

The Study on Urban Landscape Suitability Index of Indigenous Vines In Nanchang

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Abstract: This paper through brainstorming, the Delphi method, and in-meeting & after-meeting method, screening out suitability evaluation indicators of indigenous vines for urban landscapes in Nanchang. It sets up the suitability evaluation indicator system of indigenous vines to urban landscapes in Nanchang. The suitability index of 41 kinds of indigenous vines in Nanchang was calculated. Besides, 24 kinds of indigenous vines with a comprehensive score of more than 60 which were recommended by Nanchang were put forward. With these efforts, this paper can provide sufficient basis for the application of indigenous plants in vertical greening in Nanchang.

1 Introduction

Using vines to develop vertical greening can improve greening rate, enrich urban landscape, improve and protect environment, and create landscape, ecological and economic effects. Increasing the application of indigenous vines is also one of the ways to improve biodiversity and maintain urban ecological security. Based on the investigation of indigenous vine species in Nanchang, this paper studies the selection of vines in three-dimensional greening in Nanchang. The comprehensive evaluation indexes and index weight value system are established to evaluate the indigenous vines in Nanchang, and the suitable species are selected for vertical greening in Nanchang.

2 Material and Method

2.1 Data Collection and Collation

The indigenous vines studied in this paper are all from the field survey conducted by the author. By using the method of route survey and key survey items, the periphery and interior of Nanchang urban areas are investigated. The periphery of the city includes Meiling Forest Park, Shengshuitang Forest Park and Xiangshan Forest Park. The interior of city mainly aims at Yaohu Forest Botanical Park, Aixi Lake Wetland Park, Bayi Park, People's Park and other large parks, as well as residential areas, enterprises and institutions with better greening and main urban roads. The investigation involves plant species, characteristics, habitats and ornamental characteristics, etc. The field investigation and inductive statistics are carried out, and photos are taken at the same time for recording and filing. According to *Flora of Jiangxi* ^{[1] [2] [3]}, it is found that

there are 23 families, 32 genera and 41 species of indigenous vines in Nanchang, and 6 families, 7 genera and 7 species of them have been used in urban greening.

2.2 Research Method

2.2.1 Construction of Suitability Index of Indigenous Vines in Urban Landscape

This paper through brainstorming, the Delphi method, and "in-meeting & after-meeting" method, selects suitability evaluation indicators of indigenous vines for urban landscape in Nanchang so as to establish the suitability evaluation index system of indigenous vines in urban landscape in Nanchang.

2.2.2 A Study on the Suitability Evaluation System of Nanchang Indigenous Vines in Urban Landscape

Taking Nanchang indigenous vines as the object, the evaluation indexes of urban landscape suitability of indigenous vines are stratified by expert scoring method. The weight of each evaluation index on urban landscape suitability of Nanchang indigenous vines is determined by analytic hierarchy process. The evaluation index system of urban landscape suitability of Nanchang indigenous vines is established. By calculating the product of the score and the weight of each index of the evaluation system of Nanchang indigenous vines for urban landscape suitability, and calculating the cumulative value, the suitability index of Nanchang indigenous vines in urban landscape was obtained. According to the urban landscape suitability index of Nanchang indigenous vines, the level of Nanchang indigenous vines can be divided into four grades: Grade I,

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Grade II, Grade III and Grade IV, indicating Excellent, Good, Mediocre and Bad respectively^[4].

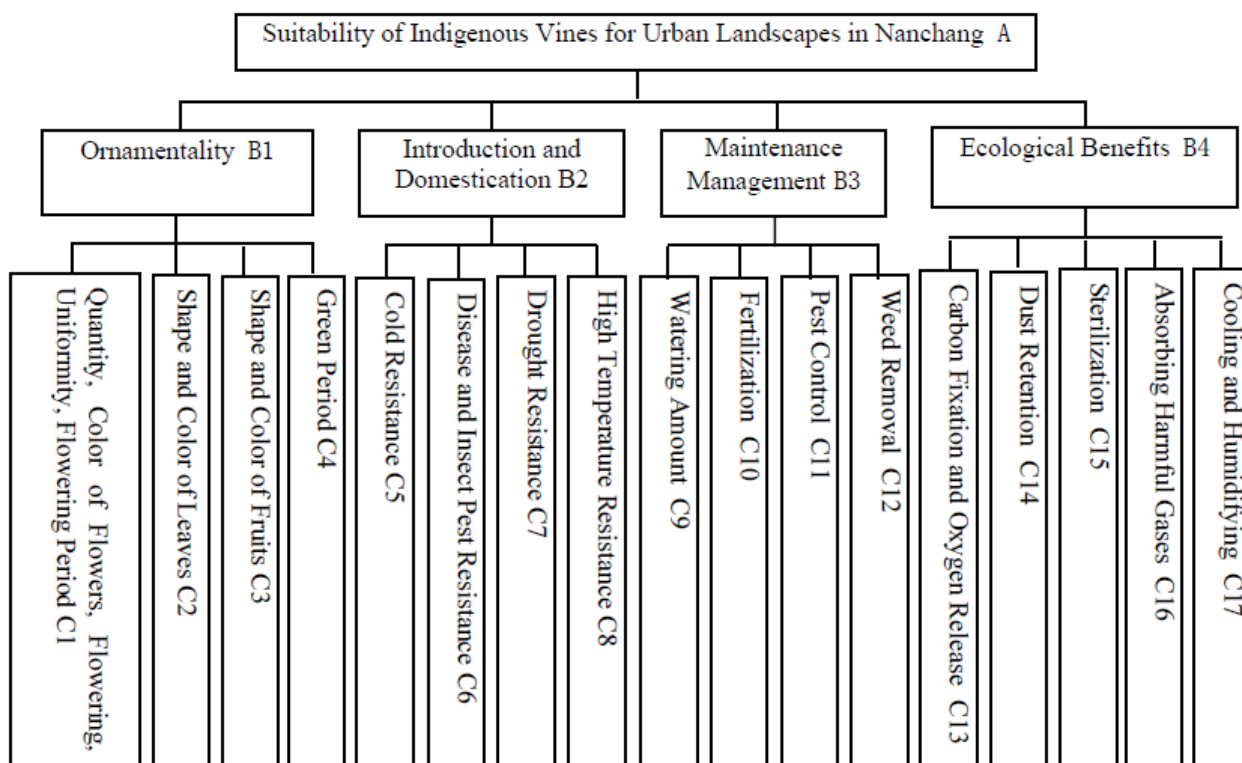
3 Establishment of Evaluation System

3.1 Evaluation Index System of Urban Landscape Suitability of Indigenous Vines in Nanchang

By collecting and sorting the domestic literature on indigenous vines and other related studies, combined

with the research content of forest city and landscape aesthetics, 26 evaluation indexes are collected; ten experts are invited to select the evaluation indexes of Nanchang indigenous vines for urban landscape suitability by brainstorming, the Delphi method, and “in-meeting & after-meeting” method. The target layer is Nanchang indigenous vines for urban landscape suitability, with 4 indexes in the criterion layer and 17 indexes in the scheme layer. The evaluation index system of Nanchang indigenous vines for urban landscape suitability is determined. See Table 1.

Tab. 1 The Evaluation Index System of the Suitability of Indigenous Vines for Urban Landscapes in Nanchang



3.2 Calculation of Suitability Index for Urban Landscape of Indigenous Vines in Nanchang

The suitability of indigenous vines in urban landscape is measured according to the suitability evaluation indexes of indigenous vines in urban landscape. By calculating the product of the score and weight of 17 indexes in the suitability evaluation system of indigenous vines in urban landscape, the cumulative value is defined as the suitability index of indigenous vines in urban landscape. According to the values of the suitability indexes of

indigenous vines in urban landscape, the degree of the suitability of indigenous vines in urban landscape is measured.

The suitability indexes of indigenous vines in urban landscape are expressed as percentages, and its different scores are attached according to the weight of each index. Therefore, according to the suitability index of indigenous vines in urban landscape, the suitability level can be divided into five grades: Grade I, Grade II, Grade III and Grade IV, indicating Excellent, Good, Mediocre and Bad respectively. The results are shown in Table 2.

Tab.2 Division standard table of indigenous plants suitability index rank in urban landscape

Grade of Indigenous Vines	Indigenous Vine Suitability Index	Grade in Urban Landscape	Note
I	90-100		Excellent
II	70-90		Good
III	60-70		Mediocre
IV	0-60		Bad

3.3 A Study on Evaluation Index System of Urban Landscape Suitability of Indigenous Vines in Nanchang

3.3.1 Construct Judgment Matrixes

Based on the investigation of experts from Jiangxi Provincial Department of Forestry, East China Forestry

Investigation, Planning and Design Institute of State Forestry Administration, and Jiangxi's universities, the relative importance judgment matrix of each criterion layer under each target layer of Nanchang indigenous vine urban landscape suitability evaluation is obtained. The judgment matrixes are shown in Table 3, Table 4, Table 5, Table 6 and Table 7.

Tab.3 Judgement matrix(B1-C)

	Ornamentality	Introduction and Domestication	Maintenance Management	Ecological Benefits
Ornamentality	1	0.5	2	0.5
Introduction and Domestication	2	1	3	0.5
Maintenance Management	0.5	0.5	1	0.333333
Ecological Benefits	2	2	3	1

Tab.4 Judgement matrix(B1-C)

	Green Period	Shape and Color of Leaves	Quantity, Color of Flowers, Flowering, Uniformity, Flowering Period	Shape and Color of Fruits
Green Period	1	1	2	3
Shape and Color of Leaves	1	1	1	2
Quantity, Color of Flowers, Flowering, Uniformity, Flowering Period	0.5	1	1	2
Shape and Color of Fruits	0.333333	0.5	0.5	1

Tab.5 Judgement matrix(B2-C)

	Watering Amount	Fertilization	Pest Control	Weed Removal
Watering Amount	1	2	2	2
Fertilization	0.5	1	1	3
Pest Control	0.5	1	1	2
Weed Removal	0.5	0.333333	0.5	1

Tab.6 Judgement matrix(B3-C)

	High Temperature Resistance	Drought Resistance	Cold Resistance	Disease and Insect Pest Resistance
High Temperature Resistance	1	2	1	3
Drought Resistance	0.5	1	2	2
Cold Resistance	1	0.5	1	2
Disease and Insect Pest Resistance	0.333333	0.5	0.5	1

Tab.7 Judgement matrix(B4-C)

	Cooling and Humidifying	Dust Retention	Absorbing Harmful Gases	Carbon Fixation and Oxygen Release	Sterilization
Cooling and Humidifying	1	1	2	2	3
Dust Retention	1	1	1	2	2
Absorbing Harmful Gases	0.5	1	1	2	2

Carbon Fixation and Oxygen Release	0.5	0.5	0.5	1	0.5
Sterilization	0.333333	0.5	0.5	2	1

3.3.2 Hierarchical Ordering and its Consistency Test

The eigenvectors of the criterion layer corresponding to the target layer and the scheme layer corresponding to the criterion layer are obtained through each judgment

matrix, and then the weight is calculated by the eigenroot method, and the consistency of the total weight is tested. The results are shown in Table 8.

Tab.8 Consistency Test of Hierarchical Single Permutation

Single Sequencing	A-Bn	B1-Cn	B2-Cn	B3-Cn	B4-Cn
λ_{max}	4.180669	4.045692	4.168615	4.117141	5.136683
CR	0.066915	0.016923	0.06245	0.043386	0.0305096

3.3.3 Overall Hierarchical Ordering

According to the above hierarchical structure, the comprehensive weight of urban landscape suitability of Nanchang indigenous vines is calculated. Each index is

weighted and quantified. The score of each index is determined by using the percentage system (upper limit exclusion method). Each index is divided into three levels, and each level is given a certain score. The results are shown in Table 9.

Tab.9 Total Hierarchy Permutation of the Suitability of Indigenous Vines for Urban Landscapes in Nanchang

	Ornamentality	Introduction and Domestication	Maintenance and Management	Ecological Benefits	Weight	Scores
	18.46%	28.89%	11.79%	40.86%		
Green Period	36.47%				6.73%	7
Shape and Color of Leaves	27.71%				5.12%	5
Quantity, Color of Flowers, Flowering, Uniformity, Flowering Period	23.30%				4.30%	4
Shape and Color of Fruits	12.52%				2.31%	2
High Temperature Resistance		36.47%			10.54%	11
Drought Resistance		27.71%			8.01%	8
Cold Resistance		23.30%			6.73%	7
Disease and Insect Pest Resistance		12.52%			3.62%	4
Watering Amount			38.88%		4.59%	5
Fertilization			25.58%		3.02%	3
Pest Control			23.12%		2.73%	3
Weed Removal			12.42%		1.46%	1
Cooling and Humidifying				30.52%	12.47%	12
Dust Retention				24.50%	10.01%	10
Absorbing Harmful Gases				21.33%	8.72%	9
Carbon Fixation and Oxygen Release				10.67%	4.36%	4
Sterilization				12.98%	5.30%	5

4 Results and Discussion

41 species of indigenous vines in Nanchang are evaluated and calculated. The results are shown in Table 10. Among them, except the 24 kinds of vines that have been applied in gardens with a grade above “Good”, including evergreen vines such as *Stauntonia obovatifoliola* subsp. *Urophylla*, *Jasminum lanceolarium*, *Millettia dielsiana*, and *Millettia pachycarpa*, and deciduous vines such as *Actinidia chinensis*, *Aristolochia debilis*, *Clematis finetiana* and *Akebia quinata*, there are

many other indigenous vines with high comprehensive score and application potential to be developed and utilized.

In China, there is a large population with relatively sparse vacancy of land resources, and the per capita green space rate is seriously low. Nowadays, the area that can be used for landscaping is getting smaller and smaller. Making full use of vines for vertical greening is an important way to expand the greening space, increase the amount of urban greening area, improve the overall greening level, and improve the ecological environment.

As an important part of urban three-dimensional greening, indigenous vines are also one of the ways to maintain regional landscape and biodiversity.

Tab.10 The Mark Sheet of the Suitability Indexes of Indigenous Vines for Urban Landscapes in Nanchang

Specific Name	Latin Name	Comprehensive Evaluation	Grade
Stauntonia obovatifoliola subsp. Urophylla	<i>Stauntonia obovatifoliola</i> subsp. <i>Urophylla</i>	92	I
Sirthwort	<i>Aristolochia debilis</i>	90	I
Chinese gooseberry	<i>Actinidia chinensis</i>	93	I
Creeper	<i>Parthenocissus tricuspidata</i>	95	I
Star jasmine	<i>Trachelospermum jasminoides</i>	92	I
Chinese kadsura vine	<i>Kadsura longipedunculata</i>	72	II
Henry clarke	<i>Schisandra henryi</i>	70	II
Schizandra sphenanthera Rehd et WWils.	<i>Schisandra sphenanthera</i>	70	II
Clematis armandi Franch	<i>Clematis finetiana</i>	87	II
Akebiaquinata	<i>Akebia quinata</i>	84	II
Berba aristolochiae mollissimae	<i>Aristolochia mollissima</i>	81	II
Trichosanthes laceribractea Hayata	<i>Trichosanthes laceribractea</i>	82	II
Zehneria japonica	<i>Zehneria indica</i>	80	II
Millettia dielsiana Harms	<i>Millettia dielsiana</i>	76	II
Millettia pachycarpa Benth	<i>Millettia pachycarpa</i>	76	II
kudzu	<i>Pueraria motana</i> var. <i>lobata</i>	78	II
Celastrus orbiculatus	<i>Celastrus orbiculatus</i>	73	II
Sabia swinhoei	<i>Sabia swinhoei</i>	75	II

Specific Name	Latin Name	Comprehensive Evaluation	Grade
Jasminum lanceolarium Roxb	<i>Jasminum lanceolarium</i>	80	II
Jasminum sinense Hemsl.	<i>Jasminum sinense</i>	73	II
Cynanchum caudatum Maxim.	<i>Cynanchum auriculatum</i>	83	II
Uncaria	<i>Uncaria rhynchophylla</i>	82	II
Honeysuckle	<i>Lonicera japonica</i>	75	II
Gongronema nepalense	<i>Codonopsis lanceolata</i>	78	II
Bittersweet herb	<i>Solanum lyratum</i>	70	II
Stemona tuberosa Lour	<i>Stemona tuberosa</i>	82	II
Dioscorea japonica	<i>Dioscorea japonica</i>	82	II
Stephania cepharantha hayata	<i>Stephania cephalantha</i>	67	III
Bauhinia champsoni	<i>Bauhinia championii</i>	64	III
Bauhinia glauca	<i>Bauhinia glauca</i>	64	III
Rhynchosia volubilis Chinese	<i>Rhynchosia volubilis</i>	64	III
Fervine Herb	<i>Paederia scandens</i>	66	III
Paederia scandens	<i>Paederia scandens</i> var. <i>tomentosa</i>	66	III
Semen Cuscutae	<i>Cuscuta chinensis</i>	61	III
Radix asparagi	<i>Asparagus cochinchinensis</i>	65	III
Japanese Snailseed	<i>Cocculus orbiculatus</i>	48	IV
Root	<i>Ampelopsis cantoniensis</i>	48	IV
Cantoniensis	<i>Ampelopsis cantoniensis</i>	48	IV
planch	<i>Ampelopsis chaffanjonii</i>	50	IV
Ampelopsis chaffanjonii	<i>Ampelopsis chaffanjonii</i>	50	IV
Japanese cayratia herb	<i>Cayratia japonica</i>	53	IV
Parthenocissus dalzielii	<i>Parthenocissus dalzielii</i>	56	IV

Acknowledgments

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