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Researches on Attractive Flowered Natural Woody Plants of Bursa Flora in Terms of Landscape Design

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***Abstract*—**One of the most important criteria that increase the success of design in landscape architecture is the visual effect. The characteristics that affect visual appearance in plant design vary depending on the phenological periods of the plants. In plants, although different effects are observed in different periods of the year, this effect is felt most prominently in flowering periods. For this reason, knowing the flowering time, duration and flower characteristics should be considered as a factor increasing the success of plant design. In this study, flower characteristics of natural woody plants with attractive flowers have been examined. Because of the variability of these characteristics of plants in the region, consideration of these criteria in the planting design processes in the region may increase the success of the design. At the same time, when species selection is made considering the obtained data, visuality and sustainability of natural species can be possible in Bursa city with planting design.

***Keywords*—**Bursa, flower characteristics, natural plants, planting design.

I. Introduction

THE plant material, which is the most important living element of the landscape design, offers a wide range of choices to the designer with today's perspectives. Within this rich diversity, the landscape designer is responsible for choosing the correct and successful species in order to ensure the sustainability of the designed areas in urban spaces [1]. Using plant material for various purposes dates back to ancient times; the use of woody plants goes back to the 5th century [2], [3].

The success of a holistic landscape design in urban areas is only possible when the designer understands the nature of the material used and takes care of the criteria that nature requires while making a selection. If the correct species selection is not made, even the best care methods may not allow species to adapt and be compatible [4], [5], [1].

Besides the selections made from natural plants in the city, the visual impact of plants on urban design is also an important criterion. According to Arnold [4], the most important function of plants in urban areas is to provide the visual connection necessary to perceive the city's unlimited scale in the human mind. The plant material can create different effects in terms of visual properties such as form, size, stem, leaf, fruit, and flower.

Color is the element with the greatest impact, especially in plant design used in areas where people live in. Some colors can be perceived more easily than others, and others can affect human physiology and psychology differently [6], [7]. Colors affect human physiology and emotions [8]. With floral plants that show the most coloring in planting design, identification of places and facilitation of visual perception are ensured. By emphasizing seasonal changes with different color features, the city environment becomes richer in terms of naturalness. The flowering characteristics of the plants resulting from the natural life cycle also enable the perception of nature by humans [1].

Color affects the spatial perception in landscape design. It reveals whether the items used are close, distant or remarkable [9]. Because of the high visual impact of warm colors, they appear to converge towards the viewer, and therefore warm colors are often used to reduce the effect of large spaces. And bright colors tend to excite and stimulate, cool colors are more appropriate for relaxation and serenity.

In landscape practices, the designs made with colors can be considered under three headings: monochrome, polychrome and natural arrangements [10].

Monochrome arrangements are unfavorable arrangements since they represent monotony and stillness by using only one color generally. This kind of arrangements is unfavorable arrangements since they represent monotony and stillness. They should only be preferred in big areas [10].

In polychrome arrangements, many different colors are aimed to be used in a large number and in a multi-purpose way. This is a desired feature not only in plants but also in architectural designs. This kind of arrangements can create complexity, therefore they are mostly unfavorable [10].

In natural arrangements, the composition and colors in nature are used as they are. In a sense, nature is imitated [10].

When design visuality is considered, arrangements should also be considered. At the same time, natural plants should be included in these arrangements.

In this research, information about natural woody plants that can be used in Bursa city has been obtained. In line with the changing needs of our cities along with the urbanization process, it was aimed to make a selection of the natural plants of the city of Bursa in a correct and conscious manner in order to ensure the continuity of the natural plants and visuality.

II. Material

This study is focused on Bursa, one of the biggest cities of Turkey and natural woody plants with attractive flowers which are located in Bursa province are the main material of this research.

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This study is focused on Bursa, one of the biggest cities of Turkey. Bursa Province lies south of the Marmara Region, between 39° 30'-40° 37' north latitudes and 28° 06'-29°58' east longitudes. It is surrounded by Bilecik, Sakarya in the east, Kocaeli, Yalova, Istanbul and the Marmara Sea in the north, Kutahya in the south and Balıkesir in the west (Fig. 1). There are important plains in Bursa Provincial area. The Bursa Plain, which the city spreads through, is the most important of these and occupies a large area in the northwest skirts of Uludag. The warmest months of Bursa are July - August and the coldest months are February and March. The total annual precipitation is 736.1 mm and the average relative humidity is around 69% [11]. Mediterranean climate is dominant in Bursa province which is located on the coast of Marmara sea, summer is warm and dry, winters are warm and rainy. As we move away from the sea, the semi-continental climate is seen in the inner parts [12], [13].

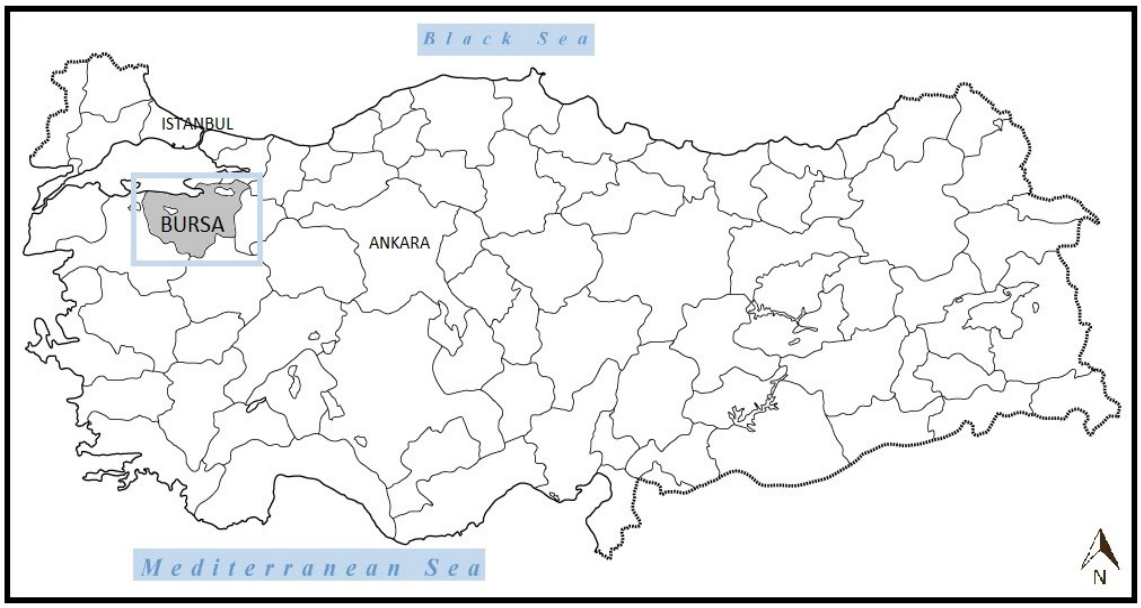

Fig. 1 The location of the field of study in Turkey

III. Method

The method of the research was formed by evaluating observations and analyzes made in the research area. In this context, land works have been carried out with respect to the woody plant species determined by using studies such as [14]-[23], [12], and species with attractive flower characteristics were observed in situ and evaluated in terms of landscape design.

IV. Findings

According to the findings obtained in the survey, the names of families, genera, and species of natural woody plants which are attractive flower characteristics in Bursa city are given in Table I. When the distributions of natural woody plants, which have attractive flower characteristics in Bursa city, by family, genus, and species were examined, it was found that there were 22 genera and 33 species belonging to 15 families (Table II). Distribution of attractive flowered natural woody plant species by life forms is given in Fig. 2. The flower color and flowering times of the species can be found in Table III-VII and Figs. 3, l4.

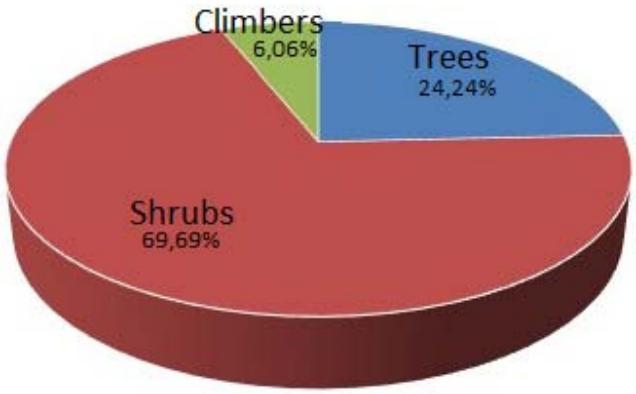

Fig. 2 Distribution of Attractive Flowered Natural Woody Plant Species by Life Forms

According to Fig. 2, the highest number of life forms of the attractive-flowered natural woody plants in Bursa is shrubs, and the least are climbers.

According to Table II, the families with the most attractive-flowered natural plant species in Bursa city are; Fabaceae (Leguminosae) (5), Ericaceae (4), Cistaceae (3), Oleaceae (3) and Rosaceae (3).

TABLE I
FAMILY, GENUS AND SPECIES NAMES OF ATTRACTIVE FLOWERED NATURAL WOODY PLANTS IN BURSA

Family	Genus	Species	Common Name	Life Form
Fabaceae (Leguminosae)	Cercis	*Cercis siliquastrum* L. ssp. *siliquastrum*	Judas Tree, Redbud	Tree
Cistaceae	Cistus	*Cistus laurifolius* L.	Laurel-Leaved Rock Rose	Shrub
Cistaceae	Cistus	*Cistus salviiflorus* L.	Rock Rose, Salvia cistus, Sage Leaf Rock Rose	Shrub
Cistaceae	Cistus	*Cistus creticus* L.	Rock Rose, Cretan Rockrose	Shrub
Fabaceae (Leguminosae)	Chamaecytisus	*Chamaecytisus hirsutus* L.	-	Shrub
Fabaceae (Leguminosae)	Chamaecytisus	*Chamaecytisus austriacus* L.	-	Shrub
Fabaceae (Leguminosae)	Chamaecytisus	*Chamaecytisus pygmaeus* L.	-	Shrub
Cornaceae	Cornus	*Cornus mas* L.	Cornelian Cherry, Cornelian Cherry Dogwood	Tree
Cornaceae	Cornus	*Cornus sanguinea* L. subp. *sanguinea*	Dogwood, Bloodtwig Dogwood	Tree
Tymelaeaceae	Daphne	*Daphne oleides* L.	Olive-Leaved Daphne	Shrub
Tymelaeaceae	Daphne	*Daphne pontica* L.	Twin-Flowered Daphne	Shrub
Tymelaeaceae	Daphne	*Daphne sericea* L.	Daphne	Shrub
Ericaceae	Erica	*Erica arborea* L.	Briar Root	Shrub
Oleaceae	Fraxinus	*Fraxinus ornus* L.	Flowering Ash	Tree
Lauraceae	Laurus	*Laurus nobilis* L.	Bay Tree, Sweet bay, Grecian Laurel, True Laurel	Tree
Oleaceae	Olea	*Olea europa* L.	Olive, African olive, European Olive	Tree
Oleaceae	Phillyrea	*Phillyrea latifolia* L.	Green Olive Tree	Tree
Rosaceae	Pyracantha	*Pyracantha coccinea* Roem.	Scarlet Firethorn	Shrub
Rosaceae	Rosa	*Rosa gallica* L.	French Rose	Shrub
Rosaceae	Rosa	*Rosa canina* L.	Dog Rose	Shrub
Ranunculaceae	Clematis	*Clematis viticella* L.	Purple Clematis	Climber
Ranunculaceae	Clematis	*Clematis cirrhosa* L.	Fern-Leaved Clematis	Climber
Anacardiaceae	Rhus	*Rhus coriaria* L.	Elm-Leaved Sumach, Sicilian Sumac	Shrub
Liliaceae	Ruscus	*Ruscus aculeatus* L.	Butcher's Broom - Knee Holly	Shrub
Fabaceae (Leguminosae)	Spartium	*Spartium junceum* L.	Spanish Broom, Weaver's Broom, Spanish Broom	Shrub
Styracaceae	Styrax	*Styrax officinalis* L.	Storax Tree	Shrub
Tamariaceae	Tamarix	*Tamarix parviflora* DC.	Small-Flowered Tamarisk	Shrub
Tiliaceae	Tilia	*Tilia argentea* Desf.ex.DC.	Silver Lime	Tree
Ericaceae	Vaccinium	*Vaccinium myrtillus* L.	Bilberry, Whortleberry	Shrub
Ericaceae	Vaccinium	*Vaccinium uliginosum* L.	Bog Bilberry	Shrub
Ericaceae	Vaccinium	*Vaccinium arctostaphylos* L.	Caucasian Whortleberry	Shrub
Caprifoliaceae	Viburnum	*Viburnum tinus* L.	Laurustinus, Laurestinus Viburnum	Shrub
Verbenaceae	Vitex	*Vitex agnus-castuss* L.	Agnus Castus, Lilac chastetree, Vitex, Chastetree	Shrub

TABLE II
DISTRIBUTION OF NATURAL WOODY PLANTS WITH ATTRACTIVE FLOWERS IN BURSA BY FAMILY, GENUS AND SPECIES

Family	Genus	%	Species	%
Fabaceae (Leguminosae)	3	13,64	5	15,15
Cistaceae	1	4,55	3	9,09
Cornaceae	1	4,55	2	6,06
Tymelaeaceae	1	4,55	3	9,09
Ericaceae	2	9,09	4	12,12
Oleaceae	3	13,64	3	9,09
Lauraceae	1	4,55	1	3,03
Rosaceae	2	9,09	3	9,09
Ranunculaceae	1	4,55	2	6,06
Anacardiaceae	1	4,55	1	3,03
Liliaceae	1	4,55	1	3,03
Styracaceae	1	4,55	1	3,03
Tamariaceae	1	4,55	1	3,03
Tiliaceae	1	4,55	1	3,03
Caprifoliaceae	1	4,55	1	3,03
Verbenaceae	1	4,55	1	3,03
Total	**22**	**100**	**33**	**100**

According to Table III, natural woody plants with attractive flowers are 9 kinds of white, 4 kinds of whitish-cream, 4 kinds of pink, 2 kinds of pinkish white, 3 kinds of pinkish-purple, 4 kinds of yellow, 3 kinds of greenish-yellow, 2 kinds of yellowish-white, 1 kind of red and 1 kind of greenish-red color.

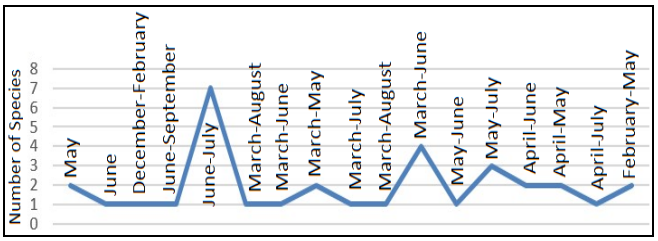

Fig. 3 Number of Attractive Flowered Natural Woody Plant Species by Months

According to Fig. 3, the plants with attractive flower characteristics in Bursa have the highest flowering time in May, June, and July. According to Fig. 4, the plants with attractive flower characteristics in Bursa have the highest flowering time in summer and the least in autumn. Considering the flowering periods in Tables III-VII with proper selection of species, the floral characteristics of natural

plants throughout the year can be used in landscape designs.

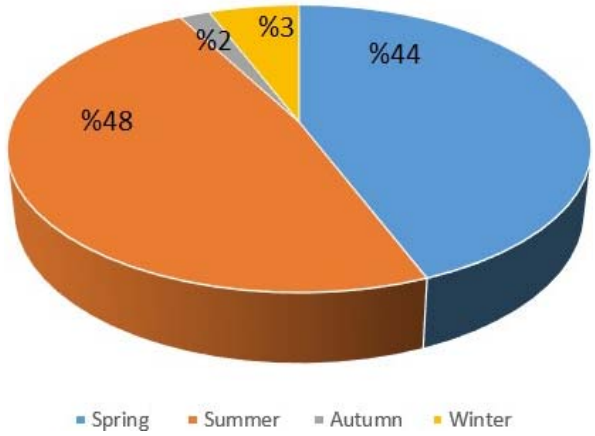

Fig. 4 Distribution of Attractive Flowered Natural Woody Plant Species by Seasons

TABLE III
FLOWER COLOR AND FLOWERING TIME OF NATURAL WOODY PLANTS WITH ATTRACTIVE FLOWERS IN BURSA

Species	Flower Color	Flowering Time
Cercis siliquastrum L. ssp. *siliquastrum*	Pinkish-Purple	April-May
Cistus laurifolius L.	White	May-June
Cistus salviiflorus L.	White	June-July
Cistus creticus L.	Pink	March-June
Chamaecytisus hirsutus L.	Yellow	April-June
Chamaecytisus austriacus L.	Yellow	May-June
Chamaecytisus pygmaeus L.	Yellow	April-June
Cornus mas L.	Greenish-Yellow	March-May
Cornus sanguinea L. subp. *sanguinea*	Whitish-Cream	May-June
Daphne oleides L.	Whitish- Cream	May-August
Daphne pontica L.	Greenish-Yellow	March- August
Daphne sericea L.	Pink	February-May
Erica arborea L.	White	March-July
Fraxinus ornus L.	Whitish- Cream	April-May
Laurus nobilis L.	Greenish-Yellow	March-May
Olea europa L.	White	May
Phillyrea latifolia L.	White	May
Pyracantha coccinea Roem.	White	June-July
Rosa gallica L.	Pinkish-White	June-July
Rosa canina L.	Pinkish-White	May-July
Clematis viticella L.	Pinkish-Purple	June-July
Clematis cirrhosa L.	Yellowish-White	June-July
Rhus coriaria L.	Red	June-July
Ruscus aculeatus L.	White	February-May
Spartium junceum L.	Yellow	April-July
Styrax officinalis L.	White	June
Tamarix parviflora DC.	Pink	May-June
Tilia argentea Desf.ex.DC.	Yellowish-White	May-June
Vaccinium myrtillus L.	Greenish-Red	May-July
Vaccinium uliginosum L.	Pink	June-July
Vaccinium arctostaphylos L.	White	May-July
Viburnum tinus L.	Whitish-Cream	December-February
Vitex agnus castuss L.	Pinkish-Purple	June-September

TABLE IV
SPECIES OF ATTRACTIVE FLOWERING NATURAL PLANTS IN SPRING

Species	Flowering Season
Cercis siliquastrum L. ssp. *siliquastrum*	Spring
Cistus laurifolius L.	Spring-Summer
Cistus creticus L.	Spring-Summer
Chamaecytisus hirsutus L.	Spring-Summer
Chamaecytisus austriacus L.	Spring-Summer
Chamaecytisus pygmaeus L.	Spring-Summer
Cornus mas L.	Spring
Cornus sanguinea L. subp. *sanguinea*	Spring-Summer
Daphne oleides L.	Spring-Summer
Daphne pontica L.	Spring-Summer
Daphne sericea L.	Winter-Spring
Erica arborea L.	Spring-Summer
Fraxinus ornus L.	Spring
Laurus nobilis L.	Spring
Olea europa L.	Spring
Phillyrea latifolia L.	Spring
Rosa canina L.	Spring-Summer
Ruscus aculeatus L.	Winter-Spring
Spartium junceum L.	Spring-Summer
Tamarix parviflora DC.	Spring-Summer
Tilia argentea Desf.ex.DC.	Spring-Summer
Vaccinium myrtillus L.	Spring-Summer
Vaccinium arctostaphylos L.	Spring-Summer

TABLE V
SPECIES OF ATTRACTIVE FLOWERING NATURAL PLANTS IN SUMMER

Species	Flowering Seson
Cistus laurifolius L.	Spring-Summer
Cistus salviiflorus L.	Summer
Cistus creticus L.	Spring-Summer
Chamaecytisus hirsutus L.	Spring-Summer
Chamaecytisus austriacus L.	Spring-Summer
Chamaecytisus pygmaeus L.	Spring-Summer
Cornus sanguinea L. subp. *sanguinea*	Spring-Summer
Daphne oleides L.	Spring-Summer
Daphne pontica L.	Spring-Summer
Erica arborea L.	Spring-Summer
Pyracantha coccinea Roem.	Summer
Rosa gallica L.	Summer
Rosa canina L.	Spring-Summer
Clematis viticella L.	Summer
Clematis cirrhosa L.	Summer
Rhus coriaria L.	Summer
Spartium junceum L.	Summer
Styrax officinalis L.	Summer
Tamarix parviflora DC.	Spring-Summer
Tilia argentea Desf.ex.DC.	Spring-Summer
Vaccinium myrtillus L.	Spring-Summer
Vaccinium uliginosum L.	Summer
Vaccinium arctostaphylos L.	Spring-Summer
Vitex agnus castuss L.	Summer-Autumn

TABLE VI
SPECIES OF ATTRACTIVE FLOWERING NATURAL PLANTS IN AUTUMN

Species	Flowering Season
Vitex agnus castuss L.	Summer-Autumn

TABLE VII
SPECIES OF ATTRACTIVE FLOWERING NATURAL PLANTS IN WINTER

Species	Flowering Season
Daphne sericea L.	Winter-Spring
Ruscus aculeatus L.	Winter-Spring
Viburnum tinus L.	Winter

V. CONCLUSION

Flower color in plants is more memorable than other features. Flower colors can directly influence the users of an area and the beneficiaries of this space. In this context, colors should be selected in accordance with the functions and forms in the areas in consideration of color effects [24]. Consideration should be given to the evaluation of the flowers and other organs, which are attractive features of the design plants, in such a way that the design will produce appropriate or opposite color harmonies throughout. Plants with brightly colored flowers should be in groups and be used only in certain areas.

In plant design, the effects of plants' color should also be considered. Yellow is a color bringing joy and liveliness, and it relaxes people. It inspires and makes people feel mentally alert. It carries a meaning that reflects the communal living and working together. Long time observation of yellow is said to positively affect the neural and circulatory systems. Yellow is the first color that is distinguished by human eye [8].

Red reminds the sun, flame, and blood. It creates boldness and determination in humans with its lively, strong and dynamic features. It is a color that excites. It represents struggle and liveliness. It creates tension in excessive use and longtime observation, and it accelerates the blood flow [25].

Green is the dominant color of nature and spring. It creates the feelings of inertia, peace, and trust. It emphasizes life, liveliness, and creativity [25]. It is the first element that emerges in the memories regarding the places and areas that were experienced in the past. It was determined to have a decreasing effect on digestion problems. It balances the strength and negative effects of the warm colors.

Purple is known as the symbol of delicacy, prestige, wealth, and self-confidence. It creates the will of thinking and creating in the observer, and it increases tolerance. When it is used dominantly it can create eagerness and in long time observation, it can reveal the fears in the subconscious. Light shades of it or its usage with yellow decrease these disadvantages [26].

Pink is known as the symbol of harmony, cuteness, calmness, joy, and love. It creates inertia, clearness, and peace in the observer [27]. Its balancing color is green. It has a positive effect on calming down. It can be used in the gardens of jailhouses and hospitals.

White is the symbol of cleanness, pureness, honesty, and continuity. It creates a favorable and positive effect. Since it distributes light, it should be preferred in the designs in the places where the temperature is high.

If the bright colors in the design are located in specific areas, individually, in multiple and different places, this can lead to confusion and irregular appearance [7]. Warm colors are often used in front yards and entrances. The bright and warm colors are exciting and can cause to move towards the landscape. Designs in red, yellow, white and pink add life and vitality while at the same time draw attention to the perception of the sensor.

Discovering examples of sustainable design, urban planting, the presence and composition of natural plants in the city have great prospects. As one of the natural elements of urban landscape, the design of urban plantation with natural plants with a sustainable approach in the context of plant species selection positively contributes to the decrease of environmental problems caused by today's cities. The selection of plant species to be used in urban areas containing many elements of urban identity, from natural species proved to be compatible with the city, enables the urban aesthetics and local identity of the city to be revealed more strongly through the plants [2]. In this context, 33 attractive flowered natural woody plant species determined within the scope of the study have great importance in the creation of sustainable designs for the city of Bursa. Spaces may have flowery plants throughout the year with right plant selection. The right selection in the planting design might be beneficial to protect the natural species and continuity of the city visuality. Also, protecting the natural species helps to contribute positively to the reduction of environmental problems.

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