THE ANALYSIS OF THE ACCUMULATION OF FOUR KINDS OF ATMOSPHERIC POLLUTION ELEMENTS IN FIFTEEN KINDS OF LANDSCAPE PLANT LEAVES

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ABSTRACT

This paper aims to reveal the difference of foliage sulfur content in common road green trees in Nanjing. Fifteen afforestation trees were selected from four sampling sites, and the sulfur content of the leaves was analyzed. The results indicate that there is a significant difference in the amount of foliage sulfur content for different species of trees at different sites. The foliage sulfur content near Chemical Works and Door of Taiping-Beijing East Road is higher than those near Nanjing Forestry University and Zhongshan Botanical Garden. The seasonal variation of sulfur content for some trees is also evident. The sulfur content of the majority of trees, with the exception of Ligustrum Lucidum and Viburnum awabuki, increases according to the season. Tree species have been sorted using three classifications on the basis of year-round foliage sulfur content. Populus Canadensis, Ligustrumquihoui, and Platanus hispanica are classified into the first category, where the sulfur content was high. The second category includes Osmanthus fragrans, Lorpetalum chinense, and Ligustum Lucidum, and those varieties displayed a moderate sulfur content. Viburnum awabuki, Cinnamomum camphora, Buxus sinica and Aucuba japonica var. variegata are classified into the third category, which means that their sulfur content was low.

Key words: Landscape plant, Foliage, Pollution elements, Accumulation.

INTRODUCTION

Recently, one of the principle causes of urban environmental pollution is the emission of lead, copper, chlorine, and sulfur waste products (Lachapelle et al., 2012; Parolin et al., 2002; Pyankov et al., 1999). Plant leaves are more sensitive to changes in the environment as plants evolve; the physical appearance of the leaves reflect the influence of environmental factors that force the plants to adapt accordingly (Zeng et al., 2013; Anand et al., 2003; Wang et al., 2005). Therefore, the contaminants found in landscape plant leaves can be used as an indicator of urban environmental pollution (Figure 1).

Figure 1. A map of study areas in Nanjing

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In recent years, scholars have strived to evaluate the atmospheric environmental benefits of urban greening plants. They want to accumulate garden plants that can absorb atmospheric pollutants, including sulfur and lead, and to screen out typical pollutants (Du et al., 2007a; Du et al., 2007b).

Currently, the Nanjing green plant leaves are able to absorb lead. Information regarding their interaction with sulfur and chlorine has not been reported. In view of this, our study chose 15 kinds of common green plants (Magnolia grandiflora, Sophora Japonica, Populus, Broussonetia papyrifera, Pterocarya stenoptera, Koelreuteria bipinnata, Prunus cerasifera, Acer palmatum Thunb, Platanus, Pittosporum tobira, Buxus sinica, Aucuba japonica, Cinnamomum camphora, Viburnum awabuk, and Ligustrum quihoui). The polluted area and control area were tree leaf pollution elements that would help us determine the pollutant content. This study aims to compare the abilities of different species of trees to absorb and accumulate pollution elements, in order to provide a theoretical basis for the enrichment of air by garden plants.

**MATERIALS AND METHODS**

**Design Sampling Time and Location:** According to the difference in the degree of atmospheric pollution in Nanjing, we chose 2 different functional areas. The Nanjing chemical plant served as our pollution area, and the Nanjing forestry university campus was our clean area. Garden plants of different seasons were checked for lead, copper, chlorine, and sulfur content in May, July, and September of 2012. 1.2 The sample collection and preparation

We examined plants during spring, summer, and autumn of 2012 in different functional areas in order to choose the species with the healthiest leaves. For each species of tree, we measured the height, diameter at breast height (DBH), and the growth situation. Each sample point was taken randomly from 3 to 4 strains. The sampling location was the choice canopy outside out the area in all four directions. The height distance control was approximately 2.5 meters. From every branch, we chose 3 to 5 pieces of old leaves as a sample. We collected 10 to 12 leaves from large leaf trees, and 20 to 25 leaves from lobular species. We placed the collected blades in a self-sealing plastic bag and transported them back to the lab for processing. The specific steps are as follows: the blade is washed with water, then immersed in distilled water for six hours before being placed in the oven filming for 1 h under 105 °C. The samples are dried at 72 ℃ to constant weight, and the samples are crushed using 60 mesh. The powder samples are set aside for later analysis.

**RESULTS AND DISCUSSION**

**Garden Plant Leaves Of Seasonal Change Of Lead, Copper, Chlorine and Sulfur Point:** The physiological activities of the plants often changes seasonally. This affects the ability of the plants to absorb pollutants and to mutate, so the presence of pollutants presents some changes. Table 1 shows the trees from the pollution area and their leaf lead, copper, chlorine, and sulfur content. The progression of spring, summer, and autumn showed increasing trends as time went on. This situation allows us to divide the trees into three categories. The first category is an apparent variation in pollutant content. For example, the copper content of the Koelreuteria bipinnata leaf in autumn is 4.92 times that of it in the spring. The chlorine content of a Populus deltoides leaf in autumn is 4.58 times that of it in the spring. The second category is an evident change of pollutant content as time goes on, but this change is not as evident as it is in those species of the first category. The Pterocarya stenoptera and Prunus cerasifera leaves have lead content in the fall that is 3.81 and 3.16 times, respectively, that of their lead content in the spring. The copper content of Platanus hispanica leaf in autumn is 3.70 times that of the spring. Pittosporum tobira, Populus deltoides, Cinnamomum camphora, and Prunus cerasifera leaves showed sulfur contents in autumn that were respectively 3.38, 3.12, 3.06 and 3.00 times that of the spring. The third category shows a very slight change in pollution content. Magnolia grandiflora, Sophora japonica, Broussonetia papyrifera, Acer palmatum, Buxus sinica, Aucuba japonica, Viburnum odoratissimum and Ligustrum lucidum leaves show very little change in pollutant elements as time goes on. As a result, it can be determined that some of the species are subject to seasonal variations of pollutant content. Spring is the period of germination, which means that pollutant elements disperse, resulting in a relatively low content during that time. In summer, the Rush Dilute Effect is present, wherein the element accumulation speed cannot keep up with the growth of the blades. In autumn, the plant enters the slow-growth phase, so the accumulation of pollutants is more outstanding. This is consistent with the results of Mei et al. (2005) and Li et al. (2014), who

**Sample Measuring and Data Processing:** The airy card reagent digestion samples include barium sulfate turbidimetry for the determination of sulfur content (Huang et al., 1990; Pang et al., 2008). Calcium oxide dry ashing - silver nitrate titration for the determination of chlorine content (Liet. al., 1982; Zhang et al., 2014), and flame atomic absorption spectrophotometry for the determination of copper and lead content (Wang et al., 2009; Zhang et al., 1984). In this paper, we use Microsoft Excel and Spss 17.0 and Word 2003 software for statistics and analysis.
found that heavy metal content in plant leaves changes with the seasons, first falling between spring and summer, and rising during fall.

Inconsistent results stem from differences between the selected species, the geographical locations, and the climates in which the plants are found. Garden Plant Leaf, Copper, Chlorine and Sulfur Content of Function Change: Table 1 presents 15 kinds of garden plant leaves and their respective lead, copper, chlorine, and sulfur content in two functional areas. The leaves collected in autumn reach the maximum pollutant content, so we sample from both the highly polluted area and the clean area during that time. All garden plant leaf contaminants have similar variations. Those found in the Nanjing chemical plant have higher pollutant content than those from the Nanjing forestry university campus. Among the samples, the difference in lead content between the two locations has been especially visible in *Pterocarya fraxinifolia*, *Sophora japonica*, *Magnolia grandiflora*, *Koelreuteria paniculata*, *Viburnum odoratissimum*, *Aucuba japonica*, *Platanus hispanica*, *Buxus sinica*, and *Populus deltoids*. The rest of the trees showed a significant difference, as well. The difference in copper content between the two areas was most prevalent in *Cinnamomum camphora*. With the exception of *Pittosporum tobira* and *Ligustrum lucidum*, the rest of the trees showed significant differences. For *Magnolia grandiflora*, there was no significant difference between the two areas in terms of chlorine content, but the rest of the trees exhibited extremely significant differences. Only *Sophora japonica* and *Broussonetia papyrifera* showed a significant difference in sulfur content, while *Ligustrum lucidum* and *Buxus sinica* showed no significant difference and the rest of the trees showed a moderate difference. These differences can be explained by the variation in pollutants in each area. Around the Nanjing forestry university campus far away from downtown, there are not industrial enterprises, while near the chemical plant, industry is prevalent. The Nanjing forestry university campus thus has a lower concentration of atmospheric pollution than urban and industrial zones. Therefore, the garden plants found there have relatively low contents of pollutants in the leaves.

<table>
<thead>
<tr>
<th>Element</th>
<th>Tree species</th>
<th>Contaminated Zone</th>
<th>Clean Zone</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>May</td>
<td>July</td>
</tr>
<tr>
<td>Pb</td>
<td>FY</td>
<td>1.180±0.135a</td>
<td>3.690±0.047b</td>
</tr>
<tr>
<td></td>
<td>GH</td>
<td>2.040±0.241a</td>
<td>4.220±0.123b</td>
</tr>
<tr>
<td></td>
<td>GS</td>
<td>2.070±0.176a</td>
<td>3.150±0.155b</td>
</tr>
<tr>
<td></td>
<td>FY</td>
<td>3.220±0.124a</td>
<td>3.860±0.047b</td>
</tr>
<tr>
<td></td>
<td>HT</td>
<td>2.050±0.151a</td>
<td>2.120±0.119a</td>
</tr>
<tr>
<td></td>
<td>JZ</td>
<td>1.870±0.080a</td>
<td>2.540±0.078b</td>
</tr>
<tr>
<td></td>
<td>LS</td>
<td>2.340±0.077a</td>
<td>3.660±0.114b</td>
</tr>
<tr>
<td></td>
<td>NZ</td>
<td>2.450±0.070a</td>
<td>2.780±0.065b</td>
</tr>
<tr>
<td>Pb</td>
<td>SH</td>
<td>1.210±0.130a</td>
<td>1.460±0.045ab</td>
</tr>
<tr>
<td></td>
<td>SJ</td>
<td>1.580±0.068a</td>
<td>2.880±0.118b</td>
</tr>
<tr>
<td></td>
<td>XL</td>
<td>2.240±0.080a</td>
<td>3.470±0.109b</td>
</tr>
<tr>
<td></td>
<td>XY</td>
<td>2.150±0.107a</td>
<td>2.060±0.133a</td>
</tr>
<tr>
<td></td>
<td>XZ</td>
<td>1.440±0.074a</td>
<td>2.540±0.041b</td>
</tr>
<tr>
<td></td>
<td>LS</td>
<td>2.360±0.031a</td>
<td>3.650±0.074b</td>
</tr>
<tr>
<td></td>
<td>ZY</td>
<td>1.890±0.096a</td>
<td>3.730±0.107b</td>
</tr>
<tr>
<td>Cu</td>
<td>FY</td>
<td>4.150±0.053a</td>
<td>8.470±0.053b</td>
</tr>
<tr>
<td></td>
<td>GH</td>
<td>3.780±0.046a</td>
<td>8.450±0.049b</td>
</tr>
<tr>
<td></td>
<td>GS</td>
<td>4.090±0.056a</td>
<td>9.260±0.053b</td>
</tr>
<tr>
<td></td>
<td>FY</td>
<td>7.550±0.083a</td>
<td>8.140±0.064b</td>
</tr>
<tr>
<td></td>
<td>HT</td>
<td>3.770±0.048a</td>
<td>4.500±0.106b</td>
</tr>
<tr>
<td></td>
<td>JZ</td>
<td>2.280±0.053a</td>
<td>4.160±0.030b</td>
</tr>
<tr>
<td></td>
<td>LS</td>
<td>1.580±0.065a</td>
<td>5.670±0.120b</td>
</tr>
<tr>
<td></td>
<td>NZ</td>
<td>3.950±0.099a</td>
<td>4.560±0.078b</td>
</tr>
<tr>
<td></td>
<td>SH</td>
<td>2.330±0.045a</td>
<td>4.430±0.044b</td>
</tr>
<tr>
<td></td>
<td>SJ</td>
<td>2.600±0.063a</td>
<td>5.480±0.050b</td>
</tr>
<tr>
<td></td>
<td>XL</td>
<td>1.940±0.047a</td>
<td>5.220±0.074b</td>
</tr>
<tr>
<td></td>
<td>XY</td>
<td>3.360±0.089a</td>
<td>4.780±0.047b</td>
</tr>
</tbody>
</table>

Table 1. 15 kinds of garden plants in different seasons each function leaf lead, copper, chlorine and sulfur content more (p < 0.05 and p < 0.05)
The size of the accumulative value (X) is divided into the following three range (Table 2): X ≥ 2, 1 ≤ X ≤ 2, and X < 1. Accordingly, garden plants can be divided into three categories. The first category has plants with high lead, copper, chlorine, and sulfur content, as seen in Magnolia grandiflora, Sophora japonica, Populus deltoides, Broussonetia papyrifera and Prercyaceae. The second category, which includes Koelreuteria paniculata, Prunus cerasifera, Acer palmatum, Platanus hispanica, and Pittosporum tobira, has a moderate amount of pollution elements. Plants such as Buxus sinica, Aucuba japonica, Cinnamomum camphora, Viburnum odoratissimum, which display low pollutant content, make up the third category.

Garden Plant Leaf Lead, Copper, Chlorine and Sulfur Content of Multiple Comparison: Table 3 shows 15 kinds of garden plant leaves with multiple

<table>
<thead>
<tr>
<th></th>
<th>Lead</th>
<th>Copper</th>
<th>Chlorine</th>
<th>Sulfur</th>
</tr>
</thead>
<tbody>
<tr>
<td>FY</td>
<td>0.230±0.043a</td>
<td>0.350±0.047ab</td>
<td>0.474±0.045b</td>
<td>0.290±0.022a</td>
</tr>
<tr>
<td>GH</td>
<td>0.240±0.041a</td>
<td>0.550±0.025a</td>
<td>0.690±0.047c</td>
<td>0.410±0.027**</td>
</tr>
<tr>
<td>GS</td>
<td>0.380±0.030a</td>
<td>0.620±0.062b</td>
<td>0.770±0.074b</td>
<td>0.400±0.029**</td>
</tr>
<tr>
<td>G</td>
<td>0.210±0.052a</td>
<td>0.320±0.056a</td>
<td>0.551±0.040b</td>
<td>0.370±0.002**</td>
</tr>
<tr>
<td>HT</td>
<td>0.190±0.037a</td>
<td>0.420±0.050b</td>
<td>0.643±0.054a</td>
<td>0.380±0.036**</td>
</tr>
<tr>
<td>JZ</td>
<td>0.500±0.054a</td>
<td>0.560±0.047a</td>
<td>0.860±0.043b</td>
<td>0.610±0.062**</td>
</tr>
<tr>
<td>LS</td>
<td>0.240±0.044a</td>
<td>0.420±0.014b</td>
<td>0.470±0.033b</td>
<td>0.280±0.041**</td>
</tr>
<tr>
<td>S</td>
<td>0.230±0.038a</td>
<td>0.280±0.039a</td>
<td>0.340±0.041a</td>
<td>0.250±0.036**</td>
</tr>
<tr>
<td>SH</td>
<td>0.190±0.026a</td>
<td>0.350±0.013a</td>
<td>0.360±0.035b</td>
<td>0.233±0.0401</td>
</tr>
<tr>
<td>SJ</td>
<td>0.150±0.040a</td>
<td>0.200±0.057a</td>
<td>0.410±0.048b</td>
<td>0.240±0.055**</td>
</tr>
<tr>
<td>XL</td>
<td>0.340±0.044a</td>
<td>0.510±0.060b</td>
<td>0.650±0.046b</td>
<td>0.440±0.053**</td>
</tr>
<tr>
<td>XY</td>
<td>0.250±0.043a</td>
<td>0.370±0.029ab</td>
<td>0.430±0.046b</td>
<td>0.314±0.053 **</td>
</tr>
<tr>
<td>XZ</td>
<td>0.170±0.039a</td>
<td>0.340±0.044b</td>
<td>0.520±0.039c</td>
<td>0.280±0.029**</td>
</tr>
<tr>
<td>YS</td>
<td>0.330±0.042a</td>
<td>0.870±0.040b</td>
<td>1.030±0.042c</td>
<td>0.760±0.078**</td>
</tr>
<tr>
<td>ZY</td>
<td>0.210±0.028a</td>
<td>0.460±0.035b</td>
<td>0.630±0.065c</td>
<td>0.340±0.041**</td>
</tr>
</tbody>
</table>
comparison results of lead and copper content. The majority of the garden plants show a significant or extremely significant correlation between lead and copper content. As for lead content, none of the species showed significant differences. In terms of copper content, there was also no significant difference any of the species.

Table 2. 15 kinds of garden plant leaf lead, copper, comprehensive analysis of chlorine and sulfur

<table>
<thead>
<tr>
<th>Tree species</th>
<th>Pb/ Cl/%</th>
<th>Cu/ mg.kg⁻¹</th>
<th>S/%</th>
<th>Pb</th>
<th>Cu</th>
<th>Cl</th>
<th>S</th>
<th>Summation</th>
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</thead>
<tbody>
<tr>
<td>FY</td>
<td>1.860</td>
<td>3.870</td>
<td>0.338</td>
<td>0.184</td>
<td>0.597</td>
<td>0.986</td>
<td>0.209</td>
<td>0.336</td>
</tr>
<tr>
<td>GH</td>
<td>2.280</td>
<td>3.920</td>
<td>0.131</td>
<td>0.280</td>
<td>0.777</td>
<td>1.000</td>
<td>0.041</td>
<td>0.679</td>
</tr>
<tr>
<td>GS</td>
<td>1.470</td>
<td>3.220</td>
<td>0.231</td>
<td>0.370</td>
<td>0.429</td>
<td>0.801</td>
<td>0.122</td>
<td>1.000</td>
</tr>
<tr>
<td>FY</td>
<td>2.800</td>
<td>2.870</td>
<td>0.718</td>
<td>0.181</td>
<td>1.000</td>
<td>0.701</td>
<td>0.516</td>
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<td>0.850</td>
<td>0.103</td>
<td>0.263</td>
<td>0.313</td>
<td>0.125</td>
<td>0.019</td>
<td>0.618</td>
</tr>
<tr>
<td>JZ</td>
<td>0.590</td>
<td>2.730</td>
<td>0.301</td>
<td>0.250</td>
<td>0.052</td>
<td>0.661</td>
<td>0.179</td>
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<tr>
<td>LS</td>
<td>1.960</td>
<td>3.320</td>
<td>0.192</td>
<td>0.190</td>
<td>0.639</td>
<td>0.829</td>
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<td>NZ</td>
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<td>0.490</td>
<td>0.130</td>
<td>0.090</td>
<td>0.275</td>
<td>0.023</td>
<td>0.040</td>
<td>0.000</td>
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<td>SH</td>
<td>0.810</td>
<td>0.480</td>
<td>0.151</td>
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<td>0.020</td>
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<td>SJ</td>
<td>0.660</td>
<td>2.120</td>
<td>0.132</td>
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</tr>
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<td>0.890</td>
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<td>0.547</td>
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<tr>
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<td>0.410</td>
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<td>0.000</td>
<td>0.000</td>
<td>0.000</td>
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</tr>
<tr>
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<td>2.100</td>
<td>0.900</td>
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<td>0.140</td>
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<td>0.643</td>
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<tr>
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<td>0.361</td>
<td>0.595</td>
<td>0.161</td>
<td>0.714</td>
</tr>
</tbody>
</table>

Table 3. 15 kinds of garden plant leaves multiple comparison of lead and copper content

| Pb | Cu | FY | GH | GS | FY | GH | GS | FY | GH | GS | FY | GH | GS | FY | GH | GS | FY | GH | GS | FY | GH | GS | FY | GH | GS |
|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|
|    |    | 1  | N  | N  | "  | "  | "  | N  | "  | "  | N  | "  | "  | N  | "  | "  | N  | "  | "  | N  | "  | "  | N  | "  | "  | N  | "  | "  |
|    |    | N  | "  | N  | "  | "  | "  | N  | "  | "  | N  | "  | "  | N  | "  | "  | N  | "  | "  | N  | "  | "  | N  | "  | "  | N  | "  | "  |
|    |    | N  | "  | N  | "  | "  | "  | N  | "  | "  | N  | "  | "  | N  | "  | "  | N  | "  | "  | N  | "  | "  | N  | "  | "  | N  | "  | "  |
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Note: under the diagonal, said copper content on the diagonal respectively lead; "/": p < 0.05; "##": p < 0.01; N/n: p ≥ 0.05.

Table 4 shows the 15 kinds of garden plant leaves and their chlorine and sulfur content. For most of the plants, the difference in chlorine and sulfur content was not significant, but a few of the plants had a significant or extremely significant difference. The plants with an significant and extremely significant differences are Pterocaryahupeheasis and Sophora japonica, Magnolia grandiflora, Pittosporum tobira, Ligustrum lucidum, Viburnum odoratissimum, Aucubajaponica, Cinnamomum camphora, Populus deltoides; Sophorajaponica and Pterocaryahupeheasis, Magnolia grandiflora, Acer palmatum Thunb, Buxus chinensis Rehd., Populus deltoides; Prunus persica; Acer palmatum Thunb, Buxus chinensis Rehd., Populus deltoides; Viburnum odoratissimum and Pterocaryahupeheasis, Magnolia grandiflora, Acer palmatum Thunb, Buxus chinensis Rehd., Populus deltoides; Aucuba japonica Thunb and Pterocaryahupeheasis, Magnolia grandiflora, Acer
palmatumThunb, BuxussinicaRehd, Populusdeltoides; Platanushispanicac and Magnolia grandiflora, Pittosporum tobira, Cinnamomumcamphora, Populus deltoides; BuxussinicaRehd, and Sophora japonica, Magnolia grandiflora, Pittosporum tobira, Ligustrumlucidum, Aucuba japonica Thunb, Cinnamomumcamphora, Populus deltoides; CinnamomumcamphoraandPterocaryahupeheasis, Broussonetiapapyrifera, Magnolia grandiflora, Acer palmatumThunb, Platanushispanica, BuxussinicaRehd, Populusdeltoides, Prunuscerasifera; Populusdeltoides and all plants; Prunuscerasifera and Magnolia grandiflora, Pittosporum tobira, Cinnamomumcamphora, Populus deltoides.  

In terms of sulfur content, 15 kinds of garden plant respectively with the rest of the plants had significant or extremely significant difference is:Pterocaryahupeheasis and Broussonetiapapyrifera, Prunuscerasifera; Sophora japonica and Ligustumlucidum, Viburnum odoratissimum, Aucuba japonica Thunb, Buxussinica Rehd; Broussonetiapapyrifera and Pterocaryahupeheasis, Magnolia grandiflora, Pittosporum tobira, Acer palmatum Thunb, Koelreuteriapaniculata, Ligustumlucidum, Viburnum odoratissimum, Aucuba japonica Thunb, Platanushispanica, Buxussinica Rehd, Cinnamomumcamphora; Magnolia grandiflora andBroussonetiapapyrifera, Prunuscerasifera; Pittosporum tobira.

### Table 4. 15 kinds of garden plant leaves multiple comparison of chlorine and sulfur content

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Note: under the diagonal said sulfur content, chlorine content on the diagonal said: / #: p < 0.05; ## / #: p < 0.01; N/n: p ≥0.05.

**Conclusion:** The greening trees’ pollution elements can be characterized by chlorine > copper > lead > sulfur. The four pollution elements also show significant differences among the species of trees: Sophora japonica, Magnolia grandiflora and Populusdeltoides. High copper content was visible in Pterocaryahupeheasis, Sophora japonica, Broussonetiapapyrifera, Magnolia grandiflora, Acer palmatum Thunb, Koelreuteriapaniculata, Aucuba japonica, Buxussinica, and Prunus cerasperifera. We saw chlorine and its relatively high sulfur content in Populusdeltoides and Broussonetiapapyrifera. The reasons for this difference...
may be related to the nature of the pollutant, the structure of the plant, the height of the leaf, or the soil and climate conditions.

Fifteen kinds of garden plant leaves containing lead, copper, chlorine, and sulfur due to seasonal changes in pollution are examined. We have taken plants from two different functional areas—one polluted area and one clean area. We have collected samples at different times throughout the year, are able to see that pollution content increases as time goes on.

If we were to classify the plants based on their cumulative pollutant content, it would be done as follows: *Magnolia grandiflora*, *Sophora japonica* L., *Populus deltoides*, *Broussonetia papyrifera*, and *Pterocarya hupeheasis* are first class; *Koelreuteria paniculata*, *Prunus carasifera*, *Acer palatum*, *Platanus hispanica*, and *Pittosporum tobira* are second; and *Buxus sinica*, *Aucuba japonica*, *Cinnamomum camphora*, *Viburnum odoratissimum*, and *Ligustrum lucidum* are third. Therefore, in order to both reduce air pollution and beautify the environment, *Magnolia grandiflora*, *Sophora japonica*, *Populus deltoides*, *Broussonetia papyrifera*, and *Pterocarya hupeheasis* should be given preference.

Growing plants may be influenced by both human and natural factors, and are often affected by a variety of pollution elements \( t \)[199]. This paper has analyzed the factors of the season and the location of the plant. Our next step is to investigate other factors, including leaf structure, specific leaf weight, direction of the wind, and soil.

**REFERENCES**


