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#### Research Article

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# Seasonal color matching method of ornamental plants in urban landscape construction

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**Abstract:** Traditional seasonal color matching methods of ornamental plants only study the color attributes of plants, but not through qualitative and quantitative research on seasonal color matching of plants, resulting in imperfect matching methods. Five landscape units were selected from five representative streets in Harbin, namely, Central Avenue, Gogoli, Zhongshan Road, Xinyang Road, and Huanghe Road. Seasonal periods of Harbin from 2014 to 2018 were defined using the difference in seasonal time division and duration characteristics by the method of climate temperature division, and the beginning time of each season in 2019 was deduced. Meanwhile, according to the NCS color value data of each species in different seasons and the length of each season, the seasonal color matching results of each landscape unit case were established. The results of seasonal color matching of each landscape unit case were evaluated by weighted method. The results showed that the richer the NCS color value of plant species ornamental traits in plant landscape, the more the color seasonal encounter of ornamental traits and the longer the duration, the better the matching results of plant seasonal color. Based on the research results, the NCS color value and its ornamental period of ornamental characters of plant species, the color matching scheme of landscape color, and the selection of plant species were proposed.

**Keywords:** urban gardens, construction, ornamental type, plants, seasonal phase, color matching

## 1 Introduction

In urban landscape works, the beauty of plants is mainly presented by visual beauty, which is most sensitive to color. In the construction of urban gardens, ornamental plants are rich in color, which can create colorful landscape in planting design [1]. At the same time, the landscape of ornamental plants changes with time, which makes the color of plants present in different seasons cause the flowing color melody, showing a unique seasonal beauty. Therefore, the color of trees, flowers, and plants should take into account the change in seasons and people's ornamental psychology. Colors are the most touching elements in the environment. Colors are ubiquitous in gardens [2]. To successfully use color in gardens, we must master the basic concept of color, understand the emotional factors expressed by color, and be good at using different colors to express the overall coordination; in addition, we must be familiar with the seasonal changes of different plants, and use the rich color changes of plants to dress up perfect and ideal garden color emotions [3].

In urban landscape construction, ornamental plants are mainly concentrated in urban road green space, which is an important component of urban color [4]. The ornamental character color of plants in the growing and dormant seasons is an element of the color rhythm of urban landscape. The accuracy of the seasonal phase color of plant landscape in its design drawings and the actual landscape effect expression affects the quality of seasonal phase color design of plant landscape. Improving the expression level of seasonal color matching design of ornamental plants is of great significance to the quality of seasonal color of landscape plants in urban landscape construction [5]. At present, because of the lack of dynamic database of color data in different geographical regions and seasons, there is no enough scientific basis for the expression of plant seasonal color encounter characteristics. There are many problems, such as beautiful drawings, poor actual effect of planting plant landscape, and so on.

At present, more and more attention has been paid to the scientificity of seasonal color matching of ornamental

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plants in urban landscape construction. The research on plant seasonal color matching mainly focuses on phenology, duration of ornamental traits, and seasonal change in space [6]. For seasonal color, RHS color card, NCS color card, and MATLAB are used to study the color attributes of color-leafed trees and flowering plants. However, there are few reports on the qualitative and quantitative study of plant landscape seasonal color matching [7].

In recent years, Chinese scholars have attached great importance to the design of ornamental plants in urban landscape construction. Pan Buchang, Wang Zhiqing, and others put forward the application of color-leafed plants in landscape configuration in 2006, and studied the configuration of seasonal color of ornamental plants in landscape architecture, which provided an effective basis for landscape construction [8]. In 2006, Li Zhiqiang put forward a brief discussion on the application of color in landscape plant design to people's emotional psychology, combining ornamental plants with people's emotions and psychology in urban landscape construction, and providing an effective basis for color matching of ornamental plants in urban landscape construction [9]. Deng Chen put forward the landscape design and plant allocation based on eco-saving horizon in 2017. An effective design method was put forward for the ecology of ornamental plants in urban landscape construction, and effective suggestions were put forward for the sustainable development of ornamental landscape design in urban landscape construction [10].

#### 2 Materials and methods

#### 2.1 Climate and site condition

Harbin is located in the eastern longitude 125°42′–130°10′, latitude 44°04′–46°40′, located in the eastern end of Songnen Plain, belongs to the continental monsoon climate of the middle temperate zone, with an annual average temperature of about 3.6°C and an annual average temperature difference of 42.2°C with distinct. Harbin has four distinct seasons, short spring and autumn, and long winter for nearly half a year. Therefore, Harbin is selected as the research object of seasonal color matching method of ornamental plants in urban landscape construction. The NCS color card with compatibility with common drawing software CAD and Photoshop was used to study. On the basis of collecting 306 plant color data every 3–5 days during the growing season of Heilongjiang Botanical Garden to establish a research database, five typical cases of urban

landscape construction were selected for relevant research, to explore the meso-view of urban landscape construction. Based on the preliminary study on the division of seasons by climatic temperature method in the past 5 years, the NCS color values and time series dynamic change characteristics of ornamental characters of leaves, flowers, and fruits in spring, summer, and autumn were collected in different growing seasons. From the perspective of color composition of plant landscape and characteristics of seasonal encounter, the ornamental plant season in urban landscape construction was discussed. Phase color matching method can provide reference for seasonal color design of ornamental plant landscape in Harbin and even the whole country. To effectively design the seasonal color matching method of ornamental plants in urban landscape construction, five landscape units were selected from five representative streets in Harbin for analysis.

#### 2.1.1 General situation of ornamental plant landscape in Central Street

Because of the special climate conditions in Harbin, the spring is late and the time is shorter, the plant germination time is faster, and the spring landscape is fleeting. There are no other plant landscapes besides street trees. The plant landscape of Central Street in summer is the most abundant season of the year. The bushy roadside trees, together with the fixed and movable flower beds, make the Central Avenue beautiful and let visitors linger. Central Avenue in autumn has a fascinating view [11]. With the continuation of plant landscape in summer, along with the change in leaf color on the pavement and the planting of autumn grass and flowers, the autumn plant landscape of Central Street is rich and colorful. Winter is the most beautiful season in this city, but for Harbin, this high-latitude urban plant landscape performance is somewhat inadequate. In winter, only the street trees are left on the streets after defoliation, and there is no much aesthetic feeling. Fortunately, with the ice and snow landscape with Harbin characteristics, the scenery of Central Street can be restored. Because of the limitation of the width and use of roads, there is little room for afforestation in the streets of Central Street. Nowadays, only roadside single-row street trees are planted perennially for Acer saccharum Marsh, which is not commonly used in other streets with local characteristics. The planting method of tree pond was adopted. Movable flower bed combination and roadside flower bed were planted in the middle of the road with grass flowers such as Petunia hybrida Vilm, Tagetes erecta L.,

Malus halliana, Rudbeckia hirta L., Sytinga microphylla and other shrubs and five-color grass flower bed sculptures. The combination of these flower beds can increase the number of plant landscapes in space, and the diversity of plant species can increase the level of Road plant landscapes vertically.

# 2.1.2 Overview of ornamental plant landscape in Gogoli Street

The plant landscape of Gogoli Street in spring is very few. and there are no many kinds of greening plants. In summer, like Central Street, Gogoli Street adopts movable planting troughs, which are combined with shrubs and grass flowers. As a result, the effect of plant landscape on the streets has been greatly improved, and the style and color have been greatly enriched [12]. In autumn, there is no landscape decorated with grass and flowers. However, the shearing shrubs in the planting pond are still there and extend the summer landscape of the street appropriately. In winter, the vegetation landscape of Gogoli Avenue is scarce, and there are few and uneven street trees, which are remarkably messy. Planting on Gogoli Street seems to go through several different stages. According to the tree species on the street, Salix matsudana is planted in tree ponds. The volume gap is very obvious and the tree shape effect is very poor [13]. Sabina chinensis var. sargentu, Coleus blumei benth, Crabapple, Vinca major and Petumia hybrida are planted in the movable tree pool. After the formation of various plant landscapes, it can reflect the effect of plant landscapes adapted to architecture, and the color and creativity have been greatly enriched.

### 2.1.3 Overview of ornamental plant landscape on Zhongshan Road

In spring, Zhongshan Road looks green at the roadside. The planting of early spring flowers and shrubs adds various colors to Harbin. In summer, the roadside vegetation landscape is greener and the crown is fuller [14]. In autumn, especially in late autumn, with the change in plant leaf color, the overall effect of color is increased. In winter, Zhongshan Road has a wide and tidy road surface, and the traffic flow is like knitting. The roadside plant landscape reflects a beautiful background. The landscape construction of Zhongshan Road will carry out large-scale greening in patches and successively. After transformation, the number of greening planting varieties will be increased from more than 30 to more

than 40. Nearly 1,000 sugar maple trees will run through Zhongshan Road, Ulmus pumila, Svringa oblata, and Populus alba 'Berolinensis' L. will become the main tree species on Zhongshan Road. Among them, trees and shrubs such as Picea koraiensis Nakai, Cornus stolonifera and Sabina procumbens will show green and red effects in winter [15]. In addition, Zhongshan Road will be afforested step by step from low to high, planting hedges, flower irrigation, trees, and so on in turn from the road to the sidewalk, showing a pattern of three-dimensional afforestation from low to high and step by step. Meanwhile, more than 4,000 lilacs, nearly 800 Syringa microphylla, more than 900 Forsythia suspensa, nearly 1,000 Ulmus pumila, and nearly 1,000 Populus argentea will be planted on Zhongshan Road. In addition, in the afforestation project of Zhongshan Road, the Nordic tree "Golden Flame Red" will be introduced and planted, which has the reputation of "spring flowers, autumn leaves, winter fruits."

# 2.1.4 Overview of ornamental plant landscape in Xinyang Road

The seasonal characteristics of different sections of Xinyang Road in spring are also different. The green quantity of Two-Belt section is not large, and the spring characteristics of street trees and flowering shrubs under trees can be seen. In summer, the landscape effect of roads is the most obvious. The crowns of roads are large and shady. They reflect each other with different types of buildings and can feel the style of modern cities. Autumn seasonal change is obvious, rich in color, and landscape hierarchy is obvious. In winter, because of the less evergreen trees planted, there is no green on the road, but the luxuriant branches add a lot of artistic conception to the overall landscape of the road [16]. There are many kinds of plants in Xinyang Road, most of which are commonly used or native trees in Harbin. There are different plant planting forms in different areas. In the application of street trees, tree pond planting and green planting are adopted. Ulmus pumila, poplar and Pinus sylvestris var. mongolica are the most widely used tree species. Flower and shrub pruning is often used under short trees with narrow plantations, such as Clove, Yanvolai, and Plum (Amygdalus triloba). In the three-board and four-belt section, the green space is sufficient. Plant species are very abundant, but because of the long time to build, plant landscape is less epochal, mostly adopt natural design. Vertical layers are rich in large trees, sub-trees, shrubs, herbs and flowers, and ground cover. Five-color grass sculptures have also been built at some road intersections.

# 2.1.5 Overview of ornamental plant landscape along the Yellow River Highway

The Yellow River Road is a very distinctive street in Harbin. A large number of trees and pruning shrubs are planted on the roadside trees and green space in spring, which can appreciate the branches of trees, early flowers of shrubs, and the overall effect of roads. In summer, a large number of three-dimensional flower beds of fivecolor grass were built on this road, which made the plant landscape of the whole road rich and colorful, reflecting the unique characteristics of the Yellow River Road and Harbin City as a whole. The seasonal change of Yellow River Road in autumn is very obvious, and the plant landscape is rich in color. Winter streets have the same characteristics as other roads in Harbin. Trees and shrubs only have branches, but after special treatment, the three-dimensional flower beds still retain color, which adds a lot of beauty to the street landscape [17]. The cross-section of the Yellow River Road is a plank-twobelt type with abundant plant species. The roadside tree is Populus argentea, with a large number of trees and pruning shrubs in roadside green space, and the plant landscape is very rich. In addition, the unique five-color grass three-dimensional flower beds of this road make the Yellow River Road unique in the road plant landscape of Harbin. A total of 16 million plants of Fivecolor Grass were planted in Northern Horticultural Street, and 208 "Five-color Grass Sculptures" were erected with a total area of 5,000 square meters. Unique shape and natural landscaping constitute another bright "city business card" in Harbin's foreign exchanges.

# 2.2 Seasonal division of plant landscape units

The color data of plant landscape in different seasons are composed of the colors of leaf, flower, and fruit season of all species, reflecting the visual color characteristics. According to Ding et al., the correlation between leaf color and temperature change in botanical gardens was studied. Because of genetic factors, leaf color changed slightly with time in the same season [18]. According to the division method of climate temperature, the division of seasons in Harbin from 2014 to 2018 was defined, and the division range of seasons in 2019 was deduced. A-6NCS 1950 color card was used to collect the quantitative data of NC colors of leaves, flowers, and fruits during individual growth period of case plants in spring, summer, and autumn. The dynamic combination of color values and duration of ornamental traits was obtained. Quantitative characteristics of state duration encounter and color perception of line of sight from different perspectives around the city were discussed to evaluate the rationality and accuracy of seasonal color matching method for ornamental plants in urban landscape construction [19].

The differences in seasonal division time and duration characteristics between 2014 and 2018 in Harbin are shown in Table 1. The starting time of each season in 2019 is similar to that in previous years.

# 2.3 NCS color value attribute of plant ornamental characters in plant landscape unit case

Among the five plant landscape unit cases collected by the institute, there are 46 species of plants (22 species of trees and 16 species of shrubs) and 6 species of herbs; the leaf color range of NCS S6020-G30Y-NCS S4550-Y90R in the growing season has 57 standard values, of which the green color values are the most, the other 6 are red color values, accounting for 10.5%, and 16 are yellow color values, accounting for (28.1%). Sixteen standard values of NCS S0300-N~NCS S3060-R90B for ornamental plants, including 6 color lines of red, white, blue, pink, purple,

Table 1: Differences between spring, summer, and autumn in the division of temperature and temperature in 2014-2018

Serial number	Years	Spring time (month-day)	Spring days (day)	Summer time (month-day)	Summer days (day)	Autumn time (month-day)	Autumn days (day)
1	2014	05-01 to 06-14	45	06-15 to 08-13	60	08-14 to 09-27	45
2	2015	04-12 to 05-16	35	05-17 to 09-01	108	09-02 to 10-11	40
3	2016	04-26 to 06-04	40	06-05 to 08-16	75	08-19 to 10-07	50
4	2017	04-11 to 05-30	50	05-31 to 09-02	95	09-03 to 09-27	25
5	2018	04-21 to 06-14	55	06-15 to 08-18	65	08-19 to 10-07	50

and yellow, of which 5 are pink, accounting for 31.3%; 10 are fruit color values of NCS 0300-N~NCS S8502-R, of which 8 are red, accounting for 80%. The NCS color values of plant ornamental traits in the case of plant landscape unit are shown in Table 2.

#### 2.4 Research method

According to the NCS color values of leaves, flowers, and fruits of each species in five plant landscape unit cases collected in different seasons of spring, summer and autumn, and combined with their ornamental period, the color time axis of ornamental traits in each species season was established. The color of ornamental traits in each plant landscape unit case was integrated by color. The color composition and the appearing time of different ornamental traits in spring, summer, and autumn [20] express the matching characteristics of dynamic color duration of ornamental traits in plant population; according to the relationship between each ornamental plant landscape unit case and its surrounding environment, the ornament can reach the spatial orientation, and the ornamental physiological visual pattern can be determined. Based on the angle of 120°, this paper chooses representative ornamental viewpoints, discusses the orientation and quantity of each ornamental plant landscape unit, and evaluates the seasonal color matching method of ornamental plants in urban landscape construction from the perspective of multi-season landscape [21].

#### 3 Results

Five typical ornamental plant landscape unit cases were selected from five streets in Harbin. The starting time of each season in 2019 was obtained according to Table 1.

#### 3.1 Ornamental plant landscape unit case 1

The results of seasonal color matching in case 1 of ornamental plant landscape unit in urban landscape construction are shown in Figure 1.

In Figure 1, the results of phase color matching show that the ornamental characteristics of this landscape unit case in growing season are as follows: tree: thick plum (spring flowers and summer fruits), Korean spruce (evergreen),

mulberry, purple leaf plum (color leaves), tea Acer (autumn leaves), north China spear (summer flowers and autumn fruits), tendon maple (autumn leaves) + water elm (spring flowers and autumn fruits), Acer (autumn leaves). Shrubs: Golden Basswood (spring flower, summer fruit, and autumn leaf), Platform Cypress (evergreen), Elderberry (spring flower and autumn Fruit); Herbs: Poa annua. The ornamental plant landscape case tree species are more and mainly arbors, and seasonal color is considerable in all three seasons. Among them, flowering plants are more in May, autumn leaves and fruit plants in August and September are more colorful, compared with the seasonal landscape color in June and July is slightly insufficient. There are four main ornamental points around the landscape unit. The seasonal effect of body landscape is three seasons landscape, and autumn is the most colorful.

## 3.2 Ornamental plant landscape unit case 2

In the case of ornamental plant landscape unit in urban landscape construction, the results of seasonal color matching are shown in Figure 2.

In Figure 2, the results of phase color matching show that the ornamental characteristics of this landscape unit case in growing season are: arbor: Betula platyphylla (autumn leaf) + Ulmus pumila, Sorbus japonica (spring flower and autumn fruit), mulberry + purple leaf plum (color leaf), golden leaf elm (color leaf), peach plum (spring flower and summer fruit); shrub: lilac (spring flower), elderberry (spring flower and autumn fruit), Syringa microphylla (spring flower), Water Wax (spring flower), Platycladus (evergreen), Japonica (evergreen); Herb: Poa annua. The ornamental color of the whole growing season is guaranteed. From the end of April till the end of May, the flowering period of Shantao-thick plum, lilac, and clove is continuous, and the landscape color is the most abundant. The plant landscape color lacks characteristics and changes from June to August. The autumn leaves and autumn fruit plants are integrated in September. Body landscape color enhances the ornamental value; the landscape unit is adjacent to the road on both sides, with a ring road inside, with five main viewing points, belonging to the three-season landscape. Under the five views, the landscape is characterized by the outstanding effect of Flower-Watching in spring. The main colors are white and purple. Although summer and autumn season have ornamental colors, the source of colors is single, and the two seasons are not rich in colors.

Table 2: Ornamental trait NCS color values in the plant landscape unit case

Species name	Color of leaves(Spring)	Color of leaves(Summer)	Color of leavesolor		Color of
	_		leaves(Autumn)	flowers	fruits
Malusbaccata	S3560-G40Y	S7020-G30Y	S2060-G50Y	S0300-N	S1580-Y80R
Salix matsudana	S4550-G40Y	S5540-G40Y	S4550-G60Y		
Salix babylonica	S4550-G40Y	S5540-G40Y	S4550-G60Y	_	_
Populusalba 'Berolinensis'	S1075-G50Y	S3065-G40Y	S3560-G60Y	S4010-Y50R	S4030-Y10F
Catharanthusroseus	_	S4550-G40Y	S3050-G50Y	S1060-R30B	
Populus × canadensis	S1075-G50Y	S6030-G30Y	S4040-G80Y		
Piceakoraiensis	S4050-G40Y	S6030-G30Y	S5040-G40Y		
Ulmuspumila	S4550-G40Y	S5540-G40Y	S4050-G80Y	_	_
Prunuscerasifera f. atropurpurea	S3560-Y90R	S8010-R10B	S6030-Y70R	S0510-R30B	S8502-R
Taxuscuspidata	S7020-G30Y	S7020-G30Y	S5030-G50Y		S1580-Y90R
Juniperusrigida	S1075-G50Y	S6020-G30Y	S5020-G50Y		
Acer tataricum subsp. ginnala	S2070-G40Y	S5040-G40Y	S3560-R		
Ulmuspumila cv. Tenue	S4550-G40Y	S5540-G40Y	S4050-G80Y		
Padusmaackii	S4550-G40Y	S5040-G40Y	S2070-G90Y	S0300-N	S5040-Y90R
Betulaplatyphylla	S3560-G40Y	S7020-G30Y	S1060-Y		
Padusracemosa	S3065-G50Y	S5540-G40Y	S0560-Y	S0300-N	S8502-R
Tageteserecta		S5540-G40Y	S3040-G50Y	S0570-Y	
Sorbusalnifolia	S3065-G40Y	S5540-G40Y	S0570-Y10R	S0500-N	S1580-Y90F
Acer mono	S3065-G40Y	S7020-G30Y	S0580-Y10R		
Acer triflorum	S3065-G50Y	S7020-G30Y	S0570-Y10R		
Morusaustralis	S3560-G40Y	S7020-G30Y	S0570-G70Y		
Sorbusjaponicus	S4550-G40Y	S5540-G40Y	S4050-G60Y	S0500-N	S1580-Y80R
Padusvirginiana 'Canada Red'	S3060-G50Y	S6030-Y90R	S3560-Y90R		
Ulmuspumila'Jinye'	S1070-G80Y	S1070-G50Y	S1070-G70Y		
Sambucuswilliamsii	S5540-G40Y	S3060-G40Y	S1080-Y	S0515-G90Y	S2070-Y90R
Loniceramaackii	S2070-G40Y	S5540-G40Y	S2070-Y	S0300-N	S1580-Y80R
Amygdalustriloba	S4050-G40Y	S5540-G40Y	S2060-G90Y	S0515-R40B	S1085-Y80R
Sabina procumbens	S2060-G40Y	S5030-G30Y	S5030-G50Y		
Spiraeasalicifolia	S2060-G50Y	S5540-G40Y	S1070-G90Y	S0530-R20B	
Euonymus alatus	S3065-G50Y	S5040-G40Y	S0570-G70Y	S0530-R10B	S0585-Y80R
Syringaoblata	S4550-G40Y	S5040-G40Y	S3560-G60Y	S2040-R40B	
Syringa vulgaris	S4050-G40Y	S5040-G40Y	S3560-G60Y	S2040-R40B	
Sytingamicrophylla	S4550-G40Y	S5040-G40Y	S3560-G60Y	S3020-R20B	
Forsythia mandschurica	S3065-G50Y	S8010-G30Y	S3060-G80Y	S0570-Y	
Cerasustomentosa	S4550-G40Y	S6030-G30Y	S2070-G90Y	S0500-N	S0570-Y70R
Ligustrumobtusifolium	S4550-G40Y	S7020-G30Y	S3060-G80Y	S0300-N	
Cornusstolonifera	S3060-G60Y	S5540-G40Y	S4550-Y90R	S0500-N	S0300-N
Sabina chinensis	S2060-G40Y	S5030-G30Y	S5030-G50Y		_
Celosia cristata	_	S4040-G50Y	S3050-G50Y	S3560-Y90R	
Hemerocallisfulva'Golden Doll'		S4040-G50Y	S5540-G40Y	S0580-Y	
Menthacanadensis		S3560-G40Y	S4040-G40Y	S2040-R60B	
Salvia splendens		S4550-G40Y	S4040-G40Y	S1580-Y80R	
Hylotelephiumerythrostictum		S1070-G30Y	S1070-G40Y	S2050-R10B	
Petunia hubrida		S4550-G40Y	S4040-G50Y	S1060-R30B	
Achilleawilsoniana		S2070-G40Y	S5540-G40Y	S0300-N	
Acnitieawiisomana Poaannua	S0575-G40Y	S3065-G40Y	S4550-G60Y	30300-14	

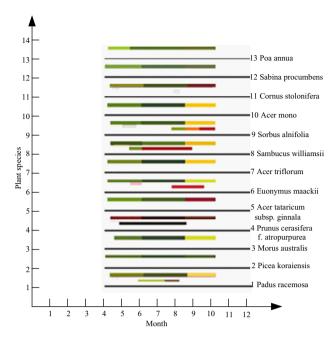


Figure 1: Ornamental plant landscape unit case 1.

## 3.3 Ornamental plant landscape unit case 3

In the case of ornamental plant landscape unit in urban landscape construction, the results of color matching in three seasons are shown in Figure 3.

In Figure 3, seasonal phase color matching results show that the ornamental characteristics of this landscape

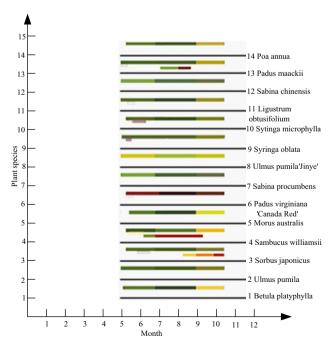


Figure 2: Ornamental plant landscape unit case 2.

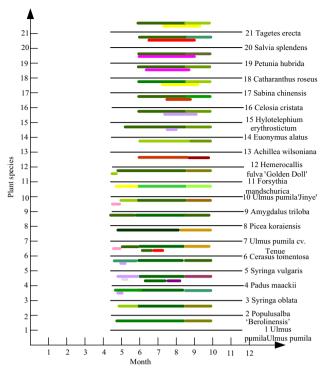


Figure 3: Ornamental plant landscape unit case 3.

unit case in growing season are as follows: arbor: Arbor, Sedum spectabile, Euonymus, Golden Leaf Ulmus, Ulmus pumila, Ulmus prunifolia, Prunus prunifolia, Poplar, Ulmus pulus; shrub: marigold chrysanthemum, Petunia, Vinna, Cockcrown Flower, Forsythia forsythia, Red Cloud, Double-petal Oceania, Peach Thick Plum, Purple, Clove; Herbs: Yarrow, Golden Baby Hemerocallis, Tropical sage. The flower color range of the plant landscape is S0300-N~S3560-Y90R, with a total of 12 standard colors, of which 4 are pink. From April 21 to May 15, the types of flowering encounters persist in two to three, covering white, yellow, pink, and purple. There are eight species of ornamental plants, lasting 81 days. From July 20 to August 24, there are six to eight species of ornamental plants, including yellow, pink, red, and purple. The ornamental plant landscape case lasts 21 days in autumn, and there are five to seven species of ornamental plants; the ornamental plant landscape case includes two species of ornamental fruit plants. The ornamental plant landscape case has a high landscape richness in summer. There are eight herbal flowers, the color range is S1060-R30B~S3560-Y90R, a total of seven standard colors, covering four color lines of yellow, pink, purple, and red. The case of the ornamental plant landscape unit has rich ornamental color, rich color in two seasons, and more herbal flowers.

#### 3.4 Ornamental plant landscape unit case 4

In the case of ornamental plant landscape unit in urban landscape construction, the matching results of seasonal color are shown in Figure 4.

The results of seasonal phase color matching in Figure 4 show that the ornamental characteristics of this landscape unit case in growing season are: arbor: Canadensis Moench, juniper (evergreen in four seasons); shrub: northeast yew (evergreen autumn fruit in four seasons), lilac (spring flower), Acer (autumn leaf) + Liaodongwater wax (spring flower); herb: golden doll Hemerocallis (summer flower), crown flower (summer flower), Mint (summer flower). The case of this plant landscape unit from May to September has considerable seasonal landscape color, among which July and August are the most abundant and June are slightly lacking in landscape ornamental color. Its main landscape is Canadensis Moench, which has four main viewing points. The overall effect of seasonal landscape is three-season landscape, and the A and B viewpoints lack spring ornamental color. The case is rich in color composition, so no additional tree species can be added and lilac and tea Acer can be increased appropriately.

## 3.5 Ornamental plant landscape unit case 5

Five seasonal color matching results of ornamental plant landscape unit cases in urban landscape construction are shown in Figure 5.

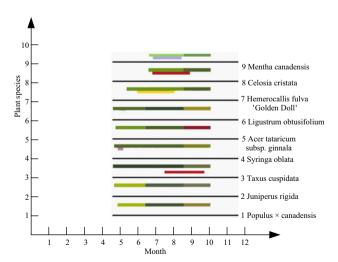


Figure 4: Ornamental plant landscape unit case 4.

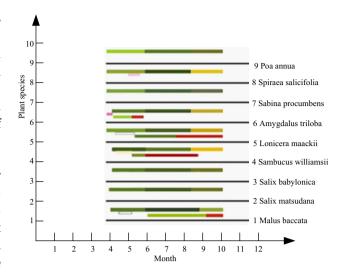


Figure 5: Ornamental plant landscape unit case 5.

In Figure 5, the results of seasonal phase color matching show that the ornamental characteristics of this landscape unit case in growing season are as follows: arbor: Malus baccata (spring flowers and autumn fruits), Dry willow, Weeping willow; shrub: *Ulmus pumila* (spring flowers and autumn fruits), Elderberry (spring flowers and summer fruits), Lonicera japonica (spring flowers and autumn fruits), Place cypress (four seasons evergreen), Spiraea willow (spring flowers); herbs: Poa annua. The case of this plant landscape unit has the best ornamental color in May and June. In July and August, except elderberry bearing red fruit, the other plants are green and lack ornamental color. In autumn of September, there are yams and honeysuckle bearing red fruit, and there are few autumn leaf species. The south side of the plant is adjacent to the square, and the viewers have a larger space to stay, totally four main ornamental spots. The whole plant landscape unit case is a seasonal landscape. The color composition is mainly white and pink. The ornamental colors in summer and autumn are deficient from four perspectives. The remaining space in the plane is small. The pink herbal flowers are preferred.

# 3.6 Quantitative weighted evaluation of seasonal colors in plant landscape unit cases

According to the investigation and analysis of five plant landscape units in the previous paper, the evaluation principles of seasonal phase color weighted evaluation of plant landscape units are summarized as follows: (1) in three seasons of spring, summer, and autumn, whether the leaves, flowers, and fruits of plant species have ornamental colors other than green is scored according to the number of color values; (2) in three seasons of spring, summer, and autumn, if there are two or more seasons with ornamental characteristics of plants other than green, score 1; (3) under different viewing points, the number of viewing points is scored according to the number of green outseason colors in spring, summer, and autumn. The seasonal color matching evaluation weights of different ornamental plant landscape units in urban landscape construction are shown in Table 3.

From the results of Table 3, we can see that the total weighted score of seasonal color matching evaluation is: case 3 (40) > case 2 (35) > case 1 (32) > case 5 (24) > case 4 (20). The highest score is case 3, with six viewing points. There are seasonal color encounters in all three seasons, and the number of color values of ornamental traits in case 2 is 5. Compared with case 3, the color value of ornamental traits was slightly less, ranking 2; case 1 of the third ranking had four viewing points, and the color values of ornamental traits in growing season were abundant, and there were seasonal color encounters in all three seasons. Case 4 with the lowest score had only two viewing points and only had seasonal encounter characteristics in spring.

Through the case study of five landscape units, it can be seen that the richer the NCS color value of plant species' ornamental traits is, the more and longer the seasonal encounter and duration of ornamental traits' color. the more viewpoints of ornamental orientation and the more seasons there are, the better the matching degree of plant seasonal color, and the quality of plant landscape seasonal color design.

The seasonal color matching method of ornamental plants in urban landscape construction was discussed through five cases of plant landscape units which are the richest in natural plant landscape in cold city Harbin. NCS color value richness of ornamental characters of plant species, seasonal meeting of ornamental characters, and satisfying multi-orientation and multiseason view are three quantitative factors, which are positively correlated with the quality of seasonal color of plant landscape. It can be used as a quantitative method of seasonal color design to effectively improve the seasonal phase of ornamental plants in urban landscape construction qualitatively and quantitatively. The quality of color matching can be summarized as follows: A Define NCS color value and ornamental period of ornamental characters of plant species

units group landscape of different evaluation color ä

Serial number				Ь	Plant species	Ş				Sea	Seasonal encounters	nters		View point		Weighted
		Spring			Summer			Autumn		Spring	Spring Summer	Autumn	Spring	Spring Summer	Autumn	
	Leaf	Leaf Flower Fruit	Fruit	Leaf	Leaf Flower	Fruit	Leaf	Leaf Flower Fruit	Fruit							
1	1	4		1		5	7			1	1	1	4	3	4	32
2	2	9		2		2	2		2	1	1	1	2	4	4	35
3	2	2	2	2		2	2	8	1	1	1	1	9	2	4	40
4		2			٣	1	1	1	1	1	1	1	2	3	3	20
5		4				3	2		2	1	1	1	4	3	3	24

The NCS color value of ornamental characters and the length of Ornamental Period of plant species were collected and sorted out under the climatic conditions of the design site. The rhythm of growth and development of plant species was clarified to ensure that the completed landscape achieved the desired effect of the design.

B Determining the color matching scheme of landscape color

At the beginning of the plant landscape design, the main color matching scheme of the plant landscape was determined, and the ornamental characteristics and thematic significance of the landscape were clarified.

#### C Selection of plant species

According to the determined color matching scheme of landscape theme, tree species with corresponding ornamental color characteristics are selected, and native tree species are selected first to ensure the ornamental effect of landscape.

D Seasonal meeting design of Ornamental Characters of plant landscape groups

Different plant ornamental traits have different time series. It is necessary to match them qualitatively and quantitatively according to the flowering time, fruit time sequence, and duration of plant species so as to prolong the whole ornamental period of landscape and realize the multi-season scenery.

E Planting and design of plant landscape space

According to the size and density of landscape space and the scope of visitors' sight, the landscape space should be planned reasonably, and the space of trees, shrubs, and grasses should be matched to form a landscape space with high and low levels and distinct layers, so as to meet the viewers' multi-perspective viewing needs.

Through the above methods, seasonal color matching of ornamental plants in urban landscape construction can effectively improve the quality of seasonal color design of ornamental plants in urban landscape construction.

## 4 Discussions

#### 4.1 Seasonal color of ornamental plants

In the landscape design of ornamental plants in the construction of urban gardens, it is necessary to make rational use of the colors presented by plants in different periods to create a harmonious and colorful space. The common

colors of garden plants are red, orange, blue, green, purple, and white, as well as various mixed colors. The importance of seasonal color matching is self-evident. The season of ornamental plants should be selected and applied according to the specific emotion of seasonal color in landscape design. Phase color mainly includes several aspects:

#### A Temperature sensation of color

Red, orange, yellow, and other warm colors give people a warm and lively feeling; blue, blue-green, blue-purple, white, and other cold colors give people a cool and quiet feeling; green are neutral colors, will not make the viewer fatigue. For designers, they should grasp the temperature sense of color and choose different colors according to the functional requirements and environmental conditions of garden green space. For example, in spring and autumn and cold areas, warm plants should be used to regulate and balance people's psychological characteristics.

#### B The sense of movement of color

Warm tones have a strong sense of movement, giving people a sense of excitement, while cold tones give people a sense of tranquility. Therefore, during the festival, warm-colored plant landscape is arranged at the entrance of the park to express the lively atmosphere. Cold blue, white, and so on are usually used to create quiet environment, such as lawn or leisure square.

#### C Distance of color

Warm color makes the viewer feel close, cold color has a sense of distance; the same color, the purity of the near front, the purity of the small retreat. In gardens, gray-green cedar can be used for background and red maple for foreground, thus opening the depth of field.

#### D The weight of color

The lightness of color is influenced by brightness and purity. The lightness of color is high, the sensation is light, the lightness is low, and the lightness is heavy. The purity of the same color phase is high and light, and the purity is low and heavy. For example, in the basic planting of garden buildings, it is advisable to select plants with strong colors, such as red roses, to enhance the stability of the building.

Plant color, like other plant visual characteristics, can be used in coordination with each other, highlighting plant scale and shape in design. In landscape design, we should follow the aesthetic principle of plant tone collocation. Only when the color and background of plants are matched reasonably and coordinated with the surrounding environment, can the beauty of color presented

by plants in seasonal change be brought into full play and unique garden landscape be created.

# 4.2 Seasonal color matching principle of ornamental plants

In the construction of urban gardens, the matching of seasonal color of ornamental plants can refer to the following principles:

#### A Principle of color contrast

Contrast is often used in landscape design, such as the main entrances and exits of square and park and major festival scenes. Contrast color plants are used to form flower beds, styles, and main body shapes. It shows a strong visual effect and creates a cheerful and warm atmosphere.

### B Principle of color harmony

Tone is composed of color, purity, lightness, warmth, area, shape, and other factors. Their interaction constitutes the environmental color. Color harmony refers to the orderly and coordinated combination of two or more colors to form a unified visual effect of color matching. In landscape design, to form the overall tone of color, we should take a main color as the main tone to form the color tendency of the landscape, and adorn the color with the color as the decoration to play a regulatory role. The harmony of plant color plays an important role in limiting space function and creating environmental sentiment. Colors are closely related to seasons. Rendering garden colors and expressing seasonal characteristics of gardens are unique functions of plants. Landscape plants rely on rich colors, showing a variety of colorful four-season maps, giving life to the old rocks and buildings. In plant planting, color combination should be coordinated with its ornamental characteristics, and the focus of scenic spots should be set according to the different characteristics of plants in four seasons, so as to deepen the connotation of landscape and create landscape blending. It is precisely because of the colorful flowers and fruits in the plant world that the garden space will not be boring. Landscape design fully considers the biological characteristics of plants such as florescence and fruit period, and reasonably uses the change in color of plants in seasonal change, showing the vitality and colorfulness of nature, which makes the viewer freshly travel and deeply intoxicated. Because of the seasonal change of plants, their colors change with time. Planting plants with different colors and different flowering periods can produce specific time landscape effect in the same area in different periods.

Landscape designers are familiar with seasonal color changes of different plants and can create flowing color music. The quality of color combination directly affects the landscape performance of gardens. If the combination is good, it can achieve the effect of unified harmony; if the combination is not good, it will be disorderly. The color combination of garden plants should be based on spring flowers or autumn fruits. Each season has its own characteristics, so that spring comes early, autumn goes late, and the season is enjoyable.

### 5 Conclusion

This paper chooses Harbin City with distinct seasons and research significance of urban landscape construction as the research object. Five plant landscape cases are selected from five representative streets in Harbin City to study the seasonal color matching method of ornamental plants in urban landscape construction. Five plant landscape cases are evaluated by weighting method. The results of seasonal color matching of ornamental plants showed that the quality of seasonal color matching of ornamental plants was determined by NCS color value of ornamental characters of plant species, seasonal meeting of ornamental characters, and view point of ornamental orientation. To improve the quality of seasonal color design of ornamental plants, under the background of digital era, the quantitative database of plant ornamental characteristics should be established in all regions, which can provide the basis for seasonal color design of ornamental plants in future urban construction.

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