Research on Regional Plant Landscape of Industrial Cities in Henan Province

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Abstract. Plant landscape is an indispensable part of the city. Regional plant landscape not only has excellent ecological benefits, but also can better show the regional characteristics and human culture of the city. Through the analysis of plant landscape in the industrial city, it is concluded that how to make better use of plants to create urban plant landscape with regional characteristics is the focus of regional plant landscape construction.

1 Introduction

With the rapid development of China's economy, the process of urbanization and industrialization has also been significantly accelerated. In the early stages of urban industrial development, the backwardness of industrial technology and the unreasonable development of resources caused serious environmental pollution. With the advancement of science and technology, the optimization and upgrading of the industrial structure, coupled with the increase of people's awareness of environmental protection, and increased efforts to control pollution, the air quality in industrial cities has gradually improved. This is the epitome of most industrial cities in China. The industrial cities in Henan Province mainly include Zhengzhou, Jiaozuo, and Pingdingshan etc. As an industrial city, economic development is closely related to environmental quality. Although mining mineral resources promotes economic development, it also brings many environmental pollution problems, such as air pollution and soil pollution. As we all know, plants have the function of purifying the air and protecting the environment. In the process of applying plants to create landscapes and improve the environment, industrial cities have also formed distinctive regional plant landscapes. Therefore, this research takes the industrial cities in Henan as the research object, and studies the regional plant landscapes of each city, in order to provide a reference for greening and beautifying the city.

2 The role of plant landscape in environmental protection

2.1 Purification and noise reduction effects of plants on the city

The impact of plants on the air is mainly reflected in the fact that plants can absorb harmful gases, purify the air, and can also reduce noise and adjust the climate. Some plants are highly resistant to air pollution, and can also absorb and accumulate pollutants [1], thereby purifying the air and protecting the environment. For example, Nerium oleander, Sophora japonica, Cinnamomum camphora, Privet, Koeleria paniculata, Ginkgo, Willow, Platanus, Crape myrtle, Ailanthus altissima, Paper mulberry, Chinese rose and other tree species have high resistance to SO₂. They can be produced by absorbing and using SO₂, and Sulfate becomes a substance beneficial to plant growth. These plants usually have dense leaves, leathery leaves or waxy layers and fluff, the harmful gas is difficult to pass through [2], which can be used as the basis to select suitable anti-pollution plants for industrial cities. The high and low scattered and rich plant landscape can not only beautify the environment, but also more effectively to purify the air and reduce the noise.

2.2 Purification effect of plants on soil pollution

Plants can absorb, utilize and enrich some heavy metal elements in the soil. For example, Holly, Poplar and other tree species have a high enrichment capacity for heavy metal elements such as Cr, Zn, Cu, Pb in the soil, which can transfer the heavy metals in the soil to the above-ground parts of plants [3]. Through the centralized treatment of plant above-ground parts, it can effectively reduce soil pollution and improve soil fertility [4].

3 General situations of plants in the industrial cities of Henan Province

Henan has a long history, which has witnessed the various stages of China's historical development. As the political

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and Cultural Center for most of China's history, Henan developed many industries in ancient times and retained many ancient industrial heritages. In modern history, modern industrial cities were also born in Henan Province, such as Luoyang, Zhengzhou, and Jiaozuo [5]. Although the rise of industry has led to the rapid development of economy, but also caused urban environmental pollution, and the air pollution has become the main problem of the urban environment. In the past five to ten years, "smog" has appeared in many cities in Henan Province, and the air quality of each city in Henan Province is far behind that of other cities. In recent years, through the national policy guidance and significant efforts of governance, air quality has been significantly improved, but it has brought

various aspects of impact, plant landscape is one of them. In order to create urban landscape and reduce air pollution, some anti-pollution tree species have been applied in some cities, forming a special regional plant landscape.

Henan Province is in the central plains, belonging to the transition from subtropical to warm temperate continental monsoon climate, have four distinct seasons, and enough rainfall. Henan Province is rich in plant resources, most of northern and southern plants are grow well here. The native plants in Henan mainly include Poplar, Ailanthus altissima, Sophora japonica, Willow, Paulownia, Melia azedarach, etc. [6]. The representative plants of main industrial cities in Henan Province are shown in Table 1.

Table 1. A survey of representative plants in major industrial cities of Henan Province

Serial number	Major industrial cities	Main industry	Representative plant
1	Zhengzhou	Aluminum, steel, automobile manufacturing, cement, cigarettes, etc.	Platanus, Rosa chinensis, Chinese scholar tree, Paulownia purpurea, Populus tomentosa
2	Luoyang	Non-ferrous metal smelting, fuel processing industry, equipment manufacturing industry, etc.	Peony, Ginkgo biloba, Gleditsia sinensis Honeysuckle, Elm
3	Jiaozuo	Chemical industry, equipment manufacturing, light textile industry, metallurgical building materials industry, etc.	Chinese scholar tree, Rosa chinensis, Taxus chinensis, Eucommia, Qing tan
4	Anyang	Metallurgical building materials industry, equipment manufacturing industry, coal chemical industry, food and medicine, etc.	Chinese scholar tree, Crape myrtle, beech, Qing tan, Chou tan, An gui
5	Pingdingshan	Coal mining and washing industry, chemical industry, fuel processing industry, etc.	Camphor, Rosa chinensis, Paulownia, Cephalotaxus sinensis, Shan tong zi
6	Luohe	Food industry, chemical industry, equipment manufacturing industry, etc.	Paulownia, Rosa chinensis, Qi liu, False indigo, Ash trees

4 Case study -- Analysis of regional plant landscape in Pingdingshan

4.1 Overview of Pingdingshan

4.1.1 Natural conditions in Pingdingshan

Pingdingshan is in the central-southern part of Henan Province, between 33°08'-34°20' north latitude and 112°14'-113°45' east longitude. It is in the transitional zone between mountains and plains, and has the characteristics of high west and low east. Pingdingshan has a continental monsoon climate, located on the edge of a warm temperate zone and a subtropical climate, with four distinct seasons and enough sunlight and rainfall. The city's annual average total sunshine hours are about 1868-

2378h, and the annual average temperature is between 14.8~15.2℃; the extreme minimum temperature is -11.3℃, and the extreme maximum temperature is 38.1℃. The average annual precipitation in the city is about 1000mm, which is suitable for the growth of most woody plants.

4.1.2 Social factors in Pingdingshan

Pingdingshan's industries mainly include coal mining and washing industry, chemical industry, and fuel processing industry. Relying on abundant mineral resources and a solid industrial foundation, Pingdingshan's economic development is very rapid. Although the energy model based on coal mining has driven rapid economic growth, it has also brought serious environmental pollution and climate change. The main pollution includes: when

mining coal mines, heavy metal elements in coal gangue such as Cr, Hg, Pb, Cu, Zn, etc. enter the soil and cause soil pollution [7], air pollution caused by coal fly ash, automobile exhaust, sulfur oxide and dust in the atmosphere [8]. Besides, with the growth of the population of Pingdingshan, the demand for resources is also increasing, which leads to the exploitation of more resources. Whether it is human life activities or mining activities, it will inevitably emit a large amount of Carbon causes the continuous increase of carbon emissions, which in turn affects the environment and climate [9]. In the past few years, residents lived in an environment with poor air quality most of the time. Because of this, Pingdingshan's plants are mostly anti-pollution tree species, such as Cinnamomum camphora, Sophora japonica, Koelreuteria paniculata, Privet, etc. The plant landscape is also mainly composed of anti-pollution plants.

4.2 Analysis of Regional Plant Landscape in Pingdingshan

4.2.1 Native plants in Pingdingshan

Cinnamomum camphora is the city tree in Pingdingshan. Cinnamomum camphora has been planted in Pingdingshan since the 1990s. It has a long history of cultivation and a large scale of planting area. Cinnamomum camphora is a large evergreen tree and a subtropical evergreen broad-leaved tree. It is evergreen all the year round with luxuriant branches and leaves, and it is an excellent tree species as a shade tree, street tree and sound insulation forest. At the same time, Cinnamomum camphora is an important environmental protection tree species because of its resistance to Cl_2 and other toxic gases.

The regionality of plant image creates regional plant landscape. Due to the different natural conditions, there are rich and diverse native plants in various places. Native tree species are incomparable in adaptability, stress resistance and cost. The native plants in Pingdingshan include Torreya grandis, Elm, Paulownia, Rhamnus, Sapindus, Shan tong zi, Lian xiang, etc. The common evergreen trees are Cinnamomum camphora, Magnolia grandiflora, Arborvitae, Sabina chinensis, Cedar, Pinus tabulaeformis, Osmanthus, Privet etc.; And the common deciduous trees are Purple-leaf plum, Koelreuteria paniculata, Ginkgo, Ailanthus altissima, Chinese tallow, Melia azedarach, Sophora japonica, Albizia, Acer truncatum, Paper mulberry, Paulownia, Cotinus coggygria etc.

4.2.2 Regional plant landscape of Pingdingshan

Through the analysis of the common garden plants in Pingdingshan, the common garden plants in Pingdingshan are shown in Table 2. It can be concluded that in the industrial city, the plants with strong anti-pollution ability are mostly selected. For example, Cinnamomum camphora, Privet, Platanus, Koelreuteria paniculata, Magnolia grandiflora, and Zelkova schneideriana, etc.,

are mainly used as street trees; In the industrial zone, Sophora japonica, Melia azedarach, Ailanthus altissima, Ash tree, Paper mulberry. These plants either have strong noise reduction, smoke and dust resistance, or have a strong resistance to toxic gases. They have a strong adsorption and purification effect on industrial waste gas, and they can not only beautify the environment, but also purify the air and degrade the heavy metal pollution in the soil. In parks and residential areas, ornamental plants choose Ginkgo, Purple leaf plum, Albizia, Acer monoes, Acer palmatum, Chinese Tallow and Osmanthus, these plants not only have the characteristics of strong adaptability and strong resistance, but also have beautiful tree shape and hue changes; The plants in the waterfronts not only consider the landscape effect, but also consider the purification of water quality. For example, Reed can degrade the biological metabolism; Lotus can also reduce the content of phosphorus and nitrogen in the water, and increase the content of dissolved oxygen in the water.

5 Conclusion

The regional plant landscape not only has better ecological benefits, but also better demonstrates the city's regional characteristics and human culture. Through the analysis of the plant landscape in Pingdingshan, Henan Province, the plant landscape of industrial cities has more consideration of the ecological benefits of plants, such as the use of plants to purify air and soil to play an environmental role. At the same time, in the plant landscape construction of Pingdingshan, native plants have not been fully used. During the investigation process, the plant landscape with local characteristics is relatively lacking, with relatively few evergreen plants and colourful leaf plants, and the hue change of the plant landscape is slightly monotonous. There are few applications of plants to reflect urban characteristics. When creating a regional plant landscape, it is not only necessary to "fit the place with trees", but also to reflect the regional characteristics with the plant landscape. How to use plants to better show the urban style is a crucial aspect to be considered in the creation of plant landscapes.

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Table 2. Common garden plants in Pingdingshan

Serial number	Species name	Latin name	Tree species type	Anti-pollution effect	Application
1	Cedar	Cedrus deodara	Evergreen tree	Strong dust and noise reduction ability	Parks, streets, residential areas
2	Cinnamomum camphora	Cinnamomum camphora	Evergreen tree	Strong resistance to harmful gases such as Cl ₂ and HF	Parks, streets, industrial areas
3	Arborvitae	Platycladus orientalis	Evergreen tree	Strong endurance to dirty air	Parks, streets, residential areas
4	Sabina chinensis	Juniperus chinensis	Evergreen tree	Beautiful tree shape, pruning resistant	Parks, streets,
5	Black pine	Pinus thunbergii	Evergreen tree	Strong ability to adapt to the environment and protective effect	Parks, streets, residential areas, industrial areas
6	Pinus tabulaeformis	Pinus tabulaeformis	Evergreen tree	Resistance to barrenness, strong vitality	Parks, streets
7	Magnolia grandiflora	Magnolia grandiflora	Evergreen tree	Anti-pollution, anti-wind	Parks, streets
8	Zelkova schneideriana	Zelkova serrata	Evergreen tree	Noise reduction and dust prevention	Parks, streets
9	Cherry blossoms	Cerasus × yedoensis	Evergreen tree	Flower tree species	Parks, residential areas
10	Privet	Ligustrum lucidum	Evergreen tree or shrub	Strong adaptability and pruning resistance	Parks, streets
11	Osmanthus	Osmanthus fragrans	Evergreen tree or shrub	It has certain resistance to harmful gases such as Cl ₂ , SO ₂ , HF, etc.	Parks, residential areas, industrial areas
12	Loquat	Eriobotrya japonica	Evergreen Small Tree	Beautiful trees, foliage and fruit trees	Parks, residential areas
13	Platanus	Platanus orientalis	Large Deciduous Tree	Strong adaptability, strong resistance to a variety of toxic	Parks, streets, industrial areas

14	Sophora japonica	Styphnolobium japonicum	Deciduous tree	gases Strong resistance to harmful gases such as Cl ₂ and SO ₂	Parks, streets, residential areas, industrial areas
15	Paulownia	Paulownia fortunei	Deciduous tree	Can absorb dust and smoke, anti-toxic gas	Parks, streets, residential areas, industrial areas
16	Apricot	Armeniaca vulgaris	Deciduous tree	Flower and fruit tree species	Parks, residential areas
17	Paper mulberry	Broussonetia papyrifera	Deciduous tree	Strong adaptability, strong resistance to harmful gases such as Cl ₂ and SO ₂	residential areas, industrial areas
18	Ulmus pumila	Ulmus parvifolia	Deciduous tree	Strong resistance	Parks, residential areas, industrial areas
19	Chinese Tallow	Triadica sebifera	Deciduous tree	Barren resistance, strong resistance to HF gas	Parks, streets, residential areas,
20	Melia azedarach	Melia azedarach	Deciduous tree	Resistant to smoke and dust, strong against SO ₂	Parks, residential areas, industrial areas
21	Ailanthus altissima	Ailanthus altissima	Deciduous tree	Strong anti-smoke ability, extremely resistant to Cl ₂ , SO ₂ , nitrogen dioxide, HF	Parks, streets, residential areas, industrial areas
22	Toon	Toona sinensis	Deciduous tree	Cold resistance	streets, residential areas,
23	Hovenia dulcis	Hovenia acerba	Deciduous tree	Strong adaptability	Parks, residential areas
24	Albizia	Albizia julibrissin	Deciduous tree	Strong resistance to harmful gases such as SO ₂ and hydrogen chloride	Parks, streets, residential areas, industrial areas
25	Ash tree	Fraxinus chinensis	Deciduous tree	Anti-smoke, SO ₂ and Cl ₂	Parks, streets, waterfronts, residential areas, industrial areas
26	Metasequoia	Metasequoia	Deciduous tree	Some resistance	Parks, streets,

		glyptostrobooides		to SO ₂	waterfronts, residential areas, industrial areas
27	Acer truncatum	Acer truncatum	Deciduous tree	Foliage tree species	Parks, streets, residential areas
28	Acer monoes	Acer pictum subsp. mono	Deciduous tree	Absorb smoke, dust and harmful gases, fire-proof tree species	Parks, streets, residential areas, industrial areas
29	Bischofia javanica	Bischofia polycarpa	Deciduous tree	Absorb smoke and dust, strong anti-pollution ability	Parks, streets, waterfronts, residential areas, industrial areas
30	Ginkgo	Ginkgo biloba	Deciduous tree	Foliage tree species	Parks, streets, residential areas
31	Acer palmatum	Acer palmatum	Deciduous tree	Strong resistance to SO ₂ and smoke	Parks, streets, residential areas, industrial areas
32	Rhododendron repens	Euonymus maackii	Deciduous tree	Moderate resistance to SO ₂	Parks, waterfronts, residential areas
33	Cotinus coggygria	Cotinus coggygria	Deciduous tree	Extremely resistant to infertility	Parks, residential areas
34	Crape myrtle	Lagerstroemia indica	Deciduous tree	Reduce dust and absorb harmful gases such as SO ₂ , Cl ₂ and HF	Parks, streets, waterfronts, residential areas, industrial areas
35	Purple Leaf Plum	Prunus cerasifera f. atropurpurea	Deciduous tree	Adaptable	Parks, streets, residential areas
36	Pomegranate	Punica granatum	Deciduous tree	Flower and fruit tree species	Parks, streets, waterfronts, residential areas
37	Koelreuteria Paniculata	Koelreuteria paniculata	Deciduous tree	Strong resistance to dust, SO ₂ and ozone	Parks, streets, residential areas, industrial areas
38	Pyracantha	Pyracantha fortuneana	Evergreen shrub	Strong absorption and resistance to SO ₂	Parks, streets, residential areas, industrial areas
39	Serissa	Serissa japonica 'Variegata'	Evergreen shrub	Foliage tree species	Parks, streets, residential areas
40	Buxus japonicus	Buxus bodinieri	Evergreen shrub	Foliage tree species	Parks, streets, residential

41	<i>Phyllostachys heterocyclus</i>	<i>Nandina domestica</i>	Evergreen shrub	Adaptable Foliage and fruit tree species	areas Parks, residential areas
42	<i>Jasminum mesnyi</i>	<i>Jasminum mesnyi</i>	Evergreen shrub	Flower tree species	Parks, residential areas
43	<i>Nerium oleander</i>	<i>Nerium oleander</i>	Evergreen erect large shrub	Strong resistance to SO ₂ , carbon dioxide, HF, Cl ₂ and other harmful gases	Parks, streets, waterfronts, residential areas, industrial areas
44	Procumbent juniper	<i>Juniperus procumbens</i>	Evergreen creeping small shrub	Anti-smoke, anti-SO ₂ , hydrogen chloride and other harmful gases	Parks, streets, residential areas, industrial areas
45	<i>Pittosporum tobira</i>	<i>Pittosporum tobira</i>	Evergreen shrubs or small trees	Strong resistance to SO ₂ , HF, Cl ₂ and other toxic gases	Parks, streets, residential areas, industrial areas
46	<i>Fatsia japonica</i>	<i>Fatsia japonica</i>	Evergreen shrubs or small trees	Strong resistance to SO ₂	Parks, residential areas, industrial areas
47	<i>Ilex cornuta</i>	<i>Ilex cornuta</i>	Evergreen shrubs or small trees	Tree species for foliage and flower viewing	Parks, residential areas
48	<i>Photinia fraseri</i>	<i>Photinia × fraseri</i>	Evergreen shrubs or small trees	Foliage tree species	Parks, streets, residential areas, industrial areas
49	Redflowered Loropetalum	<i>Loropetalum chinense</i> var. <i>rubrum</i>	Evergreen shrubs or small trees	Adaptable, foliage tree species	Parks, streets, residential areas
50	Melon seeds Cycloviburnum	<i>Buxus sinica</i>	Evergreen shrubs or small trees	Foliage tree species	Parks, streets, residential areas
51	<i>Ligustrum quihoui</i>	<i>Ligustrum quihoui</i>	Semi-evergreen shrub	Resistance to a variety of toxic gases	Parks, streets, residential areas, industrial areas
52	<i>Forsythia suspensa</i>	<i>Forsythia suspensa</i>	Deciduous shrub	Strong cold resistance	Parks, streets, waterfronts, residential areas
53	<i>Chaenomeles lagenaria</i>	<i>Chaenomeles speciosa</i>	Deciduous shrub	Flower tree species	Parks, residential areas
54	<i>Berberis thunbergii</i>	<i>Berberis thunbergii</i>	Deciduous shrub	Adaptable, foliage tree species	Parks, streets, residential areas
55	<i>Bauhinia</i>	<i>Cercis chinensis</i>	Deciduous shrub	Flower tree species	Parks, residential areas

56	False indigo	<i>Amorpha fruticosa</i>	Deciduous shrub	Strong wind resistance	Parks, residential areas
57	<i>Vitex negundo</i>	<i>Vitex negundo</i>	Deciduous shrubs or small trees	Tree species for foliage and flower viewing	Parks, streets, residential areas,
58	Lilac	<i>Syringa oblata</i>	Deciduous shrubs or small trees	Tolerant to barren, cold and drought	Parks, streets, residential areas, industrial areas
59	Chinese rose	<i>Rosa chinensis</i>	Standing shrub	Cold resistance, drought resistance, strong resistance to harmful gases	Parks, streets, residential areas, industrial areas
60	Japanese spiraea	<i>Spiraea japonica</i>	Standing shrub	Tolerant to cold, drought, and barren	Parks, streets, waterfronts, residential areas
61	Creeping oxalis	<i>Oxalis corniculata</i>	Herb	Strong adaptability to soil	Ground cover
62	<i>Zoysia matrella</i>	<i>Zoysia matrella</i>	Perennial herb	Fine grass	Ground cover
63	Arab Speedwell	<i>Veronica persica</i>	Spread multi-branched herbs	Flower plant	Ground cover
64	Bermudagrass	<i>Cynodon dactylon</i>	Perennial low herb	Good soil-retaining plants	Ground cover
65	<i>Ophiopogon japonicus</i>	<i>Ophiopogon japonicus</i>	Perennial evergreen grass	Cold and drought tolerant	Ground cover
66	Lotus	<i>Nelumbo nucifera</i>	Perennial aquatic herb	Important water environment restoration plant	Parks, waterfronts, residential areas
67	Reed	<i>Phragmites australis</i>	Tall perennial or wet grass	Play an important role in the purification of sewage	Park, waterfronts
68	Calamus	<i>Acorus calamus</i>	Perennial herb	Ornamental plants	Park, waterfronts
69	Carbungi	<i>Typha angustifolia</i>	Perennial aquatic or marsh herb	Good purification effect in sewage treatment	Park, waterfronts
70	Lotos	<i>Nymphaea tetragona</i>	Perennial aquatic herb	Can absorb Pb, Hg, phenol and other toxic substances in water	Parks, waterfronts, residential areas
71	<i>Thalia dealbata</i>	<i>Thalia dealbata</i>	Perennial emergent herb	Purified water quality	Parks, waterfronts, residential areas