water uptake proportion from the deep soil layer for these species (Table S5).” (Page 23 Lines 510-512).

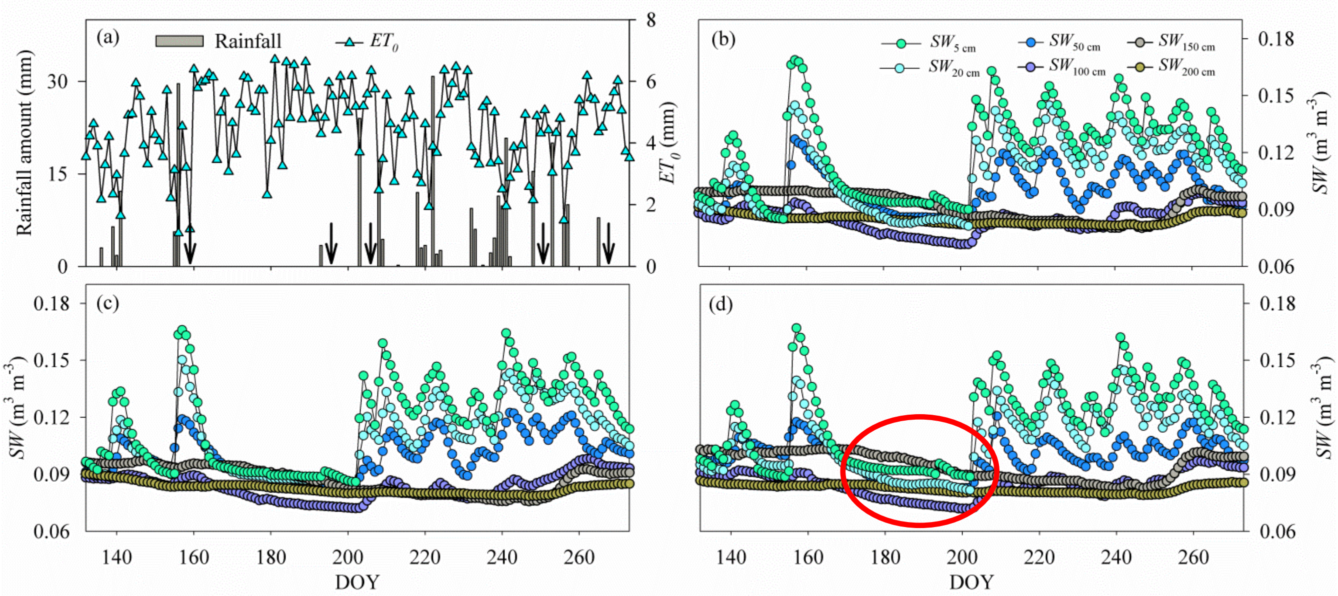


Figure 1. Variation in (a) rainfall amount, reference evapotranspiration (ET_0), and average (mean ± SD) soil water content (SW) in (b) *H. rhamnoides* pure plantation, (c) *P. tomentosa* pure plantation, and (d) mixed plantation from DOY 132 to 273 (11 May to 30 September) (n = 3). Standard deviation bars for SW at each soil layers are not shown to allow clear display of variation of SW for each plantation. Arrows in (a) indicate dates of sample collection at the first day after rainfall events: DOY 157 (6 June), DOY 194 (12 July), DOY 204 (23 July), DOY 249 (6 September), and DOY 265 (22 September).

Secondly, combined with the first adaptation type discussed in the previous paragraph (Page 22 Lines 486-495), we suggested that “Thus, both increased rainwater-recharged soil water uptake and decreased water source competition from the deep soil layer were adopted by these species in the mixed plantation to minimize water sources competition under water limited conditions.” (Page 23 Lines 512-514)

References:

Jia, X. X., Shao, M. A., Zhu, Y. J., and Luo, Y.: Soil moisture decline due to afforestation across the Loess Plateau, China, J Hydrol, 546, 113-122, 2017.

Wang, J., Fu, B. J., Wang, L. X., Lu, N., and Li, J. Y.: Water use characteristics of the common tree species in different plantation types in the Loess Plateau of China, Agr Forest Meteorol, 288, ARTN 108020, 10.1016/j.agrformet.2020.108020, 2020a.

Wu, W. J., Li, H. J., Feng, H., Si, B. C., Chen, G. J., Meng, T. F., Li, Y., and Siddique, K. H. M.: Precipitation dominates the transpiration of both the economic forest (Malus pumila) and ecological forest (Robinia pseudoacacia) on the Loess Plateau after about 15 years of water depletion in deep soil, Agr Forest Meteorol, 297, ARTN 108244, 10.1016/j.agrformet.2020.108244, 2021.

Silvertown, J., Araya, Y., and Gowing, D.: Hydrological niches in terrestrial plant communities: a review, J Ecol, 103, 93-108, 10.1111/1365-2745.12332, 2015.

Tang, Y. K., Wu, X., Chen, C., Jia, C., and Chen, Y. M.: Water source partitioning and nitrogen facilitation promote coexistence of nitrogen-fixing and neighbor species in mixed plantations in the semiarid Loess Plateau, Plant Soil, 445, 289-305, 10.1007/s11104-019-04301-9, 2019.

West, A. G., Hultine, K. R., Jackson, T. L., and Ehleringer, J. R.: Differential summer water use by Pinus edulis and Juniperus osteosperma reflects contrasting hydraulic characteristics, Tree Physiol, 27, 1711-1720, 10.1093/treephys/27.12.1711, 2007.

6. I would strongly recommend that the authors include a plot of the local meteoric water line (LMWL). This should be relatively straightforward as they have analyzed the 19 collected rainfall samples for both δ18O and δH. On top of the LMWL I would then plot the signatures of the soil water at different depths. This would provide additional insights into the data and ease data interpretation (and can also be used to double-check that rainfall samples have not undergone evaporation). For instance, the rainfall signatures in Figure S5 could be visualized and interpreted much better in a dual-isotope plot.

Response: Suggestions accepted. In response to this key point, one figure including the local meteoric water line (LMWL) and the regression between δ^{18}O and δD at three (0-30, 30-100, and 100-200 cm) soil layers has been added into the revised manuscript (see Figure S3). Meanwhile, more information has been given in "2.6 Statistical analysis" subsection in "**2 Materials and methods**" section as follows: "The shallow (0–30 cm) soil layer was vulnerable to rainfall, which exhibited high soil water δ^{18}O and δD values and large water isotope and SW variations (Table S3, Fig. S3). The middle (30–100 cm) soil layer was less vulnerable to rainfall, with moderate soil water isotope values and water isotope and SW variations. The deep (100–200 cm) soil layer was relative stable, with lower soil water isotope values and smaller water isotope and SW variations compared with shallow and middle soil layers." (Page 11 Lines 278-283).

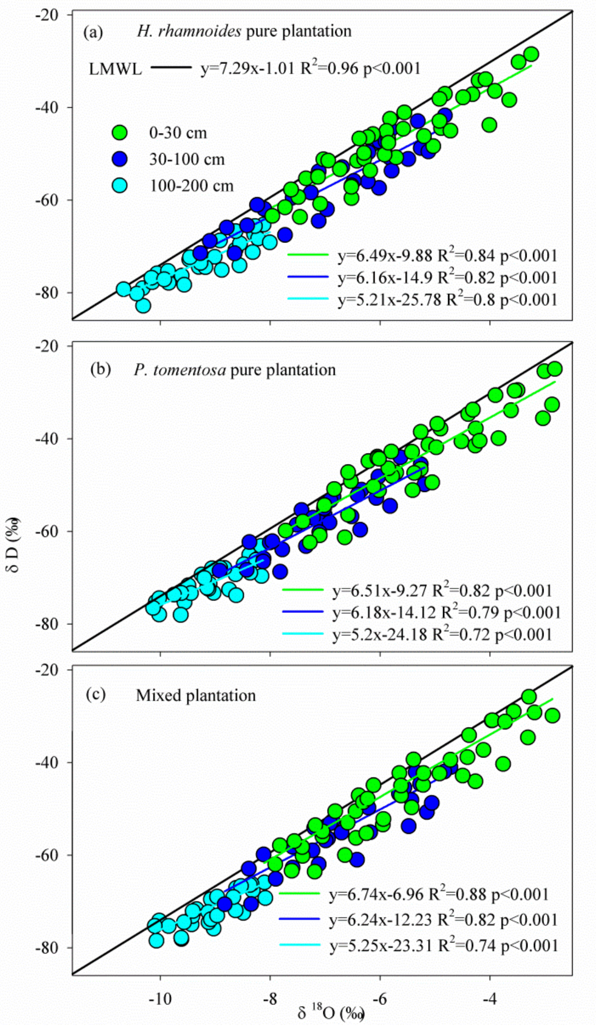


Figure S3. The linear regression relationship between δ^{18}O and δD for soil water at three soil layers (0–30, 30–100, and 100–200cm) in (a) *H. rhamnoides* pure plantation, (b) *P. tomentosa* pure plantation, and (c) Mixed plantation. The local meteoric water line (LMWL) is plotted in each panel for reference.

The slope of LMWL is 7.29 based on 19 collected rainfall (**Figure explain 3**), which is slightly lower than the global meter water line (the slope is 8.0), but close to the LMWL (the slope ranges from 7.47 to 7.76) results near the present study region in the semiarid Loess Plateau (Figure **explains 4 and 5**). The slopes between δ^{18}O and δD for three soil layers were smaller than LMWL and slightly decreased with soil layer increased.

The slightly lower slope for each of three soil layer compared with LMWL, may mainly attribute to the mixture of soil water before rainfall event and rainwater, and the soil water before rainfall generally undergo evaporation. In addition, these rainwater samples were collected immediately at the end of each rainfall event to avoid the possible evaporation. More information has been given in "2.4 Rainwater, plant stem, soil water, and leaf sample collection and measurement" subsection in "**2 Materials and methods**" section as follows: "From April to October 2018, at the end of each rainfall event, 19 rainwater samples were collected immediately using a polyethylene rain gauge cylinder placed in the weather station, and stored at 4 ℃." (Page 7 Lines 185-186).

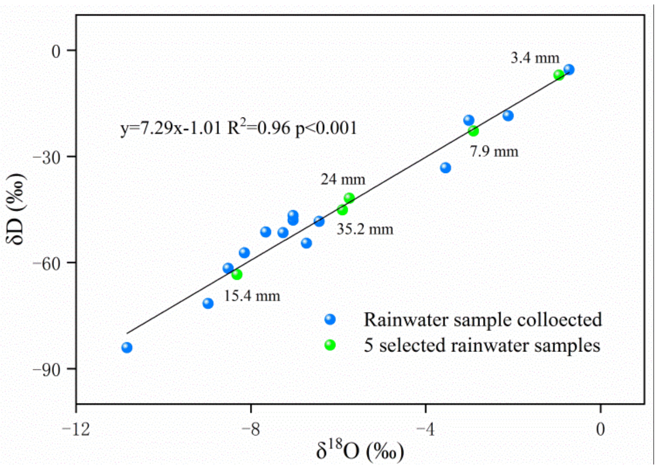


Figure explain 3 Linear regression between δ^2H and δ^{18}O in rainwater. There are 19 collected rainwater samples and 5 selected rainwater samples in the present study. The rainfall amount of each of 5 selected rainwater samples was added.

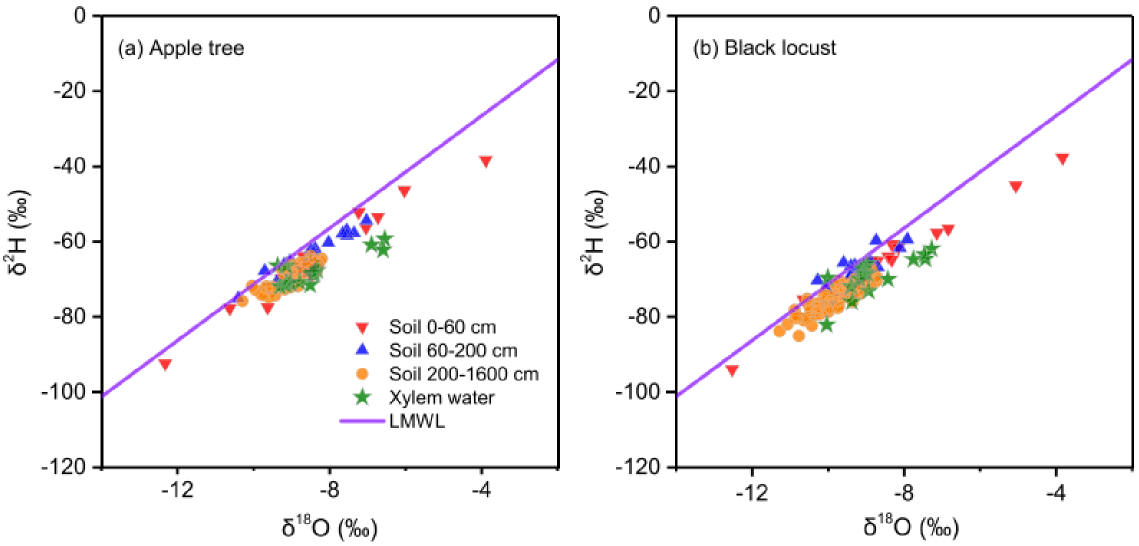


Figure explain 4 Linear regression between δ^2H and δ^{18}O in soil water for an (a) apple orchard and (b) black locust forest. LMWL represents the local meteoric water line ($y = 7.47x + 3.29$, $R^2 = 0.95$, $P < 0.01$). The isotopic composition values of xylem water from both species are also shown. This plot is from Wu et al. (2016).

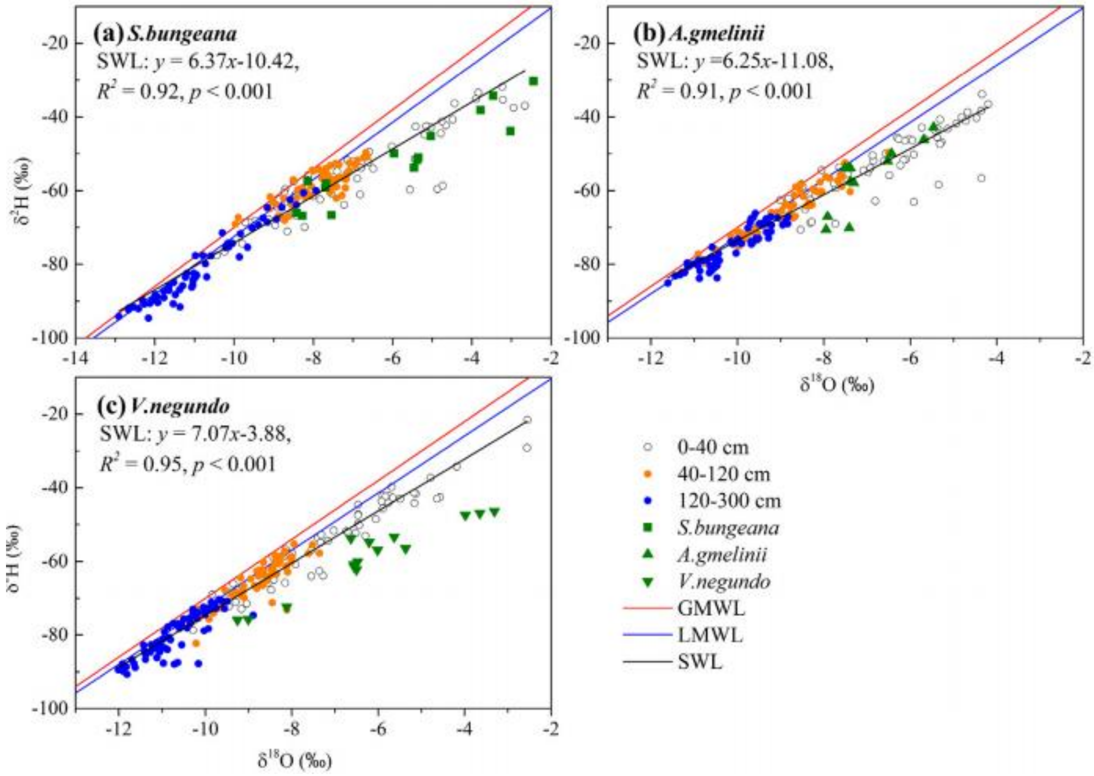


Figure explain 5 The linear regression relationship between δ^2H and δ^{18}O in soil water from three species (a) S. bungeana, (b) A. gmelinii, (c) V. negundo during the sampling periods. SWL represents soil water line based on isotopic data of soil water. LMWL represents the local meteoric water line ($y = 7.76x + 5.14$, $R^2 = 0.91$, $p < 0.01$). This plot is from Wang et al. (2017).

References:

Wu, W. J., Li, H. J., Feng, H., Si, B. C., Chen, G. J., Meng, T. F., Li, Y., and Siddique, K. H. M.: Precipitation dominates the transpiration of both the economic forest (Malus pumila) and ecological forest (Robinia pseudoacacia) on the Loess Plateau after about 15 years of water depletion in deep soil, Agr Forest Meteorol, 297, 2021.

Wang, J., Fu, B. J., Lu, N., and Zhang, L.: Seasonal variation in water uptake patterns of three plant species based on stable isotopes in the semi-arid Loess Plateau, Sci Total Environ, 609, 27-37, 2017.

Minor Comments:

1. In the study site description (section 2.1), it would be good if the authors could include a graph with the mean monthly rainfall throughout the year to get an overview of the rainfall seasonality in the study area. Right now, only the mean +- SD annual rainfall is provided, but there is no information on rainfall seasonality.

Response: Suggestions accepted. In response to this suggestion, the monthly averaged (mean ± SD) rainfall amount and air temperature have been added in Fig. S1 (c) in “2.1 Study site” subsection in “**2**

Materials and methods” section as follows: “The annual average (mean ± SD) rainfall amount and air temperature are 454.8 ± 105.2 mm and 10.6 ± 0.4 ℃ (2000–2017), respectively, with higher monthly rainfall amount and air temperature generally occurring during June–September and lower values during the other months (Fig. S1).” (Page 5 Lines 112-114)

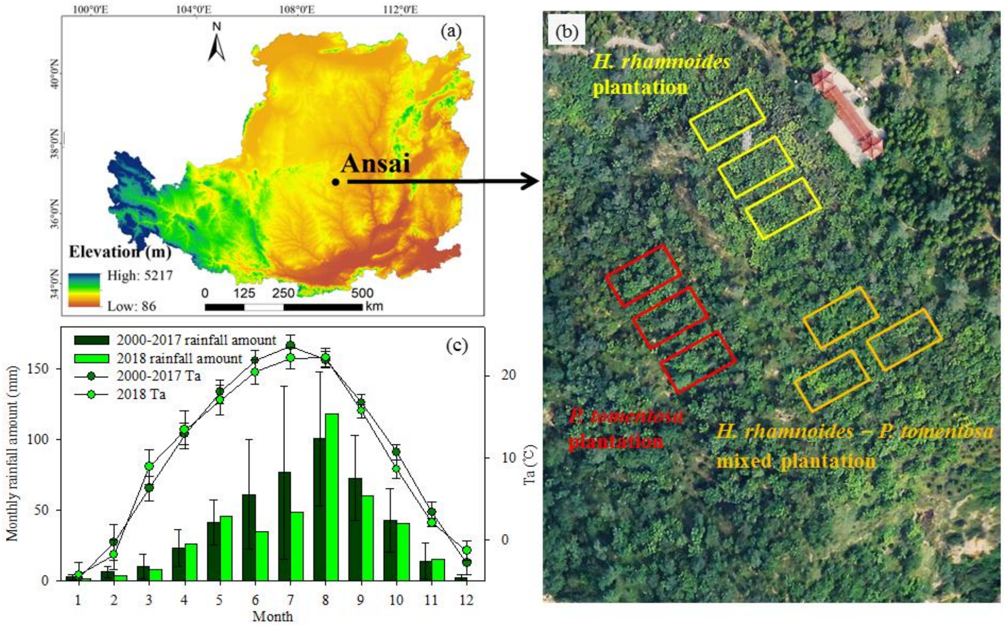


Figure S1. The geographic location of (a) study area and (b) plantation sites in the Loess Plateau of China, and (c) monthly average (mean ± SD) rainfall amount and air temperature (Ta) during 2000-2017, and monthly rainfall amount and average Ta in 2018**.** Plantation types including *H. rhamnoides* pure plantation, *P. tomentosa* pure plantation, and Mixed plantation. Three adjacent plots were selected (16 m × 10 m) for each plantation type, and the schematic diagram of these plantation types is in (b). The China basic map can be obtained from http://map.geoq.cn/arcgis/rest/services/ChinaOnlineCommunityENG/MapServer.

2. When Describing the soil texture (L.105) please indicate it is the texture you refer to and add the correct source (USDA). Besides the soil texture, kindly provide the soil class.

Response: Corrected and Added. In response to this suggestion, the soil texture, United States Department of Agriculture soil taxonomy, and the soil compositions have been written in “2.1 Study site” subsection in “**2 Materials and methods**” section as follows: “The soil is characterized as a silt loam soil according to United States Department of Agriculture soil taxonomy, with average sand (2–0.05 mm), silt (0.05–0.002 mm), and clay (<0.002 mm) compositions were 24.7 ± 1.6, 62.7 ± 0.8, and 12.6 ± 1.8%, respectively, for three plantation types at 0–50 cm soil depth. These compositions were determined using a Mastersize 2000 (Malvern Instruments Ltd., UK).” (Page 6 Lines 137-141).

Because the “United States Department of Agriculture” occurred only once in the present study, thus the abbreviation named “USDA” was not used. The method to determine the soil texture can be observed in red arrows in **Figure explain 2** as follows:

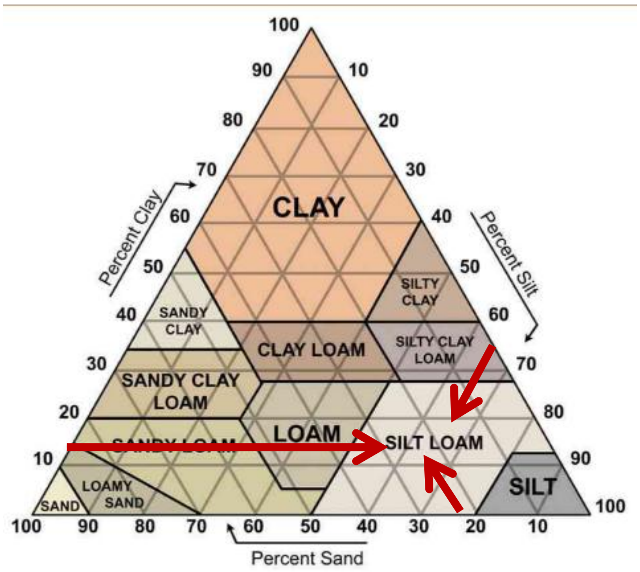


Figure explain 2 The soil texture criterion based on the percent of sand (2-0.05 mm), silt (0.05-0.002 mm), and clay (<0.002 mm). The red arrow lines represent the percent of sand, silt, and clay of our studied soil.

3. L.131: Explain what VPD stands for after equation 1 and give its units (as you have done for the other variable sin equation 1).

Response: Added. In response to this suggestion, the VPD explanation has been added in the revised manuscript in “2.2 Environmental parameter measurements and ET_0 calculation” subsection in “**2 Materials and methods**” section as follows: “where γ, s, and VPD are the psychrometric constant (kPa K^{-1}), the slope between saturation vapor pressure and air temperature (kPa K^{-1}), and vapor pressure deficit (kPa), respectively.” (Page 6 Lines 156-157)

4. L.145: What does the abbreviation TDPs mean?

Response: Added. In response to this suggestion, the TDPs has been added at its first appearance sentence in “2.3 Sap flow observation” subsection in “**2 Materials and methods**” section as follows:

“The sap flow was monitored by a pair of Granier-type thermal dissipation probes (TDPs) 10 mm in length and 2 mm in diameter in 36 selected individuals.” (Page 7 Lines 164-166).

5. L.189, Formula 4: what is PAP?

Response: Corrected. Thanks for this suggestion. It should be “RUP”but not “PAP”, and this equation has been corrected in “2.6.2 Calculation of RRS uptake proportion and water sources from different soil layers” subsection in “**2 Materials and methods**” section as follows:

“The RRS uptake proportion (RUP, %) after a recent rainfall pulse for plant was calculated as the proportion of rainwater in plant stem as follows (Cheng et al., 2006):

$$\delta^{18}\mathrm{O}\ (\mathrm{D})_{\mathrm{P}} = RUP \times \delta^{18}\mathrm{O}\ (\mathrm{D})_{\mathrm{rain}} + (1 - RUP) \times \delta^{18}\mathrm{O}\ (\mathrm{D})_{\mathrm{swb}} \tag{5}$$

$$RUP = (\delta^{18}\mathrm{O(D)}_{\mathrm{p}} - \delta^{18}\mathrm{O(D)}_{\mathrm{swb}})/(\delta^{18}\mathrm{O(D)}_{\mathrm{swa}} - \delta^{18}\mathrm{O(D)}_{\mathrm{swb}}) \times 100\% \tag{6}$$

” (Page 10 Lines 252-255)

6. L.208-209: Kindly provide a reference that supports this assumption (‘no fractionation was considered during water source uptake by plant roots’)

Response: Suggestions accepted. In response to this suggestion, the sentence has been rewritten in “2.6.2 Calculation of RRS uptake proportion and water sources from different soil layers” subsection in “**2 Materials and methods**” section as follows: “No fractionation was considered during water source uptake by these plant roots because none of the plants exhibited xerophytic or halophytic characteristics. Ellsworth and Williams (2007) and Moore and Semmens (2008) suggested that a water stable isotope fractionation generally occurred during root uptake by xerophytic or halophytic plants.” (Page 11 Lines 289-292).

References:

Ellsworth, P. Z., and Williams, D. G.: Hydrogen isotope fractionation during water uptake by woody xerophytes, Plant Soil, 291, 93-107, 10.1007/s11104-006-9177-1, 2007.

Moore, J. W., and Semmens, B. X.: Incorporating uncertainty and prior information into stable isotope mixing models, Ecol Lett, 11, 470-480, 10.1111/j.1461-0248.2008.01163.x, 2008.

7. Figure 1: it would be helpful if the X axes could start earlier (about 20 days if possible) to be able to see if the first two rainfall events that are shown in panel a) are following a dry period or not.

Response: Suggestion accepted. In response to this suggestion, the X axes of Figure 1 have extent 20 days earlier, from DOY152 in previous manuscript to DOY132 at revised manuscript. The revised Figure 1 can be observed as follows (Page 13 Lines 328-334):

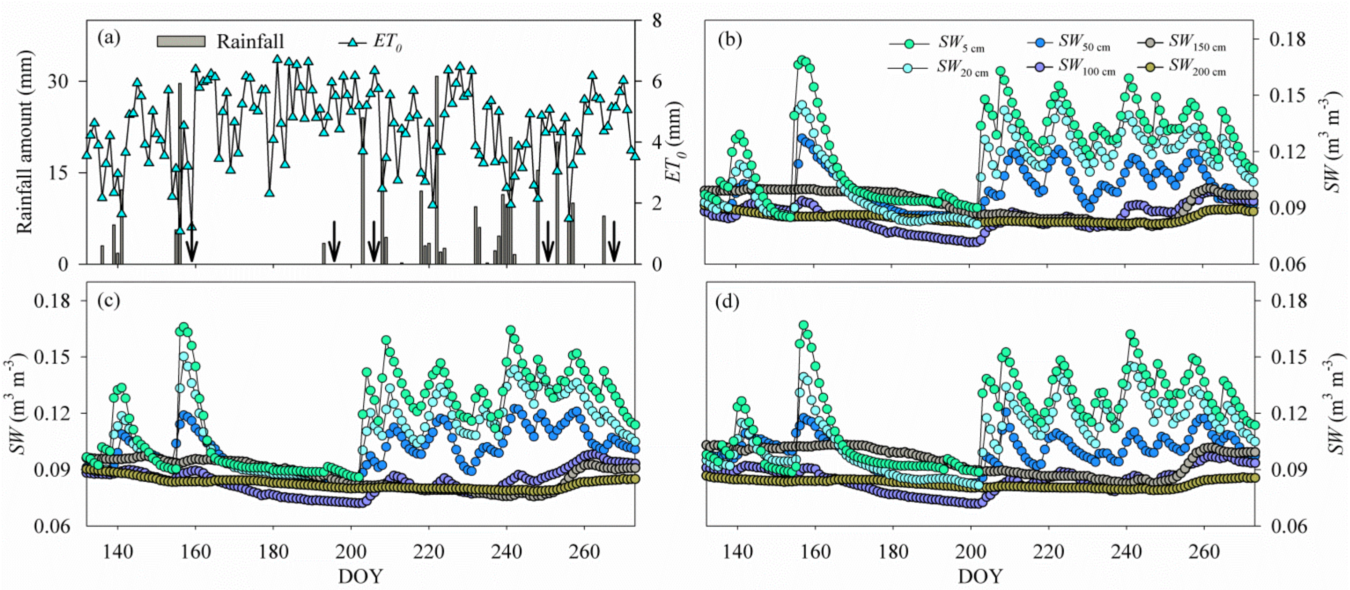


Figure 1. Variation in (a) rainfall amount, reference evapotranspiration (ET_0), and average (mean ± SD) soil water content (SW) in (b) *H. rhamnoides* pure plantation, (c) *P. tomentosa* pure plantation, and (d) mixed plantation from DOY 132 to 273 (11 May to 30 September) (n = 3). Standard deviation bars for SW at each soil layers are not shown to allow clear display of variation of SW for each plantation. Arrows in (a) indicate dates of sample collection at the first day after rainfall events: DOY 157 (6 June), DOY 194 (12 July), DOY 204 (23 July), DOY 249 (6 September), and DOY 265 (22 September).

In addition, the first selected rainfall amount is 35.2 mm, occurred in DOY 155-156, can be observed in the red box in **Figure 1** as follows. The reason that we choose the rainfall amount during DOY 155-156, is mainly because the 35.2mm was continues occurred during these two successive days. DOY 155 only received 5.6 mm rainfall from 23:00-24:00, and DOY156 received 29.6mm. Therefore, the rainfall amount (5.6mm+29.6mm=35.2mm) received during DOY 155-156 was considered as one rainfall event in our present study. The half-hourly rainfall distribution during DOY 155-156 can be observed in **Figure explain 6** as follows:

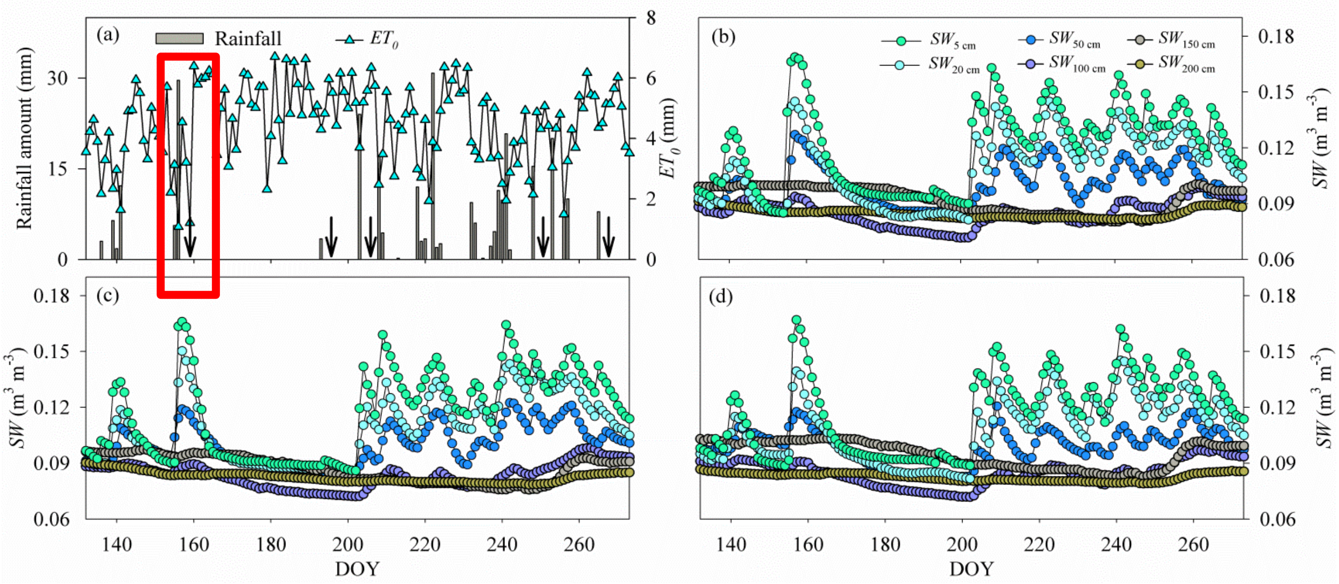


Figure 1. Variation in (a) rainfall amount, reference evapotranspiration (ET_0), and average (mean ± SD) soil water content (SW) in (b) *H. rhamnoides* pure plantation, (c) *P. tomentosa* pure plantation, and (d) mixed plantation from DOY 132 to 273 (11 May to 30 September) (n = 3). Standard deviation bars for SW at each soil layers are not shown to allow clear display of variation of SW for each plantation. Arrows in (a) indicate dates of sample collection at the first day after rainfall events: DOY 157 (6 June), DOY 194 (12 July), DOY 204 (23 July), DOY 249 (6 September), and DOY 265 (22 September).

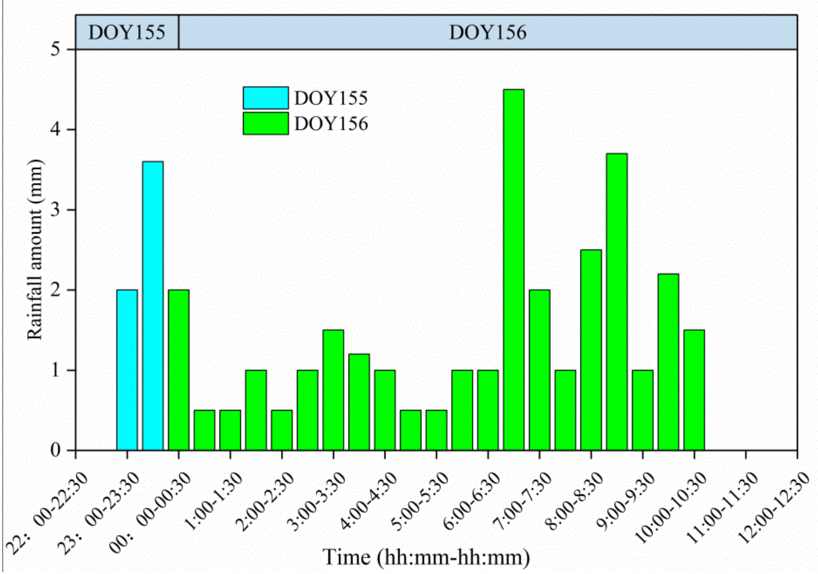


Figure explain 6 The half-hour rainfall amount during DOY155-156. The rainfall during DOY 155-156 was considered as one rainfall event in the present study.

8. Figure 2: It would be good to show the precipitation bars in this plot too.

Response: Suggestion accepted. Both the rainfall amount and arrows indicate dates of sample collection have been added in the revised Figure 2 (a) in the revised manuscript as follows (Page 14 Lines 351-355):

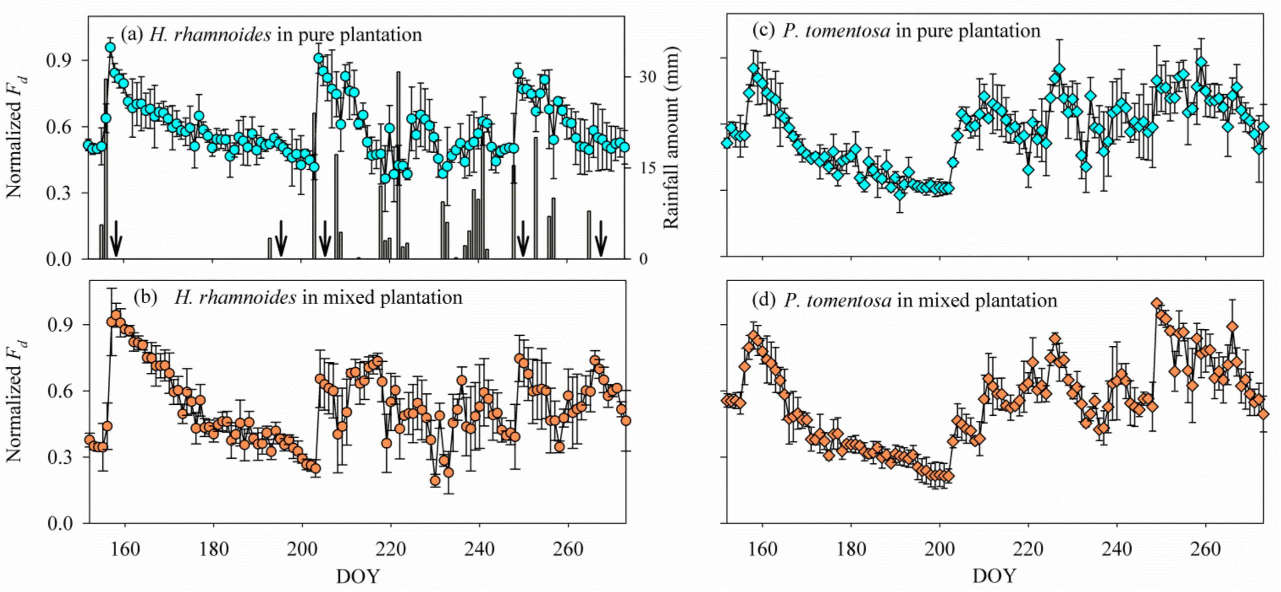


Figure 2. Variation in (a) rainfall amount, and average daily normalized F_d for *H. rhamnoides* in (a) pure and (b) mixed plantations and for *P. tomentosa* in (c) pure and (d) mixed plantations (n = 3). Arrows in (a) indicate dates of sample collection at the first day after rainfall events: DOY 157 (6 June), DOY 194 (12 July), DOY 204 (23 July), DOY 249 (6 September), and DOY 265 (22 September).

9. L.321: in figure S5, kindly add the date of rainfall events. Moreover, the dD signature of rainwater for the 3.4 and 7.9 mm events is very enriched. Could it be that there has been some evaporation of the sample going on? In any case, as I mentioned earlier, it would be really good if the authors could provide a plot of the LMWL.

Response: Added and Clarified. In response to this key point, the date of rainfall events, one figure including the local meteoric water line (LMWL) and the regression between δ^{18}O and δD at three (0-30, 30-100, and 100-200 cm) soil layers, the positive rainwater δ^{18}O and δD values in small rainfall events explanation, and the possible rainwater evaporation discussion have been added in the revised manuscript and clarified.

1) The date of five selected rainfall events have been added in Figure S7 in the revised manuscript as follows:

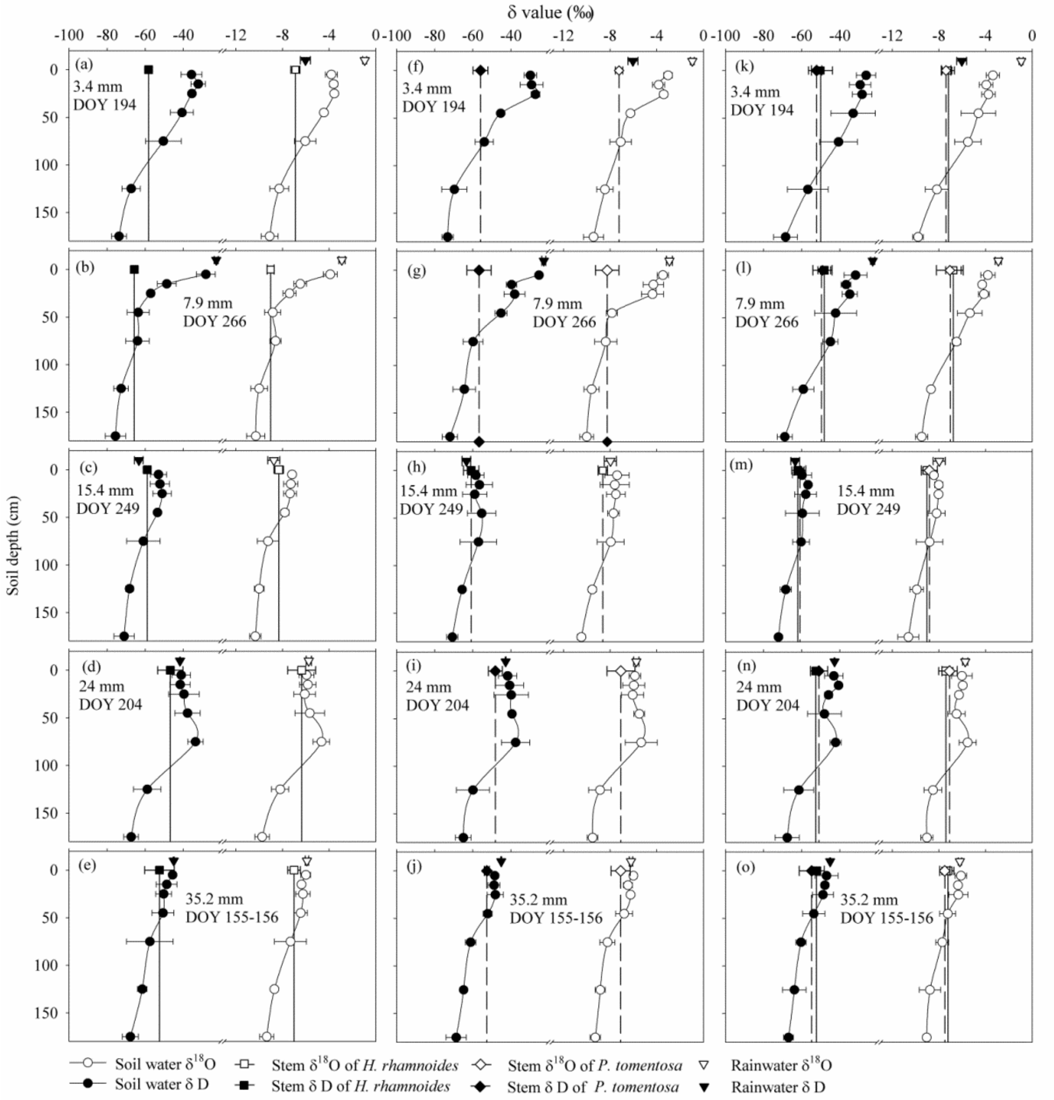


Figure S7. Variation in average (mean ± SD) δ^{18}O and δD of rainwater, stem water, and soil water at seven soil depths for *H. rhamnoides* in (a–e) pure and (k–o) mixed plantations and for *P. tomentosa* in (f–j) pure and (k–o) mixed plantations after five rainfall events. Error bars indicate the standard deviation (n = 3). The date of each five selected rainfall events is followed the corresponding rainfall amount value. The average rainwater δ^{18}O and δD for each rainfall event is calculated with 3 rainwater subsamples, which was divided from one rainwater sample.

2) One plot including the local meteoric water line (LMWL) and the regression between δ^{18}O and δD at three different soil layers (0-30, 30-100, and 100-200cm) has been added in **Figure S3** as follows.

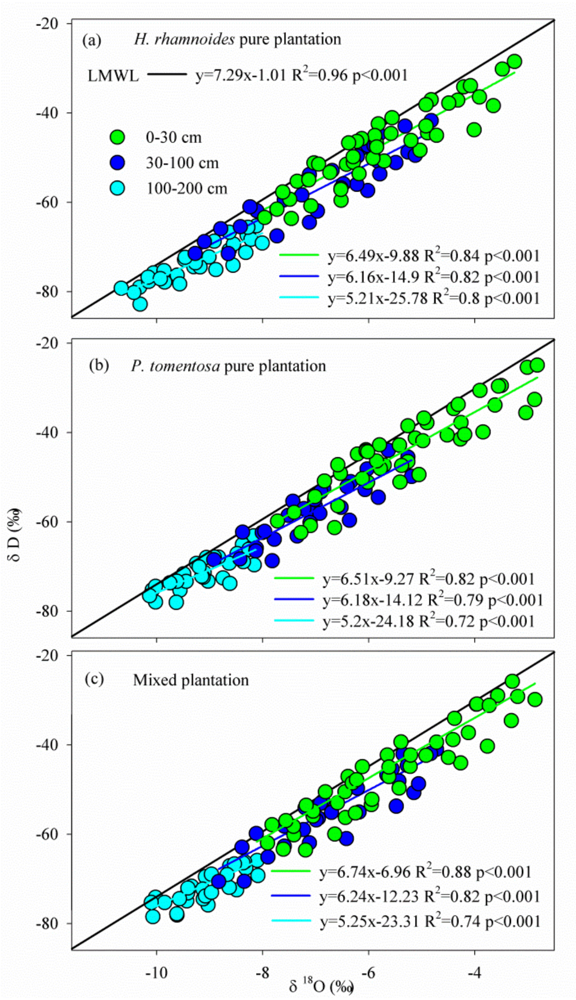


Figure S3. The linear regression relationship between δ^{18}O and δD for soil water at three soil layers (0–30, 30–100, and 100–200cm) in (a) *H. rhamnoides* pure plantation, (b) *P. tomentosa* pure plantation, and (c) Mixed plantation. The local meteoric water line (LMWL) is plotted in each panel for reference.

3) In response to positive rainwater δ^{18}O and δD values in small rainfall events, the relative sentences have been added in in "4.1 RRS uptake enhances plant transpiration for *H. rhamnoides* but not *P. tomentosa* in pure plantations" subsection in "**4 Discussion**" section as follows: "Furthermore, the δ^{18}O and δD values in small rainfall events generally exhibit more positive values than those in large rainfall events (Fig. S7). Salamalikis et al. (2016) attribute this phenomenon to the sub-cloud evaporation effect in dry conditions where rainwater in small rainfall event is more vulnerable subject to evaporation during their descent process compared in large rainfall event." (Pages 18-19 Lines 417-421)

Salamalikis et al. (2016) suggested that the positive δ^{18}O and δD values for small rainfall amount than those for large rainfall amount may mainly attribute to the sub-cloud evaporation effect in rainfall in dry conditions (**Figure explain 7**). In dry conditions, rainwater in small rainfall event is more vulnerable subject to evaporation during their descent process compared in large rainfall event (**Figure explain 7**). In the present study, the 3.4 and 7.9 mm occurred with high ET_0 period, which reflects the dry condition (**red cycles in Figure 1 as follows**), although the SW during 7.9 mm rainfall event in different soil layers were higher than those SW during 3.4 mm rainfall event.

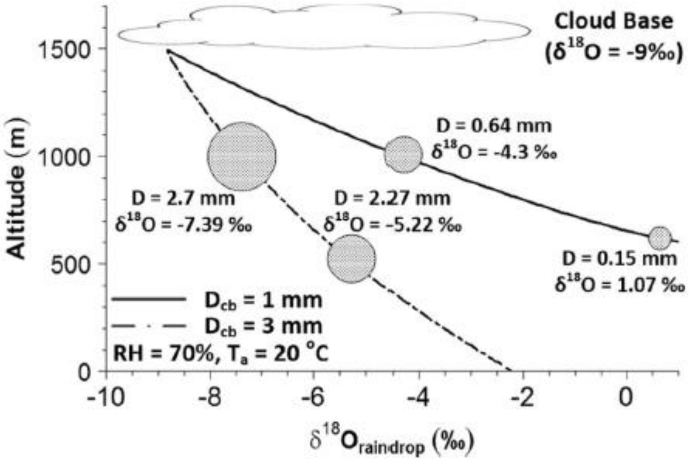


Figure explain 7 Schematic of sub-cloud evaporation effect on rainwater. This plot is from Salamalikis et al. (2016).

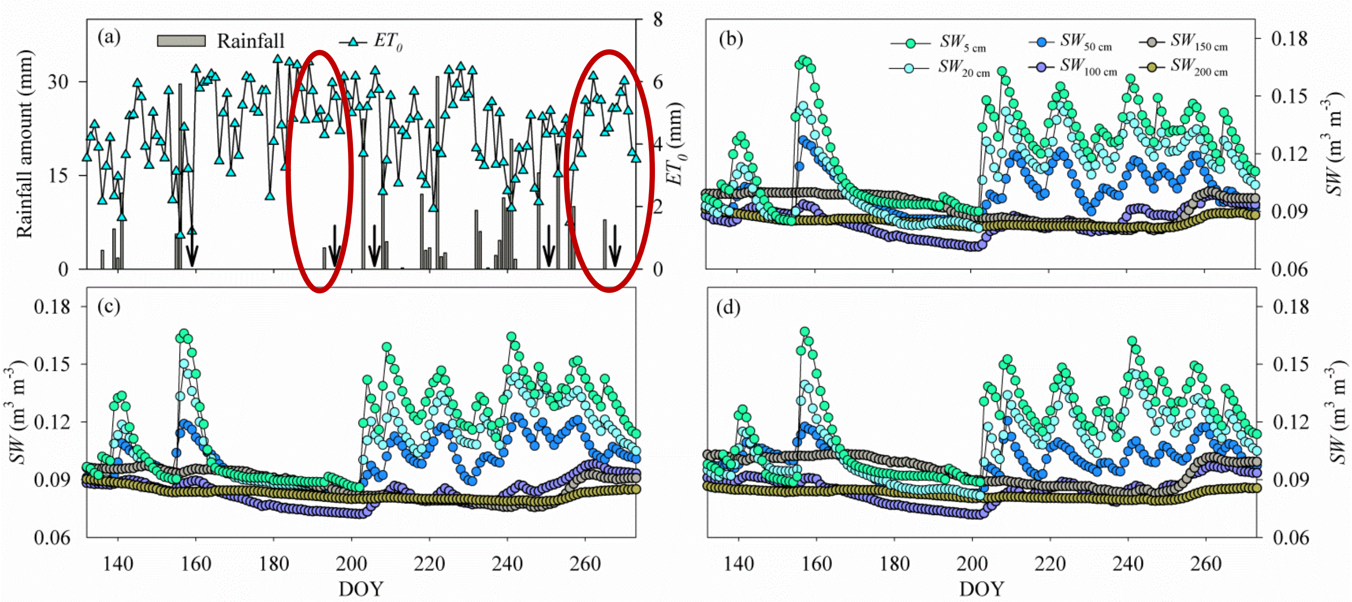


Figure 1. Variation in (a) rainfall amount, reference evapotranspiration (ET_0), and average (mean ± SD) soil water content (SW) in (b) *H. rhamnoides* pure plantation, (c) *P. tomentosa* pure plantation, and (d) mixed plantation from DOY 132 to 273 (11 May to 30 September) (n = 3). Standard deviation bars for SW at each soil layers are not shown to allow clear display of variation of SW for each plantation. Arrows in (a) indicate dates of sample collection at the first day after rainfall events: DOY 157 (6 June),

DOY 194 (12 July), DOY 204 (23 July), DOY 249 (6 September), and DOY 265 (22 September).

4) In response to the possible rainwater evaporation, one plot including the regression between δ^{18}O and δD for 19 collected rainwater samples has been added in **Figure explain 3** as follows. No rainwater would be evaporated during these rainwater samples collection as showed in **Figure explain 3**. The δ^{18}O and δD values of five selected rainwater were well matched the local meteoric water line (LMWL) (**Figure explain 3**). In addition, these rainwater samples were collected immediately at the end of each rainfall event to avoid the possible evaporation. More information has been given in “2.4 Rainwater, plant stem, soil water, and leaf sample collection and measurement” subsection in “**2 Materials and methods**” section as follows: “From April to October 2018, at the end of each rainfall event, 19 rainwater samples were collected immediately using a polyethylene rain gauge cylinder placed in the weather station, and stored at 4 ℃.” (Page 7 Lines 185-187).

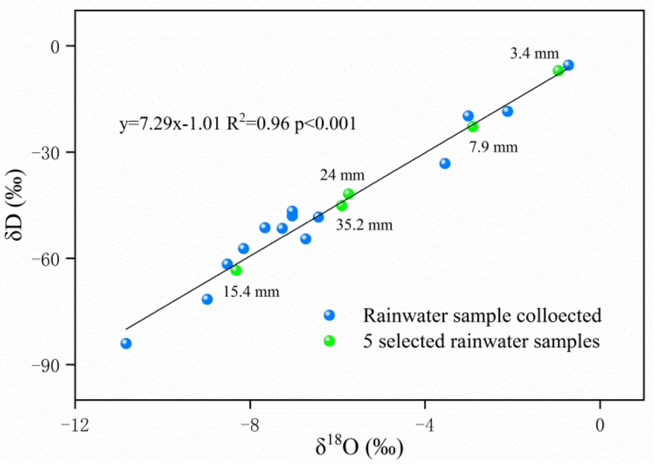


Figure explain 3 Linear regression between δ^2H and δ^{18}O in rainwater. There are 19 collected rainwater samples and 5 selected rainwater samples in the present study. The rainfall amount of each of 5 selected rainwater samples was added.

The slope of LMWL is 7.29 based on 19 collected rainfall (**Figure explain 3**), which is slightly lower than the global meter water line (the slope is 8.0), but close to the LMWL (the slope ranges from 7.47 to 7.76) results near the present study region in the semiarid Loess Plateau (Figure **explains 4 and 5**). The slopes between δ^{18}O and δD for three soil layers were smaller than LMWL and slightly decreased with soil layer increased (**Figure S3**). The slightly lower slope for each of three soil layer compared with

LMWL, may mainly attribute to the mixture of soil water before rainfall event and rainwater, and the soil water before rainfall generally undergo evaporation.

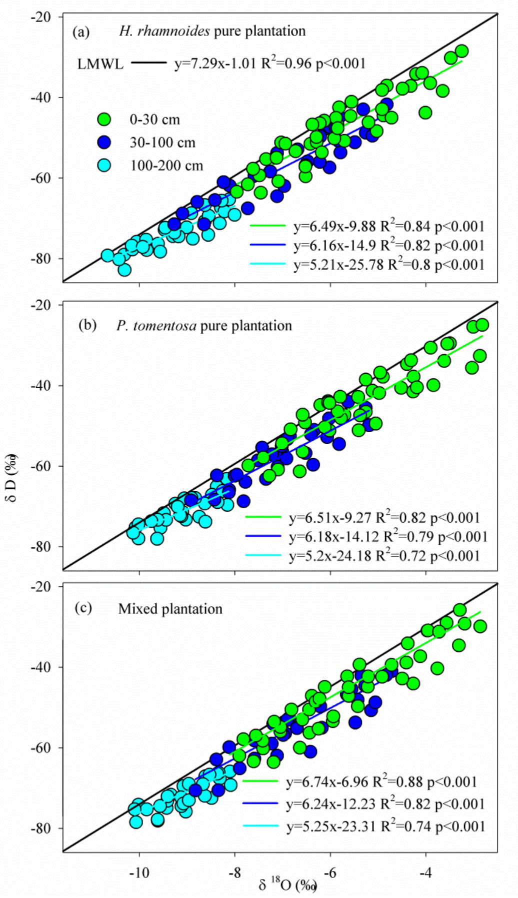


Figure S3. The linear regression relationship between $\delta^{18}O$ and δD for soil water at three soil layers (0–30, 30–100, and 100–200cm) in (a) *H. rhamnoides* pure plantation, (b) *P. tomentosa* pure plantation, and (c) Mixed plantation. The local meteoric water line (LMWL) is plotted in each panel for reference.

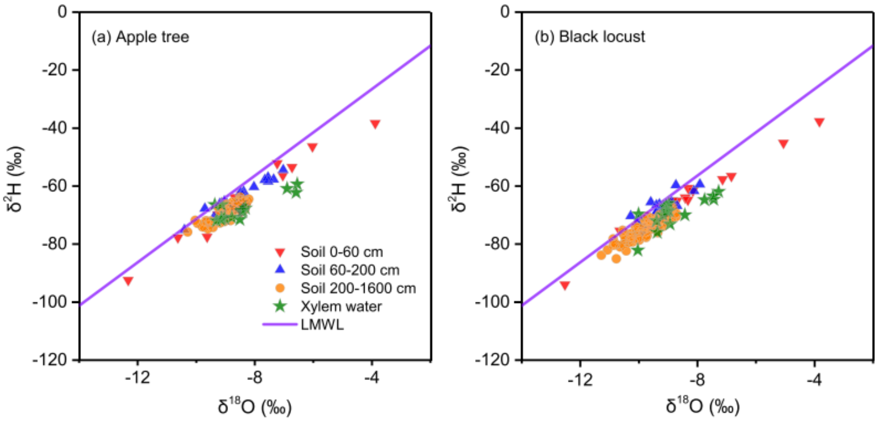


Figure explain 4 Linear regression between δ^2H and $\delta^{18}O$ in soil water for an (a) apple orchard and (b) black locust forest. LMWL represents the local meteoric water line ($y = 7.47x + 3.29$, $R^2 = 0.95$, $P < 0.01$). The isotopic composition values of xylem water from both species are also shown. This plot is from Wu et al. (2016).

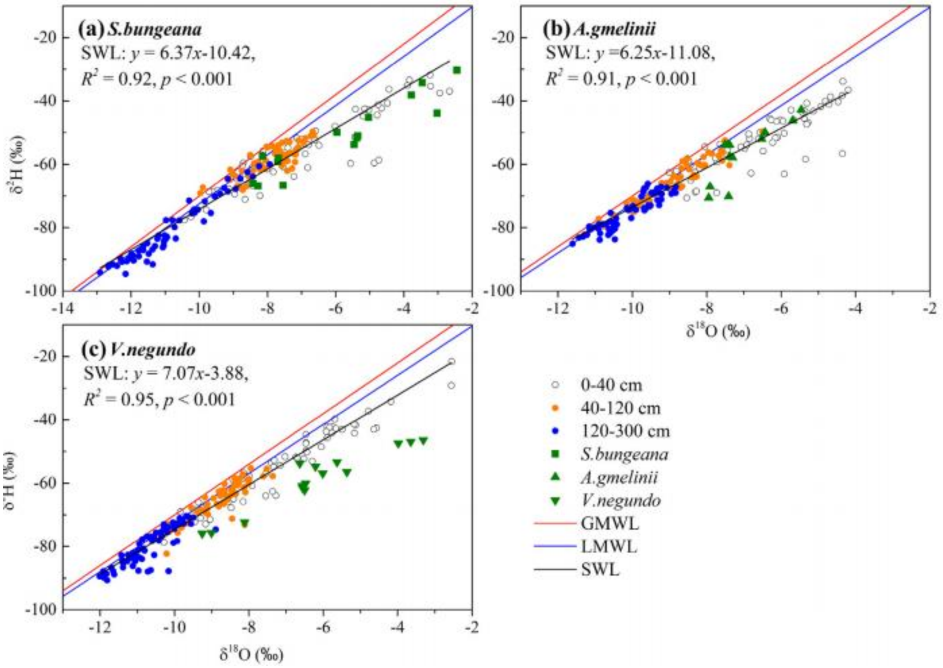


Figure explain 5 The linear regression relationship between δ^{2}H and δ^{18}O in soil water from three species (a) S. bungeana, (b) A. gmelinii, (c) V. negundo during the sampling periods. SWL represents soil water line based on isotopic data of soil water. LMWL represents the local meteoric water line ($y = 7.76x + 5.14$, $R^2 = 0.91$, $p < 0.01$). This plot is from Wang et al. (2017).

References:

Salamalikis, V., Argiriou, A. A., and Dotsika, E.: Isotopic modeling of the sub-cloud evaporation effect in precipitation, Sci Total Environ, 544, 1059-1072, 2016.

Wu, W. J., Li, H. J., Feng, H., Si, B. C., Chen, G. J., Meng, T. F., Li, Y., and Siddique, K. H. M.: Precipitation dominates the transpiration of both the economic forest (Malus pumila) and ecological forest (Robinia pseudoacacia) on the Loess Plateau after about 15 years of water depletion in deep soil, Agr Forest Meteorol, 297, 2021.

Wang, J., Fu, B. J., Lu, N., and Zhang, L.: Seasonal variation in water uptake patterns of three plant species based on stable isotopes in the semi-arid Loess Plateau, Sci Total Environ, 609, 27-37, 2017.

10. L.395-396: have you measured the depth of the groundwater level?

Response: Rewritten and Clarified. In response to this suggestion, the sentence has been rewritten in "4.1 RRS uptake enhances plant transpiration for *H. rhamnoides* but not *P. tomentosa* in pure plantations" subsection in "**4 Discussion**" section as follows: "Rainwater is the only replenished soil water source in the studied region (Shao et al., 2018), because plants cannot uptake ground water of approximately 150 m depth below the surface, which was determined through well observation (unpublished data).” (Page 18 Lines 412-414).

The approximately 100 m depth of groundwater though well observation has been published in previous studies in Loess Plateau, such as Shao et al. (2018) and Xie et al. (2018). The diagram illustrating the groundwater observation can be observed in **Figure explain 8** in Shao et al. (2018) as follows:

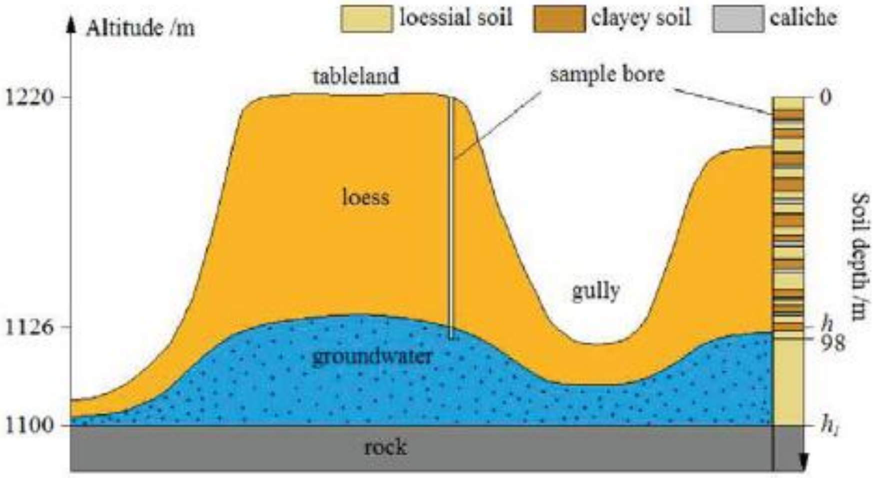


Figure explain 8 A diagram illustrating a cross section of the sampling site in the Loess Plateau of China; *h* and h_l are the depth of water table (m) and lower boundary of virtual soil layer (m) that was set as the bottom of the phreatic aquifer, respectively. This plot is from Shao et al. (2018).

In the present study, the observed groundwater was observed through well observation. The studied plantations were in tableland. The groundwater depth from the surface soil was approximately 150 m, the groundwater depth during June-September in 2018 can be observed in **Figure explain 9** as follows. These groundwater depth values have not been published. Thus, this sentence has been rewritten as “Rainwater is the only replenished soil water source in the studied region (Shao et al., 2018), because plants cannot uptake ground water of approximately 150 m depth below the surface, which was determined through well observation (unpublished data).”

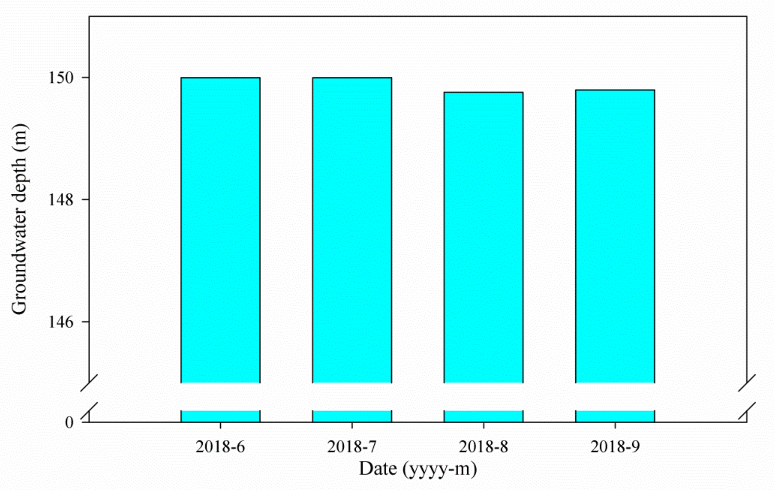


Figure explain 9 The groundwater depth from surface soil near the studied plantation.

References:

Shao, J., Si, B. C., and Jin, J. M.: Extreme Precipitation Years and Their Occurrence Frequency Regulate Long-Term Groundwater Recharge and Transit Time, Vadose Zone J, 17, 2018.

Xie, X. W., Xu, C. J., Wen, Y. M., and Li, W.: Monitoring Groundwater Storage Changes in the Loess Plateau Using GRACE Satellite Gravity Data, Hydrological Models and Coal Mining Data, Remote Sens-Basel, 10, 2018.

11. Figure 7: this is a very good overview, really clear!

Response: Thanks for this evaluation.

12. In general, I think the manuscript would benefit from some language editing as there are numerous language and grammar issues.

Response: Thanks for this suggestion, the language of revised manuscript has been has been refined by *International Science Editing*.

International Science Editing
www.internationalscienceediting.com

DATE: March 9, 2022

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To whom it may concern,

The paper "Differential response of plant transpiration to uptake of rainwater-recharged soil water for dominant tree species in the semiarid Loess Plateau" by Yakun Tang was edited by International Science Editing. We were asked not to edit the references. Please contact us if you would like to view the edited paper.

Kindest regards,

David Cushley.

If the English and our answers are not meet the standard, please give me another chance, I will revised the language again by another scientific editing service company again .