The ecological risk assessment of heavy metals in the Kuihe River basin (Xuzhou section) and the characteristics of plant enrichment

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Abstract. In order to investigate Kuihe River basin of heavy metals (As, Cd, Cr, Cu, Mn, Ni, Pb and Zn) pollution, the determination of the Kuihe River water body, the bottom of the river silt, riparian soil plants and heavy metal content of 9 kinds of riparian plants, investigate the pollution situation, so as to screen out the plants that has potential of enrichment and rehabilitation of heavy metal pollution. The results showed that Cd and Mn in the water body exceed bid; The pollution of Zn and Cu in the bottom mud is serious, potential ecological risk of heavy metals is Zn>Cu>Pb>Ni>Cd>As>Cr>Mn; Riparian soil affected by sewage and overflow of sediment has significant positive correlation with soil heavy metals, among them, the Zn and Cu are heavy pollution ;The selective absorption of heavy metals by 9 kinds of dominant plant leads to its bio concentration factor (BCF) of Cr and Pb on the low side, are all less than 1, from the translocation factor (TF), *Setcreasea purpurea* and *Poa annua* showed obvious roots type hoarding. *Poa annua* and *Lycium chinense* have a resistance on the absorption of heavy metals, *Lythrum salicaria*, *Photinia serrulata* and *Broussonetia papyrifera* have a unique advantage on enrichment of heavy metals, *Broussonetia papyri era* on a variety of strong ability of enrichment and transfer of heavy metals suggests that the woody plants in the vast application prospect in the field of rehabilitation technology of heavy metals.

1. Introduction

In recent years, water quality of China's urban rivers and lakes have been heavy pollution due to long-term sewage and industrial waste water, sewage flows and agricultural pollution irrigation have led to more widespread soil pollution [1-2]. Soil heavy metal pollution due to its concealment, accumulation, irreversibility and the vast potential of human enrichment become a global environmental problem, the traditional physical and chemical rehabilitation is expensive and difficult to popularize widely. The proposed method of ecological rehabilitationn technology provides a new way for heavy metal pollution control [3]. Therefore, the exploration of the enrichment characteristics of heavy metal hyper accumulator has become a research hotspot of environmental science and pollution ecology at home and abroad [4].

Ecological rehabilitation technology uses plants to transfer heavy metals from water or soil to plants in the form of strong absorption and enrichment of some heavy metals ,through to the plant harvest and properly handle to achieve the purpose of pollution control and ecological rehabilitation, it is known as green rehabilitation technology[5-6],which is characterized by the low cost of management, the in-situ property of the governance process, the permanent effect of the governance effect, the retention of soil resoil and the environmental friendliness for some heavy metal hyper accumulation with super absorptive capacity, and resistance to heavy metal poisoning and become the key to ecological rehabilitationn [7], the difficulty is to find the ideal cumulative plants. It is generally believed that it is a more practical way to investigate and excavate superrich plants in the area of extreme pollution (sewage channel, waste mines, etc.) [5, 7].

This research through the field investigation of Kuihe River along blowdown circumstance, on water, bottom mud, river bank on the determination of heavy metal content in soil and plant, the system investigate the heavy metal pollution situation, provide scientific basis for Kuihe River governance, and hope some plants with tolerance or over enrichment to heavy metal pollution were screened out, for a wide range of river ecological risk assessment of heavy metal pollution and ecological rehabilitation technology application provide the scientific reference.

2. Materials and Methods

2.1. Overview of the research area

The source of the Kuihe River is in Yunlong lake, Xuzhou City, Jiangsu Province, China, flows through the Suzhou City, Lingbi County, Sixian County in Anhui Province,was finally sent to Hongze lake in Sihong County, Jiangsu Province, Kuihe River length of more than 180 kilometers, only Xuzhou section about 25.75 kilometers long, is the main city of Xuzhou drainage.In early 1980s, because of a large number of industrial wastewater and domestic sewage discharged into the long term, the highest content of Kuihe River ammonia exceed the standard 80 times, the highest COD content exceed the standard 125 times, the highest content of carcinogen nitrite nitrogen exceed the standard 200 times, the Huaihe River basin is the mostheavy pollution of the river .In the past 20 years, the people's livelihood projects which is the implementation of let Kuihe River "to be clear, to be beautiful, to be alive ", has a lot to improve water quality, but still not ideal, in summer, it often stinks, which seriously affects the ecological environment.

2.2. Sample collection

In May 2016, the Kuihe River (Linda campus section) on both sides (slope of 40 degrees to 50 degrees) of natural plant communities affected by sewage were carefully investigated, collected good growth status, growth period of dominant species similar to the whole plant (bottom vertical distance within the range of 2 m),they are *Trifolium repens*, *Lythrum salicaria*, *Setcreasea purpurea*, *Poa annua*, *Pyracantha fortuneana*, *Photinia serrulata*, *Lycium chinense*, *Ligustrum lucidum*, *Broussonetia papyrifera* of 9 species,3 samples per plant at the same time,from each plant root zone within 5 cm of surface soil (0 ~ 3 cm) in a sample of 9.

2.3. Sample processing and analysis

After the river sediment and soil samples are dried naturally, the stones, plants and animals and other debris are removed, the quartering method retains 50 grams samples, after grinding, cross 100 meshes sieve, then load the self-sealing bag to seal the standby. After the plant sample is brought back to the lab, rinse with tap water and then and then washed with ultra pure water 3 times. Because the stems and leaves of herbs are difficult to separate, the plant samples are divided into the aerial part (stem, leaf, flower and fruit) and the underground portion (root system). The sample was sterilized at 105℃ for 30 min, and baked to constant mass at a temperature of 70℃ for powder storage.

To weigh respectively the soil, sludge and plant samples that were dried to the constant mass 0.5000g, gabsorbing supernatant 10 ml after precipitation, use HNO3-HClO4 method to dissolve and repeat 3 times [8]. Each batch of sample sets the corresponding nitrification acid as a blank during digestion to eliminate the error in the process of nitrification and determination .All containers used in the experiment were soaked with 2% HNO3 for more than 24 h, and the purified water was rinsed and dried. The ICE3100 spectrometers, produced by Thermo Fisher Scientific, measured the contents of 8 heavy metal elements including As, Cd, Cr, Cu, Mn, Ni, Pb and Zn.

Data processing and statistical analysis use software SPSS 20.0 and Microsoft Excel 2010.

3. Results and Analysis

3.1. Water heavy metal content

The national *Environmental Quality Standard for Surface Water* (GB3838-2002) of V class standard is mainly applicable to the water area of agricultural water and the general landscape, which is the minimum standard for the quality of environmental quality standard for surface water in China. As can be seen from Table 1, Cd and Mn are 2 times and 1.31 times as heavy as V class standard in Cu and Pb, which is heavy pollution; As for Ⅳ class standard, Cr and Zn are Ⅱ class standard, Cu and Pb are Ⅰ class standard. It is generally believed that Cd is the main heavy metal [4, 6] that restricts and poisons plant growth [4, 6]. The superstandard of Mn is related to eutrophication of water body, it is found that there are fewer aquatic plants in the Kuihe River, which may be related to the heavy pollution of Cd and Mn. The water is black and foul-smelling because of COD (Chemical Oxygen Demand), NH3-N (Ammonia Nitrogen Content), TP (Total Phosphorus) and TN (Total Nitrogen) content exceeds bid [9] and hidding danger for water governance.

Table 1 Contents of heavy metals in water samples and the surface water quality standard of class V (mg·L-1)\

	As	Cd	Cr	Cu	Mn	Ni	Pb	Zn
Water samples	0.074	0.002	0.037	0.003	0.131	0.004	0.003	0.352
Class V standard	0.1	0.001	0.1	1.0	0.1	0.02	0.1	2.0

3.2. The amount of heavy metal in the bottom of the river

The pollution index (P*i*) is often used as an indicator of soil heavy metal pollution assessment [10], and the formula for calculating the formula: P*i* = C*i*/S*i*, which is C*i*: The measured value of the pollutant element; Si: the evaluation criteria of pollution element, generally adopted Chinese soil element background value [11]. Pollution index rating standard [10]: Pi≤0.7 (clean); 0.7<P*i*≤1.0 (still clean); 1.0<P*i*≤2.0 (light pollution); 2.0<P*i*≤3.0 (moderate pollution); P*i*>3.0 (heavy pollution).

River silt is usually a gathering place of water suspended particulate matter, animal and plant residues and other substances ,the analysis of heavy metals in the bottom of Kuihe River shows (Table 2) that the contents of Cu, Ni, Pb and Zn were all higher than the soil background values of Jiangsu Province [11] , among them, Zn's mass fraction (1179mg/kg) exceeded the maximum, which was 18.83 times the background value; Pollution index Pi: Zn>Cu Zn>Cu>Pb>Ni>Cd> As>Cr>Mn, among them, Zn and Cu are heavy pollution; Pb is moderate pollution; Ni is slight pollution; As, Cd and Cr are still clean; Mn is clean.

Table 2 Contents of heavy metals in the river silt (mg·kg-1)

	As	Cd	Cr	Cu	Mn	Ni	Pb	Zn
River silt	8.14	0.12	58.26	137.92	400.2	33.44	60.19	1179
Soil background value	10	0.126	77.8	22.3	585	26.7	26.2	62.6
Pollution Index, Pi	0.814	0.953	0.749	6.185	0.6841	1.252	2.297	18.83

3.3. River soil heavy metal content

3.3.1. Pollution ecological risk assessment. Generally, the distribution of elements in soil is controlled by soil texture type and soil parent material, and the terrain slope, vegetation condition and so on are also important influencing factors [12]. Analysis of heavy metal in the riparian soil of Kuihe River shows (Table 3), average 8 kinds of heavy metal content is: Mn>Zn>Cu>Cr> Pb>Ni>As>Cd, among them, the contents of Cd, Cu, Ni, Pb and Zn exceeded the background value of soil in Jiangsu Province. The maximum / background value of Zn was the largest (6.564), followed by Cu (3.753) and Cd (2.698).

Compared with the sampling point analysis, it was found that the contents of heavy metals in soil samples near the water surface were higher, while the soil samples from the water surface were less in metal content, which might be related to the capillary transport water in the soil [13]. Pollution index Pi:Zn > Cu > Pb > Mn > Cr > As, among them, Zn and Cu are heavy pollution; Cd is heavy pollution; Pb and Ni are light pollution; Mn is still clean; Cr and Cd are clean; Ni and As are clean. Comparing the heavy metals pollution in the river mud and the riparian soil, it can be found that both Cd, Zn and Cu are heavy pollution. The content of Mn and Cr is very low, and the potential ecological risk is the least.

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Table 3 Contents of heavy metals in the riparian soil (mg·kg-1)

	As	Cd	Cr	Cu	Mn	Ni	Pb	Zn
Maximum	4.86	0.34	66.42	83.7	616.8	42.98	58.47	410.9
Minimum	2.01	0.23	34.67	40.83	380.1	17.92	25.45	100.7
Mean	3.35	0.283	50.49	67.45	495.4	30.06	39.28	238.3
Pollution Index, Pi	0.335	2.249	0.6489	3.025	0.8469	1.126	1.499	3.807

Note: $P_i = C_i/S_i$, C_i: Mean; S_i: Soil background value

3.3.2. Correlation analysis. Usually Cu in soil and Pb, C, Zn and Cd have significant positive correlation, because they are the halophile elements, and soil organic matter in S^{2-} combined into insoluble sulfide precipitation[14] of; on the other hand, the positive correlation between heavy metals also implies that they may have the same source of [15]. The Kuihe River riparian soil heavy metals according to the correlation analysis (Table 4), there was no significant positive correlation between Cu and Zn, Pb, all the other elements were significant or highly significant positive correlation, indicating the soil heavy metal has great homology. In addition to the influence of capillary water in the soil, the rainstorm in summer caused the rising of stream water and the rising of sediment, and it was also an important factor to soak the riparian soil.

Table 4 Pearson correlation coefficients of heavy metals of riparian soil (number of samples, n=24)

	As	Cd	Cr	Cu	Mn	Ni	Pb
Cd	0.999*						
Cr	0.995**	0.999**					
Cu	0.878**	0.901**	0.920*				
Mn	0.998**	1**	0.999**	0.904*			
Ni	0.999*	1**	0.999**	0.900*	1**		
Pb	0.985**	0.975**	0.964*	0.783	0.974**	0.976*	
Zn	0.996*	0.990*	0.983**	0.831	0.989*	0.990*	0.997*

Note: *: significantly different at P<0.05 level; **: significantly different at P<0.01 level.

3.4. Plant body weight metal content

3.4.1. Analysis of heavy metal content in plants. As a result of the autumn and winter every year on both sides of the Kuihe River weed scattered 2~3 times clean, so the collection of 9 dominant plants samples can be regarded as the species of the year. The heavy metal content of plant samples shows that (Table 5) *Trifolium repens, Lythrum salicaria and Pyracantha fortuneana* contain the higher As , *Lythrum salicaria* contains the higher Cd , *Trifolium repens, Lythrum salicaria, Ligustrum lucidum and Broussonetia papyrifera* contain the higher Cr , *Trifolium repens, Lythrum salicaria, Setcreasea purpurea, Pyracantha fortuneana and Photinia serrulata* contain the higher Cu, *Broussonetia papyrifera and Photinia serrulata* contain the higher Mn, *Lythrum salicaria, Trifolium repens, Setcreasea purpurea, Pyracantha fortuneana and Photinia serrulata* contain the higher Ni, *Poa annua, Lycium chinense and Broussonetia papyrifera* contain the higher Pb, *Lythrum salicaria, Broussonetia papyrifera and Photinia serrulata* contain the higher Zn.

Table 5 Contents of heavy metals in various parts of plants

Species	Position	Contents of heavy metals (mg·kg-1)								Zn/Cd
		As	Cd	Cr	Cu	Mn	Ni	Pb	Zn	
(Trifolium repens)	aerial part	6.72	0.07	30.89	208.8	436.3	46.2	0.07	548.94	7842
	underground portion	25.78	0.04	41.8	333.4	482.1	20.3	1.37	563.9	14098
(Lythrum salicaria)	aerial part	5.98	0.26	20.91	217.3	442.3	58.9	0.28	1783	6858
	underground portion	20.73	0.88	49.87	237.6	521.4	68.95	0.33	1654	1880
(Setcreasea purpurea)	aerial part	2.302	0.06	4.897	107.3	298.4	37.39	6.23	782.1	13035
	underground portion	4.89	0.14	6.932	215.3	433.7	55.2	11.89	1001	7150
(Poa ammua)	aerial part	1.03	0.06	2.44	5.82	131.6	1.17	5.39	51.78	863
	underground portion	2.31	0.19	7.18	16.62	431.2	14.07	22.97	95.46	502.4
(Pyracantha fortuneana)	aerial part	12.21	0.09	5.83	207.4	423.5	44.82	7.28	639.5	7106
	underground portion	22.04	0.12	8.933	342.1	391.2	32.43	10.44	1104	9200
(Photinia serrulata)	aerial part	0.11	0.02	7.92	193.2	739.5	34.3	10.83	983.5	49175
	underground portion	2.48	0.08	16.38	327.4	916.4	42.4	8.936	1473	18413
(Lycium chinense)	aerial part	3.93	0.07	43.87	17.98	372.7	12.98	5.82	117.5	1679
	underground portion	2.69	0.13	10.67	53.87	400.6	14.93	22.05	473.6	3643
(Ligustrum lucidum)	aerial part	2.73	0.06	22.86	238.6	90.04	1.83	3.72	815.2	13587
	underground portion	26.84	0.51	48.61	173.7	500.4	4.03	16.02	1105	2167
(Broussonetia papyrifera)	aerial part	1.77	0.37	66.78	84.32	567.9	32.9	8.43	1434	3876
	underground portion	2.56	0.11	30.67	66.88	523.1	17.98	22.07	1230	11182

Usually aquatic or wetland plants had resistance to Cu, Cd, Ni, Zn and other heavy metals, the enrichment ability of Zn is generally high, close to or exceed "hyperaccumulator" level [18]. In this study, the mass fraction of Ni and Zn in the aerial part and t underground portion of *Lythrum salicaria* is the highest among the nine plants, reaching 58.9 mg/kg, 68.8 mg/kg and1783 mg/kg, 1654 mg/kg respectively, in addition, the content of Cd, Cu, As and Cr is also higher, which may be related to the special ecological wetland plants. Further analysis found that the levels of Cd, Ni, Zn and As in the *Photinia serrulata*, which grew closer to the surface of the water, were also higher.

Generally, woody plants with high biomass and long growth cycle, and weak dependence, low maintenance cost [3, 5, 8], so it has unique advantages in terms of ecological rehabilitationn, and herb composition of three-dimensional ecological engineering rehabilitation mode [19]. The study found that the Cr content in *Broussonetia papyrifera* is highest, in addition, the content of Mn and Pb in Broussonetia papyri era and the content of As, Cu are both relatively high, basically consistent with previous studies [19-20], provides the reference for the further development of woody plant rehabilitation.

Although the ecological rehabilitationn technology has many advantages, but there are still some limitations, since the field screening of 400 kinds of hyper accumulator plants often low biomass, slow growth, low efficiency of actual rehabilitation [3,5,8] . Generally, woody plants with high biomass and long growth cycle, and weak dependence, low maintenance cost, so it has unique advantages in terms of ecological rehabilitationn, and herb composition of three-dimensional ecological engineering rehabilitation mode [19]. This study found that the content of Cr in the *Broussonetia papyrifera* was highest. Besides, the content of As, Cu in the *Broussonetia papyrifera* and the content of Mn, Pb in the *Ligustrum lucidum*, and privet was also high, consistent with previous studies basic [19-20], it provides further reference for the rehabilitationn of woody plants.

3.4.2. Analysis of plant heavy metal enrichment capacity. Bioconcentration factor (BCF) is a portion of the plant in some heavy metal content and the ratio of the same heavy metal content in soil, generally, as a reflection of the heavy metal capacity of plants, the larger the enrichment coefficient indicates that the plant has better absorption capacity of heavy metals [3-8]. Analysis Table 5 combined with Fig.1 and Fig.2 show that both the aerial part and underground portion taht BCF are greater than 1 respectively, which are As: *Trifolium repens, Lythrum salicaria, Pyracantha fortuneana, Photinia serrulata;* For Cu: *Trifolium repens, Lythrum salicaria, Setcreasea purpurea, Pyracantha fortuneana, Photinia serrulata;* For Mn: *Photinia serrulata;* For Ni: *Lythrum salicaria, Pyracantha fortuneana;* For Zn: *Trifolium repens, Lythrum salicaria, Pyracantha fortuneana, Photinia serrulata, Ligustrum lucidum and Lycium chinense.*

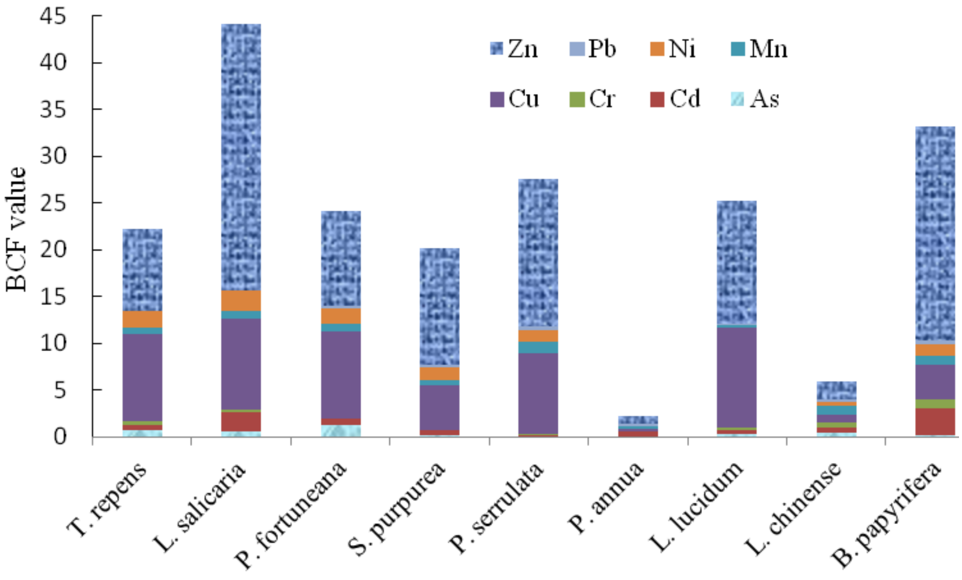

Fig.1 Bioconcentration factor (BCF) of plant aerial parts

For plants that have survived pollution, long-term natural selection has led to some defensive resistance to heavy metals: accumulator plants can actively absorb and enrich heavy metals from the soil, and transfer them to the aboveground part [15-16],the compartment plant shows passive absorption characteristics of heavy metals and stores them in the root, moving only a small amount of [21] to the aboveground part, the excluber plant resists the absorption of heavy metals and often deposits them on the root surface [15-19]. Therefore, plants with BCF greater than 1 in the above analysis can be considered as enrichment plants. Further analysis revealed that the BCF of 9 plants with As, Mn, Pb, Cr and Cd were mostly less than 1, which showed excluber plant characteristics, which may be related to the selective absorption of heavy metals by plants. The high enrichment of Zn may be closely related to the high affinity of Zn^{2+} with its root system [22-23]. The high concentration of Zn is likely to be closely related to the high fidelity of Zn with the high concentration of Zn in the *Trifolium repens, Lythrum salicaria, Setcreasea purpurea, Pyracantha fortuneana, Photinia serrulata, Ligustrum lucidum, Broussonetia papyrifera* .The BCF in *Poa annua* of 8 kinds of heavy metals is less than 1 (except for the concentration of Zn in the root of *Lycium chinense*), showing a lower enrichment capacity, which is a typical evasive plant.

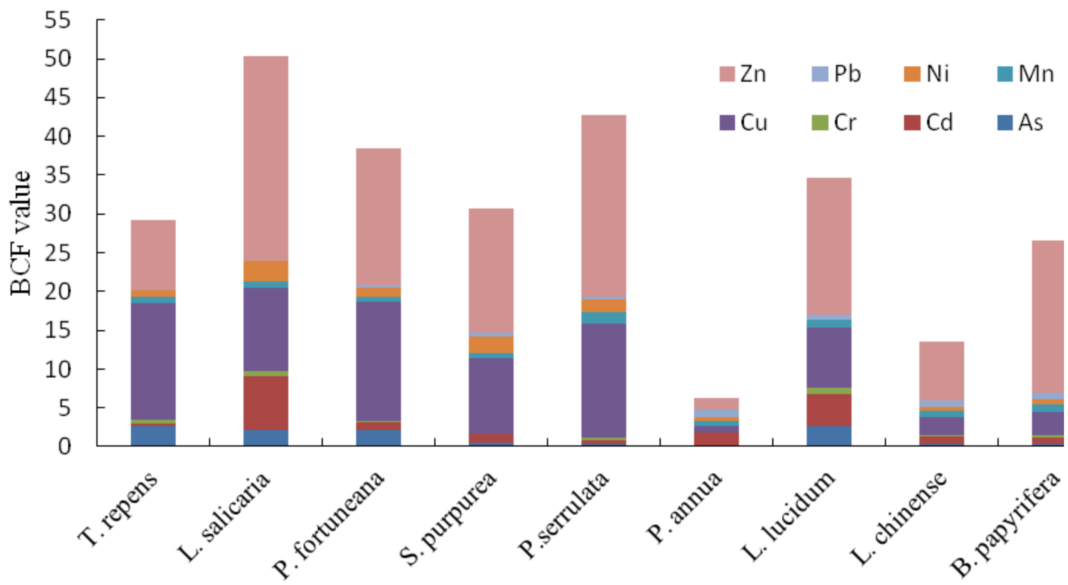

Fig.2 Bioconcentration factor (BCF) of plant underground parts

However, from the perspective of ecological rehabilitationn and ecological security of contaminated soil, the "accumulator" and "excluber" mechanism of heavy metals have the same important status [1]. accumulator is resistant to heavy metals and can transfer heavy metals to the aerial part, can be used to rehabilitation contaminated soil, but after harvesting, it should be properly handled to prevent heavy metal from causing secondary pollution to human and animals through the food chain [24]. excluber can grow well in heavy metal pollution of environment, it can be grown in use value is relatively low, severe pollution and larger derelict land, it has great significance to increase the diversity of ecosystem, maintain ecosystem stability[25]. In addition, by means of molecular biology, it can transfer its evasive master gene to the crops and improve the food safety coefficient [1].

3.4.3. Analysis of heavy metal transfer capacity. Translocation factor (TF) refers to the ratioof the amount of heavy metal in the aerial part of plant (cauline leaf flower fruit) to the amount of heavy metal in the underground portion of plant (roots) ,It can be used as a reflection of the ability of plants to transfer heavy metals from the underground portion to the aerial part [26]. The greater the

Translocation factor indicates the stronger plant's tolerance with heavy metals. Through analysis and discovery (Fig 3), of the nine plants, the TF was greater than 1, respectively. For Cd: *Lycium chinense;* For Cr: *Lycium chinense and Broussonetia papyrifera;* For Cu: *Ligustrum lucidum and Broussonetia papyrifera;* For Mn: *Pyracantha fortuneana, Lycium chinense and Broussonetia papyrifera;* For Ni: *Pyracantha fortuneana and Broussonetia papyrifera;* For Zn: *Lythrum salicaria and Broussonetia papyrifera.*

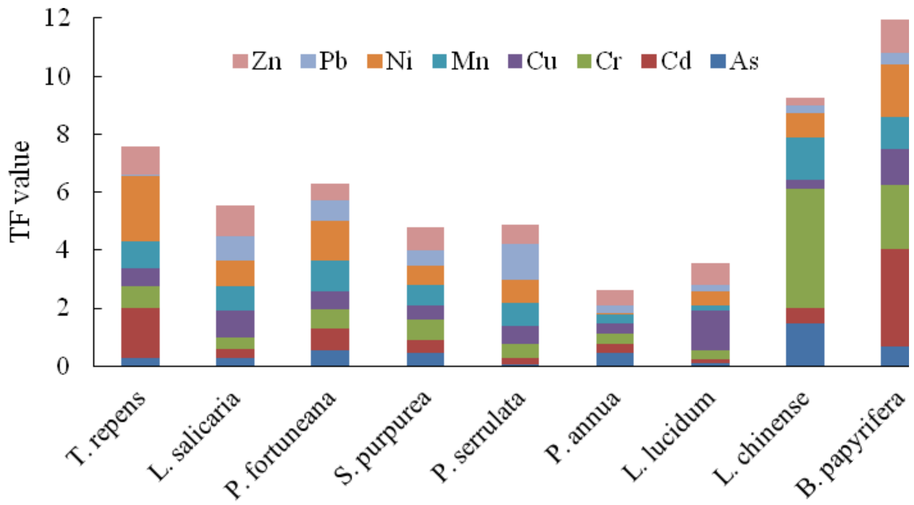

Fig 3. Transfer factor (TF) of plants

Among them, The TF of the *Broussonetia papyrifera* to Cd, Cr, Cu, Mn, Ni and Zn are all greater than 1, indicating that it has strong transfer ability. Studies have found that The roots of woody pioneer specie——*Broussonetia papyrifera* are large and absorbing [19-20], its special leaf structure (Thick and soft fur on both sides) also can effectively stop atmospheric particulates, and through the developed stomata organization to absorb atmospheric particulate matter which contains heavy metal [27]. compartment The significant characteristics of compartment that it accumulate heavy metal in the underground portion and rarely transfer upward, and TF is less than 1, the analysis found TF of the *Setcreasea purpurea* and *Poa annua* to eight kinds of heavy metals were all less than 1, is a typical compartment. In addition, *Trifolium repens* is the most transferable to Ni (TF = 2028), *Ligustrum lucidum* is the most transferable to Cu (TF = 1.37), *Lycium chinense* is the most transferable to Zn (TF =1.17) and Cd (TF =3.36), *Photinia serrulata* is the stronger transfer to Mn and Pb, It is the most prominent among the six herbs.

By Fig 3 can also see that, in addition to *Photinia serrulata* whose TF to Pb were all less than 1 eight kinds of plants, many studies have shown that Pb content of plant in the aerial part is far lower than the roots and The ability of the root system to transfer Pb to the aerial part is extremely low [8, 15-23, 25-26]. It is generally believed that the absorption of excessive Pb will have adverse effects on photosynthesis and cell division of plants, and the Pb in plant roots is mostly in the presence of precipitation, so as to reduce the activity and toxicity of Pb. The Pb in clover is mainly in the low activity of acetic acid extraction, hydrochloric acid extraction and residue state, it is less toxic to plants [22], this special physiological mechanism to balance the absorption and transfer of heavy metals in plants may be the main reason for many species of plant species to have wide Ecological amplitude [28]. Plants have the ability to resist the transfer of Pb from the roots to the aerial part, so most plants have a TF value of less than 1 for Pb.

The metallothion in plants has the function of delaying toxicity and detoxification of heavy metals. The study found that the Cd with the close combination of metallothionein level 3, 000 times larger than Zn, When Zn, Cd combine with sulfoprotein of thiol, Cd can replace Zn, so the Zn/Cd value in plants is a good index to reflect the accumulation ability of plants[23]. The greater the value of Zn/Cd, the stronger the ability of Zn migration in plants, or the root system of these plants can effectively fix Cd, thus reducing the transfer of Cd to the aerial part of the ground. As can be seen from Table 5, *Photinia serrulat*a had the largest Zn/Cd value (67588), followed by *Trifolium repens* and *Setcreasea purpurea*, and *Poa annua* had the smallest Zn/Cd value (1365.4). Chemical analysis of aquatic plants also showed that Zn is easier to transfer to leaves in plants, while Cd tends to accumulate in plant roots [18].

Hyper accumulators usually must have to satisfy three conditions: 1) The concentration of heavy metals in the aerial part of plant should reach a critical standard, such as Cu is 1000 mg/kg; 2) BCF and TF are both greater than 1; 3) They can grow well in polluted areas and produce large amounts of biomass, and they can finish life history normally [3, 5]. In this study, although the BCFof aboveground and underground portion of Ligustrum lucidum, Broussonetia papyrifera, Pyracantha fortuneana, Lythrum salicaria was greater than 1, TF were also higher than 1, but the content of Cu in plants has not reached the critical standard, therefore, can not be regarded as strictly Hyperaccumulator of heavy metal pollution, they exhibit strong endurance, which can be used for heavy metals the remediation of contaminated soil. On the other hand, it is necessary to pay more attention to the biological yield and economic benefit of plants when using plant ecological rehabilitationn techniques to rehabilitation heavy metal pollution in the environment.

4. Conclusion

1) The pollution of Cd and Mn in the Kuihe River is more serious than that of the national V level; There is a potential ecological risk for the pollution index Pi of river bottom silt: Zn > Cu > Pb > Ni > Cd > As > Cr > Mn, of which Zn, Cd and Cu are heavy pollution.

2) Riparian soil heavy metals were positively correlated, the potential ecological risk of Pi pollution index: Cd > Zn > Cu > Pb > Ni > Mn > Cr > As, where in Zn and Cu are heavy pollution, similar to the heavy metal pollution in river silt. Flooding sludge and river sewage are probably the main pollution sources of heavy metals in riparian soils.

3) In the 9 plants, most of them had lowe BCF for Cr, Mn and Pb, and TF to Pb was less than 1 except for *Photinia serrulata*. Plants often deposit Pb in the underground portion of the soil in the form of precipitation to reduce their toxicity.

4) The ability of *Poa annua* and *Lycium chinense* the accumulation of heavy metals was low, showing the typical characteristics of *excluber*; TF of *Setcreasea purpurea* and *Poa annua* on 8 kinds of heavy metals were less than 1, is the excluber; heavy metal content of *Lythrum salicaria*, *Ligustrum lucidum*, *Photinia serrulata* and *Broussonetia papyrifera* is high, has a unique advantage of heavy metals.

5) In the herbaceous plants, the transfer ability of Ni and Cd is relatively strong: *Trifolium repens*,the transfer ability of Zn;In woody plants, *Broussonetia papyrifera* has the strongest transfer ability of Cd, For Ni Cr, *Broussonetia papyrifera* also has strong enrichment and transfer ability; *Ligustrum lucidum* has the strongest transfer ability of Cu, *Lycium chinense* has the strongest transfer ability of Cr. Woody plants have great practical value in the ecological rehabilitationn of heavy metals, and they should be paid more attention to.

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