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Research Paper

Ornamental Plants Which Can Be Used in Visual Landscape Improvement in Cold Climate Regions

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Abstract: Plants in cities; help to keep the balance of the ongoing interaction between the environment and the human system by its visual and functional effects. It is possible to develop alternative solutions to eliminate visual pollution by evaluating the colour, texture, form, size and similar properties of plant materials and the potential properties of the composition with other inanimate materials such as highlighter, background forming, harmonizing and concealer. The number of ornamental plant species that grow in cold climates is less than in warm climates. For this reason, especially in the landscaping works of urban spaces, it is difficult to create the desired visuality with aesthetically qualified plants that are suitable for the ecology of the area, without creating monotony, with colour variety. In this study, the importance of ornamental plant and their compositions in the solution of visual problems in urban environments in cold climatic conditions is emphasized. The potential of ornamental plants that can be used for this purpose in preventing visual pollution is given. In addition to the design group disciplines that are effective on planning or application basis in the city and its surroundings, the studies to be carried out in detail in terms of planting design as a discipline of Landscape Architecture can provide visual improvement.

Keywords: *Visual improvement, residential landscape, urban space.*

Introduction

Visual pollution, which is a phenomenon in general environmental problems, can be defined as all the irregular formations in the natural or artificial environment that leave negative traces in memory. It is possible to develop alternative solutions to eliminate various visual contaminations using soft scape, which is one of the important landscape design elements especially in urban spaces. However, weather conditions such as wind, snow, frost, ice, diminishing daylight and long-term cold in winter cities, which dominate the winter season, restrict the use of plants in public open spaces with many negative effects.

When the definition of winter city is examined, it is seen in the literature that the temperature is below 0 °C and below 0 °C, precipitation is generally in the form of snow, daylight is felt in limited time, these three factors are defined as the city with long time periods and harsh season passes. According to Erskine (1986), the winter city is generally located at latitudes of 45° and above and with a temperature of 0 °C or less in January (Henke, 2006). Public spaces connecting society as a common ground; It is one of the most important parts of the cities, ranging from streets to squares, parks and surrounding buildings (Erdönmez & Akı, 2005; Tandoğan & Şişman, 2018).

In this study, ornamental plants that in the resolution of visual problems in habitable urban spaces in cold climate regions have been investigated and the importance of plant compositions has been emphasized. At the end of the study, a list of ornamental plants that can be used to eliminate visual pollution in public space design for cities considered as winter cities and at the same time make the area more visually impressive is given.

Ornamental Plant Characteristics That Can be Considered in Preventing Visual Pollution

In the ornamental plant material to be selected in order to prevent visual pollution of the plant designs to be made in landscape architecture: Physical properties varying according to local conditions, Functional features such as shading, screening, wind protection, space modulation, colour, texture, form, size etc. Depending on the characteristics of the architectural and aesthetic potential of

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plants should be known properties (Austin, 1982; Yazici & Gulgun, 2017; Yazici et al., 2017). Ornamental plants play an active role in the sustainability of urban life and are one of the most versatile benefits of aesthetic, ecological, socio-cultural, psychological, hygienic and functional scope. Aesthetically, ornamental plants soften the solid and sharp lines of buildings in urban areas, create interesting shapes and textures by creating contrasting shapes and textures (Booth, 1996; Yildizci, 1988; Dirik & Ata, 2005; Scarfone, 2007: Gulgun *et al*., 2014; Yazici *et al*., 2018) and provide aesthetic and physical value to the city space with features such as line, form, size, colour and texture (Yildizci, 1986) also meets the psychological and socio-cultural needs of the citizen (Konijnendijk et al., 2004; Birisci et al., 2017).

The roles of plants in design; ecological / engineering, architectural and aesthetic functions are divided into three classes (Booth, 1996; Leszczynski, 1999). In addition, it requires good practice and maintenance work (Erbas, 2003). A person's desire to live in a place suitable for his desires and tastes; aesthetically and functionally, the creation of the most appropriate outdoor spaces, design and selection of the most appropriate elements can be realized by the conscious use (Kelkit, 2002). The visual quality of single or group plant compositions is examined in terms of the line, form, texture and colour concepts that make up the visual characteristics of the plants. Although these elements are more abstract than the special effects of fruits, flowers are essential for understanding the whole composition (Ayaslıgil, 2004; Robinson, 2004). It is possible to create positive effects on the urban landscape by choosing plant species that offer attractive winter features such as leaves, fruits and stem colours in public spaces in winter cities. It is possible to see examples of this in different winter cities in the world (Figure 1).

Figure 1. Plants in winter city (**a**: Oslo, URL-1); (**b**: Stockholm, URL-2), (**c**: Moscow, URL-3)

Material and Method

The main material of this study is cities that located in cold climate region in Turkey. In addition, winter city examples and literature studies on this subject were used as auxiliary materials. In the first stage of this study, based on the definitions made for winter cities, the world that have made the Köppen climate classification maps were examined and winter city in Turkey are determined. Examples of liveable winter cities were examined and literature studies on this subject were utilized. According to the Köppen-Geiger climate classification in Turkey is 10 sub-climate types. Based on the

definitions made for winter cities, cold climate areas (D) in terms of Köppen Classification (Figure 2), the winters are severe, the average temperature of the coldest month is below -3 °C, the average of the warmest month is above 10 ° C and the soil is covered with snow for months characterized by features. According to Köppen Classification, cold climatic zones are also separated according to certain criteria (Table 1) (Türkeş & Tatlı, 2011; Öztürk et al., 2017).

Table 1. Sub-climate types of cold climate areas (D)

Climatic areas	Features
Dwa:	Winter is severe and arid, summer is long and hot
Dwb:	Winter is severe and arid, the font is cool
Dwc:	Winter is severe and arid, writing is short and cool
Dwd:	Winter is very severe, writing is short and moist
Dfa:	Severe in winter, long and hot in summer, rainy in all seasons
Dfb:	winter severe, summer short and hot, rainy in all seasons
Dfc:	winter severe, summer short and cool, rainy in all seasons
Dfd:	Winter is very severe, summer is short, rainy in all seasons

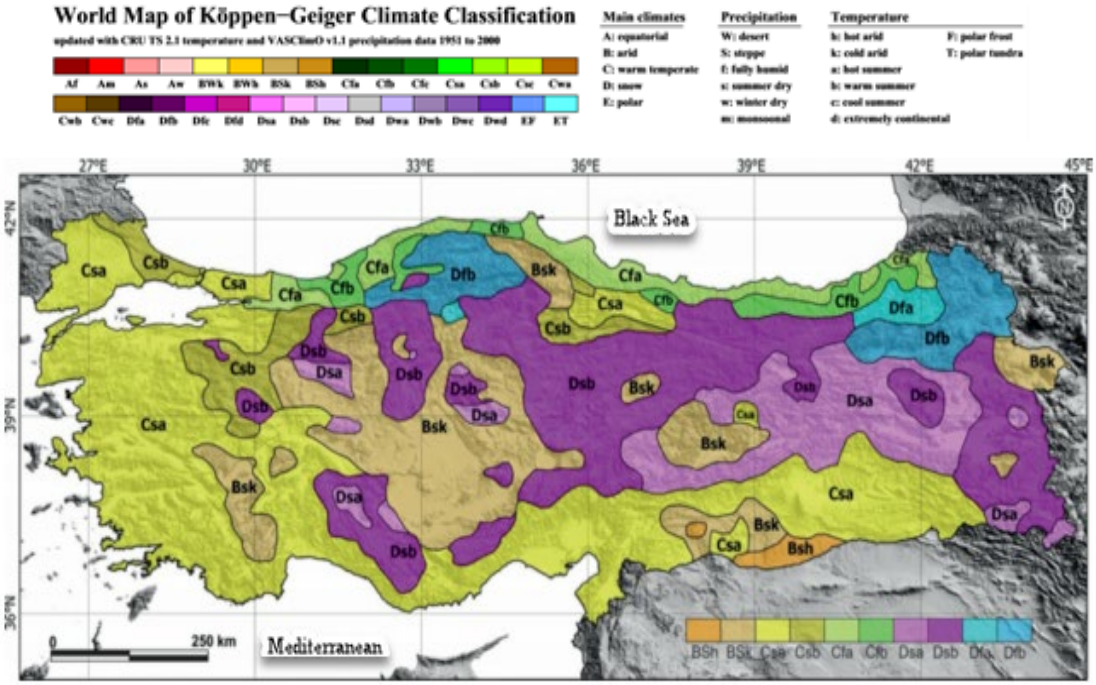

Figure 2. Köppen-Geiger sub-climate types of the Turkey (Öztürk *et al*., 2017; Kottek *et al*., 2006; Url-2)

When Köppen's world climate classification maps are examined, the provinces in Turkey corresponds to the eastern Anatolia region. For this reason, suggestions were made for Ardahan, Kars, Igdir, Agri, Van, Hakkari, Bitlis, Mus, Erzurum, Erzincan, Tunceli, Bingol, Elazig and Malatya (Figure 3). The area of Eastern Anatolian Region is 164 thousand km² and covered with high mountains. The altitude results in a cold and harsh climate, and more difficult living conditions for the people living here. Eastern Anatolian Region borders Georgia, Armenia, Azerbaijan, Iran and Iraq on the east. The cities that located in these provinces are not considered rich about ornamental plants.

In the second stage of this study, design criteria were proposed to make public spaces in winter cities more visually beautiful and liveable. In the third stage, suggestions were made for plant material that can be used in public places in winter cities. In determination of plant material, cold resistance criteria were taken into consideration. The plant material that meets these criteria are evaluated aesthetically (leaf colour, stem, fruit / flower, form) and a suggestion plant table is prepared for winter cities.

Figure 3. Region considered in the study: Eastern Anatolian Region

Findings

Plants Design in Public Open Spaces in Winter Cities

In plant design, plant selection should be made in which tolerances to hot and cold climatic conditions are appropriate. Ornamental plants that can be used in visual improvement and create effective images in winter were investigated, for Ardahan, Kars, Igdir, Agri, Van, Hakkari, Bitlis, Mus, Erzurum, Erzincan, Tunceli, Bingol, Elazig and Malatya that located in Eastern Anatolia Region (14 province).. In this direction the points to be considered in ornamental plants design in public spaces in winter cities are as follows:

- Cold and salt resistant species should be selected in terms of plant health when selecting plant material, which is the most important factor regulating urban ecology in winter cities (Pressman, 2016).
- Select vegetation for landscaping near roadways that can withstand exposure to salt, ice smelters, gravel and sand. Vegetation should be able to withstand snow loads, wind and require little maintenance throughout the year (Coleman, 2009; Pressman, 2016).
- Give preference to native plants, trees, grasses and shrubs that are colourful and/or look attractive covered with snow (Pressman, 2016).
- Use planting beds surrounded by curbs to lessen damage due to snow-clearing equipment.
- As they have an important role in providing sun and wind control around public open spaces and structures, the choice of plant should be made according to the size and character of the plant in summer and winter, and growth rate (Figure 4) (Candemir, 2009).
- Summer / winter green, evergreen plants should be selected on the northern front of public open spaces and structures. These plants will function as wind breakers and reduce heat losses, protect pedestrians from cold winds (Olgyay, 1962). Deciduous trees should be used on the south-facing facades of public spaces and buildings (Coleman, 2009; Pressman, 2016).
- Reduce wind speed in open spaces by planting dense vegetation along the edges and against any blank walls to reduce wind acceleration (Figure 4) (Pressman, 2016).
- Use soft landscaping to filter and screen views into private dwelling units, while ensuring views to the street or open spaces are maintained for surveillance (Pressman, 2016).
- The use of evergreen trees (coniferous vegetation) and shrubs in pedestrian areas will serve as wind curtains and create a favourable environment by preventing wind and snow type (City of Minneapolis, 2011).
- It is necessary to use the trees in groups instead of lining the trees in cases that will be used as wind curtains. This will provide greater resistance to wind and reduce surface evaporation (Urban systems, 2000).
- Insulation should be provided in winter by using climbing plants or intense planting on the walls of the buildings (St. Clair, 2010).
- Banquets and plants should be used in order to prevent snow fall in the entrance of buildings (Cengiz et al., 2016).

- Form, colour, fruit, etc. that increase the attractiveness of the winter character of the area. Different plant species with interesting winter characteristics should be selected (Coleman, 2009; Cengiz et al., 2016).

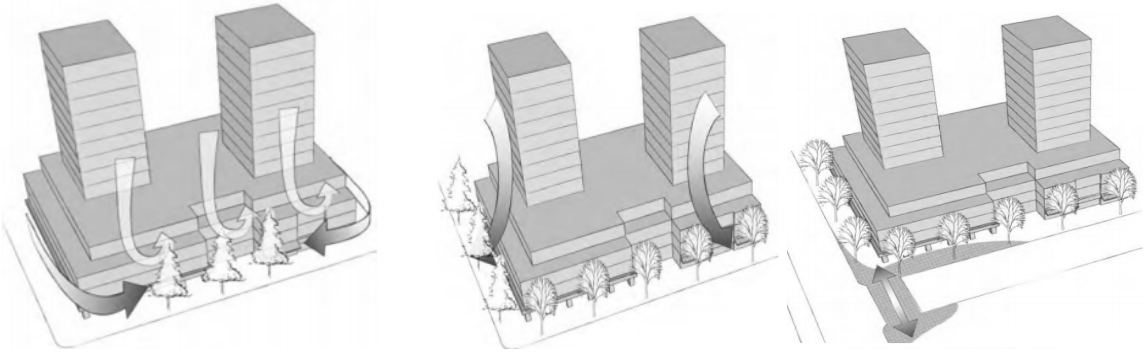

Figure 4. Use of trees to reduce the negative impact of wind (Pressman, 2016)

Plant Species That Can Be Used in Public Places in Winter Cities

In the public spaces discussed in the scope of the study; The types of plants that can be used in cities with severe winter, short summer and rainy season are given below, by taking advantage of the Alp , 2007, Tandoğan & Şişman 2018 and with another research in the table Table 1. and Table 2. Accordingly, it will be possible to make the area more interesting by creating different color and visual effects with plants in successive seasons throughout the year in public spaces, which are the visual pollution of winter cities. However, large and coniferous trees and shrubs are suitable plants for aesthetic and functional purposes in plant design studies for winter cities. Broad-leaved trees; *Acer campestre, Acer pseudoplatanus, Aesculus hippocastanum,* are resistant to salt and are suitable for use as wind and snow curtains. From coniferous trees, *Abies concolor* and *Picea pungens* are suitable for creating snow and wind curtains. *Fraxinus americana, Picea pungens, Symphoricarpus orbiculatus* and *Syringa vulgaris* are suitable for use in winter cities because of their salt-resistant plant species and their visual values.

Table 1: List of trees that can be used in plant design of winter cities

	Scientific name	Plant height (m)	Flowering time	Characteristics of plants
Trees	*Abies cilicica*	30	-	Light green body
	Abies concolor	25-30	-	Blue Green Conifer
	Acer campestre	10-15 m	-	Autumn yellow leaf color
	Acer negundo	More than 15 m	-	Autumn leaf color
	Acer platanoides	20-30	April	Red leaves
	Acer rubrum	25-40	-	Red leaves
	Aesculus carnea	20-25	April- May	Red Flowers
	Aesculus hippocastanum	20-25	April -May	White flowers
	Amygdalus communis	Up to 12 m	April -May	Light pink blossoms
	Betula alba	20-25	April	White body
	Catalpa bignonioides	7-15	June-July	Powder pink flowers
	Crataegus monogyna	3-7	-	Red berries (until winter)
	Cydonia japonica	1-1,5	April	Pink / Red flowered
	Cupressus arizonica	25	March -April	General view of bluish
	Elaeagnus angustifolia	5-7	June	General view of bluish and yellow flowers
	Fraxinus americana	More than 15 m	-	Green, bright gray
	Laburnum anagyroides	80-100 cm	May	Yellow flowers
	Ligustrum vulgare	5-7	June- July	Dark green leaves
	Malus floribunda	6-7	May	Pink flowers
	Picea ssp.	30-40cm	-	Bluish body
	Picea abies	More than 15 m	-	Decorative image

	Picea pungens 'Glauca'	20-25	-	Blue green color
	Pinus sylvestris	More than 15 m	-	Gray green color of tree and yellow color of trunk
	Prunus cerasifera Pissardii Nigra	5-8	April- May	Burgundy leaves
	*Prunus ceracifera '*Atropurpurea'	7-9	April - May	Red petals, white flowers
	*Prunus serrulata "*Kanzan"	7-10	May	Pink flowers
	Robinia pseudoacacia "Deca Isneana Hispida"	20-30	June	Pink flowers
	Salix caprea	12-15	April - May	Downy flowers
	Tamarix tetrandra	4-5	June	Tulum image
	Tilia tomentosa	20-25	June	Pink flowers

Table 2: List of Shrubs that can be used in Plant Design of Winter Cities

	Scientific name	Plant height (m)	Flowering time	Characteristics of plants
Shrubs	*Berberis thunbergii*-Atropurpurea	1.50- 3	May-June	Bouquet-red leaves
	Buddleja davidii	3	July- September	Lilac flowers
	Cotoneaster horizontalis	1.50	April	Red Berries
	Forsythia x intermedia	2-3	April-May	Yellow Flowers
	Laburnum anagyroides	5	May-June	Pink flowers
	Juniperus sabina	1-3	-	Dark green view
	Parthenocissus quenquefolia	1015	-	Red leaves in autumn
	Pyracantha coccinea	5	June- July	Orange-red berries
	Rosa hybrida	2-3	April-October	Different flower colors
	*Ribes aureum '*Prush'	1-2	April- May	Yellow Flowered Black Fruity
	Syringa vulgaris	5-6	May	Lilac flowers
	Sambucus nigra	More than 3 m	-	Black Berries
	Spiraea x vanhouttei	2-5	April-May	White flowers
	Symphoricarpos orbiculatus	1.5-2	-	White Berries
	Tamarix tetrandra	4-5	June	Tulum image
	*Thuja orientalis '*Aurea Nana'	1.5-2	-	Yellow color
	Weigela coraensis	2-3	May- June	Pink flowers
	Viburnum opulus	More than 3 m	May-early June	White flowers

Conclusions and Recommendations

The transformation of the spaces between buildings and structures in and around the city into habitable defined areas is only possible with the 'Planting Design' studies, which form an important part of the landscape architecture discipline. The compositions that emerge by arranging the visual characteristics of the plants and the functions they undertake in the design can be grasped through basic visual evaluation, which is one of the most important components of human perception. Plants, which provide climate control and aesthetical benefits in the regulation of public open spaces in cities, are one of the determining factors in revealing the living space and quality of life of the urban space with its ecological, socio-cultural, psychological, hygienic and functional benefits. However, unfavourable weather conditions in winter cities also physically and psychologically restrict human life and activities and thus the use of public open spaces. In this respect, suitable plantation should be realized in public areas and especially in areas where buildings are densely located. images of buildings with ornamental plants around them appears to be better quality than plant-free conditions, even in winter cities (Figure 5).

In the results of this study for Ardahan, Kars, Igdir, Agri, Van, Hakkari, Bitlis, Mus, Erzurum, Erzincan, Tunceli, Bingol, Elazig and Malatya provinces that located in Eastern Anatolia Region; created a list of ornamental plants for alternative use, which can provide visual improvement and create effective images in winter. In this context, it will be possible to make the area more interesting by creating different colour and visual effects with plants in successive seasons throughout the year in public spaces which are the visual pollution of winter cities. *Forsythia x intermedia* and *Syringa vulgaris,* which bloom early in the spring, will continue to colour the flowering plants such as *Buddleja davidii* and *Weigela coraensis* in summer. In autumn, the plants will be colored with fruits such as *Symphoricarpos orbiculatus* and *Pyracantha Coccinea* or red leaves such as *Acer platanoides* and *Parthenocissus quenquefolia*. Then in winter, the same area with conifers of different colours,

such as *Picea abies* and *Abies cilicica,* will have a better-quality image in terms of visual landscape. However, in parks and squares *Abies concolor, Picea pungens* and *Juniperus sabina* are coniferous plants that are suitable for forming snow and wind curtains. Broad-leaved and salt-resistant species *Fraxinus americana*, *Symphoricarpos orbiculatus* and *Syringa vulgaris* are suitable plants for creating snow and wind curtains in parks and squares.

Figure 5. Two different images of mass housing and their surrounding in winter (Url 4)

As a result, the public spaces in winter cities, which are arranged according to climatic conditions and arranged with the right planting design, will encourage the urbanite to spend more time in the outdoor space and enable the creation of more interesting urban spaces in terms of visual landscape. However, ecological improvement will also take place. Visual pollution that occurs in urban spaces includes the concern that urban objects and spaces are not aesthetic. The concept of aesthetics, on the other hand, addresses a wide audience from a single individual to a social level. Since the determinant of visual pollution is society, a social assessment seems necessary in the designs to be made. In this context, the relationships between aesthetic evaluation and user of the environment and evaluation methods should be investigated.

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