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Research Article

The change of chlorophyll content in *Syringa vulgaris* L. depending on shadow and duration

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Abstract: Various morphological and physiological characteristics of plants undergo change at different light levels. Coloration in plants is provided by pigments. The most important pigment is chlorophyll. It absorbs luminous energy and converts it to chemical energy. In this way, it allows photosynthesis where oxygen and food stuffs needed for all other living beings to live are produced. Apart from that, chlorophyll is the pigment that gives green color to plants. Chlorophyll content in plants changes due to plant type, cultivation area conditions, time, and so on. This study aims at determining the change of chlorophyll content in *Syringa vulgaris*, which is frequently used in landscaping works, in different shade environments and times. To this end, 5 different study plots were established; and three of these study plots were covered with different ratios of shade (80%, 60%, and 40%). The other study plots were established outdoor and in a greenhouse. Throughout the research process, 7 measurements were carried out at certain intervals, and it was aimed to determine change in chlorophyll content depending on environment and time.
Keywords: *Syringa vulgaris* L., chlorophyll, shadow

INTRODUCTION

Plant materials have many characteristics that distinguish them from other design elements. Plant material is one of the most important physical elements of outdoor environmental design and landscape planning. Therefore, knowing the unique characteristics, ecologies, functional uses, architectural and space-descriptive roles, visual potentials, and aesthetic use features of plants to be used in landscape architecture is one of the most important conditions of success in outdoor design and planning works.

Plants play important aesthetic and functional roles in designing landscaping spaces. This is because; plant materials are used for creating very rich and diverse decorations, structures, and spaces with their moving, dynamic, moldable, decorative, aesthetic, economical, and functional characteristics [1]. Plant material is the principal component among the elements used in urban and rural landscape planning [2, 3]. However, some difficulties are confronted in evaluating the beauty of plants as they are dynamic, undergo seasonal changes, and are affected by environmental conditions. If we do not know plants well, are not aware of their wishes, and fail to clearly show the adverse impacts of environmental conditions on them, a planting design which seems to have no problem may fail to fulfill the aesthetic, functional, and ecological functions expected from them.

Green plants make a functional contribution to urban life besides their beautiful forms. These functions are mainly about photosynthesis. Green plants produce the food and oxygen needed by all living beings through photosynthesis. The photosynthesis of plants is possible only with the existence of chlorophyll, which is the source of the green color of plants.

There is an optimal light degree under which a specific plant species can grow up in the best way. As the optimal degree is achieved less, the functions of relevant plant slow down. Change in light degree may have different impacts on a plant. The functions completely come to an end when light reaches the maximum or the minimum degree[26].

Chlorophyll is the pigment that absorbs and converts luminous energy to chemical energy, thus allows photosynthesis where oxygen and food stuffs needed for other living beings to live are produced, and provides plants with green color [4].

Chlorophyll content in foliage may vary depending on plant species, folio shape[4, 5-7], magnesium, iron, humic acid, nitrogen, mercury, copper, cadmium, and lead in soil[8-11], drought stress, salt stress, air pollution, and so on[12-16].

It has been revealed that chlorophyll content in foliage depends on the amount of light [17-19, 4]. It is stated that there are few but big chloroplasts and high chlorophyll content in plants growing up under great light conditions[20]. However, it is reported that there is not enough chlorophyll in newly-formed foliage of plants, so these foliage are bright green; and that chlorophyll content increases as a folio grows mature, and therefore its color becomes darker [7]. Accordingly, chlorophyll content in plants varies depending on many factors (e.g. depending on time in vegetation period)[21].

The present study aims to determine the change of chlorophyll content in *Syringa vulgaris* L., which is frequently used in landscaping works, depending on the environmental conditions and time. *Syringa vulgaris* L. is a plant from Oleaceae family. *Syringa vulgaris* L., which loses foliage in winter, naturally grows up in the Balkan Peninsula and has a shrub form that can grow height up to 5 to 6 m. It is cultivated as an ornamental plant in almost all regions of Turkey because of its beautiful flowers[22].

Change in chlorophyll content was determined through measurements carried out on individuals cultivated in 5 different environments at 7 different times, and data were interpreted through statistical evaluations.

MATERIAL AND METHOD

The study was conducted in Gölköy forest nursery located in Kastamonu city of Turkey. The study plots were established in March 2012, and plants were cultivated. 5 different environments were prepared in establishing the study plots. These environments were planned to be as follows: shady by 80%, shady by % 60, shady by % 40, outdoor, and greenhouse. In early 2012, 5 Syringa vulgaris were put in each parcel, and routine works were performed on plants for 1 year. Measurements were started as plants leafed in May 2013. Measurements were carried out once every 15 days before the foliage started to turn yellow. A total of 7 measurements were performed. From each plant, 10 foliage were subjected to measurements.

Chlorophyll measurements were conducted via Apogee CCM-200 chlorophyll meter, and results were obtained in Chlorophyll Concentration Index (cci). The obtained data were evaluated through SPSS 17.0. The data were subjected to variance analysis. Duncan’s test was administered to those data which yielded significant differences at a confidence level of minimum 95%, and the results were interpreted.

RESULTS

Table 1 presents the results of variance analysis showing the weekly change in chlorophyll content.

The table 1 indicates that the chlorophyll content varied depending on time, and such variation was statistically significant at 99.9% confidence level on the basis of weeks. Duncan’s test was administered to see the weekly change in chlorophyll content. The results of this test are given in Table 2.

The table 2 shows that 6 homogenous groups were formed in terms of chlorophyll content on a weekly basis; chlorophyll content was lowest in the 7th and the 1st weeks; and it reached the highest level in the 4th and the 5th weeks by increasing as of the 1st week. Figure 1 illustrates the chart that presents the temporal change in chlorophyll content.

As is clear from the figure 1, chlorophyll content gradually increased in the course of time, reached the highest level in the 8th week when the 4th measurement was carried out, and then started to decrease. Table 3 contains the results of variance analysis made to determine the change in chlorophyll content depending on environment.

As it is seen in the table 3, the change of chlorophyll content depending on environment was statistically significant at 99.9% confidence level. Duncan’s test was administered to the data in order to see the change in chlorophyll depending on environment. The results are given in table 4.

The table 4 demonstrates that chlorophyll content did not vary in the area shady by 60%, in the area shady by 40%, and outdoors at a statistically significant level but increased in the areas shady by 80% and reached the highest level in the greenhouse environment.

Table 1. The variance analysis results concerning weekly change in chlorophyll content

	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	438587,970	6	73097,995	14,444	,000
Within Groups	3481732,260	688	5060,657		
Total	3920320,230	694			

Table 2. Duncan's test results about weekly change in chlorophyll content

Weeks	Groups					
	1	2	3	4	5	6
7	102,36					
1	110,44	110,44				
2		128,95	128,95			
3			138,32	138,32		
6				154,33	154,33	
5					162,33	162,33
4						179,29
Sig.	,442	,078	,372	,128	,446	,107

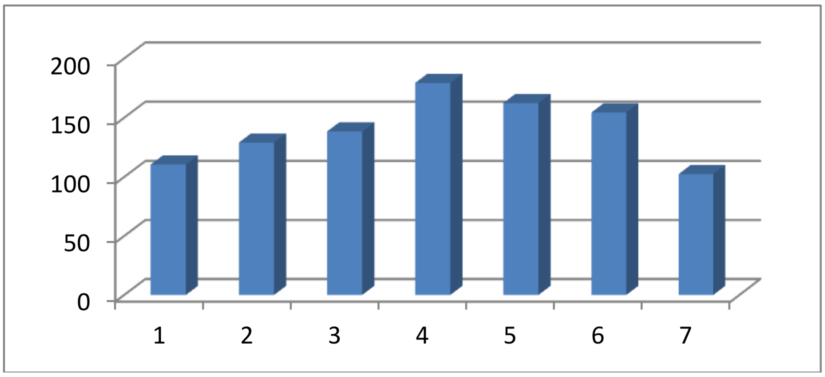

Fig-1: Temporal change in chlorophyll content

Table 3. The variance analysis results concerning change in chlorophyll content depending on environment

	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	193105,029	4	48276,257	8,937	,000
Within Groups	3727215,201	690	5401,761		
Total	3920320,230	694			

Table-4: Duncan's test results about change in chlorophyll content depending on environment

Shadow	Groups		
	1	2	3
60%	125,89		
40%	128,57		
Open Area	138,70	138,70	
80%		148,68	
greenhouse			171,35
Sig.	**,176**	**,262**	**1,000**

DISCUSSION

It is known that chlorophyll content in foliage undergoes change under the influence of many environmental factors, plant species and folio shape being the first place [4,5,6,7, 23]. It is reported that there is not enough chlorophyll in newly-formed foliage of plants, so these foliage are bright green; and that chlorophyll content increases as a folio grows mature, and therefore its color becomes darker [4]. That is consistent with the results of this study. As a matter of fact, it was seen in the present study that chlorophyll content increased in the course of time, and after a while it started to decrease.

Chlorophyll content in foliage depends on the amount of light [4,18, 17]. It is stated that there are few but big chloroplasts and high chlorophyll content in plants growing up under great light conditions[20]. The relationship between the amount of light and chlorophyll content in foliage was handled in some other studies, too [24, 17, 18, 19, 9] reports that foliage in shady environments and foliage getting light have different internal and external structures; tissues providing resistance develop well in the plants growing up under great light conditions; and chloroplasts are few but big, and chlorophyll content is high in these plants.

Foliage chlorophyll content determines the leaf absorptance, and thus the fraction of light absorbed for any given incident light availability[25]. Limit light intensity value varies by plant species (i.e. plants requiring light and plants requiring shade). Increase in photosynthesis in parallel with the rise in light intensity varies from plant species to plant species to a certain degree. For example, although *Pinus taeda* seedlings photosynthesize in parallel with the increase in light up to 100% light, many foliate species achieve the highest photosynthesis value when the amount of light is 30%[20].

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