Study on Purification Capacity of *Platanus Orientalis* on Compound Pollution of Atmospheric SO_2-Pb

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Abstract: The purification capacity of SO_2 and Pb for plants is the basis of the ecological rehabilitation of SO_2-Pb compound pollution with plants.The experiment studies the purification capacity of *Platanus orientalis* on SO_2 and Pb by field sampling. The results show that the purification capacity of Pb is strong for *Platanus orientalis*, but is weak for SO_2 or the absorbed SO_2 is transferred to other organs, and no significant correlation between SO_2 purification and Pb purification.

Introduction

Compound pollution of SO_2-Pb in atmosphere is the main air pollutant, which extremely threatens life security as well as people's health. Seeking efficient measures of compound pollution of SO_2-Pb has been a considerable point of urban eco-environment construction[1-3]. The technology of ecological rehabilitation, which is economical, secure and sustainable, has been the significant strategy of recovering chemical oriented atmospheric pollution[4]. The experiment studies the purification capacity of *Platanus orientalis* to SO_2 and Pb by field sampling in SO_2-Pb compound polluted area and non-polluted area, which provided important basis for the ecological rehabilitation of SO_2-Pb compound pollution with plants in the atmosphere.

Materials and methods

Materials

During the late summer and early autumn (September, 2014), *Platanus orientalis* was selected as the experimental material. During this period, the metabolic rate is the fastest and the accumulation of pollutants in the leaves is the highest.

Experimental method

Setting the area surrounding Jian Refinery(36°42N, 117°10′E)as polluted area of SO_2-Pb, and setting Lily nursery(36°41′N, 117°15′E)as contrast area simultaneously. Jinan Refinery is a major source of $SO_2$and Pb pollution, and the nursery, which is away from the refinery 10km, has the similar climate conditions and soil, acidic brown soil, with Jinan Refinery.

Select 2 sampling points in four directions(east, south, west and north)respectively in polluted area and 3 plants with similar growth condition in each sampling point. Each plant was cut out 4 annual branches with normal growth. The non-polluted area was sampled in the same way. The branches of the polluted area were randomly divided into three groups for three replicates experiment, and each group has 8 branches. Twenty-four branches were selected randomly from each sampling point of non-polluted area, and the grouping method is the same as the polluted area.

The determination of SO_2 content in the leaves of *Platanus orientalis* is EDTA complexometric titration and Pb content is spectrophotometry[5-6]. The experimental data is dealt with variance analysis, multiple comparison (LSD) and correlation analysis by using SPSS software.

Results and discussion

The contents of Sulfur and Pb in *Platanus orientalis* leaves in different areas were measured (see Table 1), and the data are the average of triplicate experimental measurements.

Table 1 Contents of Sulfur and Pb of *Platanus orientalis* leaves in different areas

Contents of Sulfur and Pb \ Different areas	East（X1）	South（X2）	West（X3）	North（X4）	Contrast area（X0）
Sulfur content （mg/g·FW）	9.01±0.67	7.80±0.55	5.80±0.43	8.74±0.69	8.89±0.75
Pb Content （mg/kg·FW）	6.17±0.25	7.12±0.37	6.51±0.21	6.87±0.34	3.68±0.15

Analysis of purification capability of *Platanus orientalis* leaves on SO_2

One-way variance analysis of Sulfur content of *Platanus orientalis* leaves in different areas(see Table 2).

Table 2 Variance analysis of Sulfur content of *Platanus orientalis* leaves in different areas

Source	Degree of freedom	SS(Sum of squares of deviations)	MS（Mean square）	F（Mean square ratio）
Different areas	4	19.513	4.878	8.220**
Error	10	5.934	0.593	
Total	14	25.447		
S =0.7703 R-Sq = 76.68% R-Sq（Adjustment）= 67.35%				$F_{0.05}$=3.48 $F_{0.01}$=5.99

Note: ** indicates extremely significant difference (P<0.01), * indicates significant difference (P <0.05).Tables below are the same as above.

As can be seen from Table 2, there is an extremely significant difference in Sulfur content of *Platanus orientalis* leaves in different areas (P<0.01). Then multiple comparative analysis of different regions are carried out(see Table 3).

Table 3 Multiple comparison of Sulfur content of *Platanus orientalis* leaves in different areas

Xi \ Xi-Xj	Original value	Xi-X3	Xi-X2	Xi-X4	Xi-X0
X1	9.01	3.21**	1.21	0.27	0.12
X0	8.89	3.09**	1.09	0.15	
X4	8.74	2.94**	0.96		
X2	7.80	2.00**			
X3	5.80				
Test value $D_\alpha=q_\alpha(a,f)\sqrt{\frac{MS}{m}}$		$D_{0.05}$= 0.6534	$D_{0.01}$=0.9293		

As can be seen from Table 3, there is no significant difference in Sulfur content of *Platanus orientalis* leaves between the east(X1), the south(X2) and the north(X4) compared with the contrast area(X0), while there exists an extremely significant difference between the west(X3) and the contrast area(X0). Under compound pollution of atmospheric SO_2-Pb stress, there is no significant effect on Sulfur content in *Platanus orientalis* leaves, or the absorbed SO_2 was transferred to other organs.

Analysis on purification capability of *Platanus orientalis* leaves to Pb

One-way variance analysis of Pb content in *Platanus orientalis* leaves in different areas(see Table 4).

Table 4 The variance analysis for Pb content of *Platanus orientalis* leaves from different areas

Source	Degree of freedom	SS(Sum of squares of deviations)	MS（Mean square）	F（Mean square ratio）
Different areas	4	22.999	5.750	44.407**
Error	10	1.295	0.129	

Total	14	24.294			
S = 0.3598 R-Sq = 94.67% R-Sq（Adjustment）= 92.54%			$F_{0.05}$=3.48	$F_{0.01}$=5.99	

As can be seen from Table 4, there is a significant difference in Pb content of *Platanus orientalis* from different areas (P<0.01). Then multiple comparative analysis of different regions is made(see Table 5).

Table 5 Multiple comparison of Pb content of *Platanus orientalis* leaves in different areas

Xi	Original value (Xi-Xj)	Xi-X0	Xi-X1	Xi-X3	Xi-X4
X2	7.12	3.44**	0.95**	0.61	0.25
X4	6.87	3.19**	0.70*	0.36	
X3	6.51	2.83**	0.34		
X1	6.17	2.49**			
X0	3.68				
Test value	$D_\alpha=q_\alpha(a,f)\sqrt{\frac{MS}{m}}$	$D_{0.05}$= 0.6534	$D_{0.01}$=0.9293		

As can be seen from Table 5, there is a significant difference in Pb content of *Platanus orientalis* leaves in the east (X1), the south (X2), the west(X3) and the north(X4) compared with the contrast area(X0), and Pb content of *Platanus orientalis* leaves in polluted area is significantly higher than that in contrast area(see Table 1). And there was also a significant difference in Pb content of *Platanus orientalis* leaves between the east (X1), the south(X2) and the north(X4). Under compound pollution of atmospheric SO_2-Pb stress, there is significant effect on Pb content of *Platanus orientalis* leaves.

Correlative analysis of purification capability of *Platanus orientalis* leaves on SO_2 and Pb

The contents of Sulfur and Pb of *Platanus orientalis* leaves were analyzed by correlation analysis(see Table 6).

Table 6 Correlation analysis of Sulfur and Pb content of *Platanus orientalis* leaves

Indexes	Pb content	Sulfur content
Pb content	1	
Sulfur content	-0.353	1

As can be seen from Table 6, the contents of Sulfur and Pb of *Platanus orientalis* leaves are low negative correlation. Pb content of *Platanus orientalis* leaves is higher than that in contrast area(X0), and Sulfur content of *Platanus orientalis* leaves is slightly lower than that in contrast area(see Table 1). It's presumed that the absorbed SO_2 by *Platanus orientalis* leaves is not involved in complexing Pb. Therefore, under compound pollution of atmospheric SO_2-Pb stress, there is no significant correlation between SO_2 purification and Pb purification.

Conclusions

The experimental results show:

(1)Sulfur content of *Platanus orientalis* leaves in polluted area is slightly lower than that in contrast area, and the purification capacity of SO_2 in the atmosphere is weak or the absorbed SO_2 is transferred to other organs.

(2)Pb content of *Platanus orientalis* leaves in polluted area is significantly higher than that in contrast area, and the purification capacity of Pb in the atmosphere is strong.

(3)Under compound pollution of atmospheric SO_2-Pb stress, the contents of Sulfur and Pb of *Platanus orientalis* leaves are low negative correlation, and there is no significant correlation between SO_2 purification and Pb purification.

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