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Variation of Chlorophyll Amount in Some Landscape Plants: a case study of Rize

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Abstract: Chlorophyll, the pigment that which gives green color to plants, and Provides for the realization of the photosynthesis phenomenon in which the oxygen and nutrients are necessary for the life of all creatures. Studies have shown that the amount of chlorophyll in plants varies according to many factors. Plant type and growing conditions are at the top of these factors. In this study, it was aimed to determine the variation of chlorophyll content in some plant species which are used extensively in landscape studies in Rize city center. Rize has the highest annual rainfall in Turkey and the average annual rainfall is over 1400 mm. Therefore, the study was carried out in Rize city center and measurements were made in 16 plant types used in landscape studies in city center as 5 repetitions. Study results were evaluated by Variance Analysis and Duncan Test, lowest and highest chlorophyll values and standard deviations of species were determined. According to the results of the variance analysis, there was a significant difference in 99,9% confidence level among the species, chlorophyll levels of the tested species were collected in 9 homogeneous groups according to Duncan test results. The lowest amount of chlorophyll was found in *Prunus*

cerasifera (17,40 cci) and the highest amount of chlorophyll was found in *Citrus reticulata* (129,04 cci).

Keywords: Landscape Plant, Chlorophyll, Rize

INTRODUCTION

Chlorophyll is one of the most important pigments that provide coloration in plants and allows photosynthesis to occur. As a result of photosynthesis, green plants synthesize organic compounds using chlorophyll and light energy. Thus, chlorophyll absorbs light energy and converts it into chemical energy[1,2] .Thus, chlorophyll provides the photosynthesis that oxygen and nutrients required for the life of all other living things are produced [2].

Green plants fulfill many functions during photosynthesis. They reduce air pollution in environments where they are exposed[3-11], decrease noise [12], affect psychologically positive [13], It reduces energy consumption[14,15] , is an important economic resource[2,10,11,16-21], prevents erosion [22], Reduce the speed of the wind, keeping the soil with its roots, it prevents transportation of the soil by river, protects wild life and hunting resources. The open green areas in which plants are found are important areas of activity for both adults and children [23-26].In addition to these, planting adds aesthetic value. Hence plants are indispensable elements of landscape studies. The plants used in landscaping work provide a combination of aesthetic, social, ecological and economic functions[5, 18, 20, 21, 27-32.]

Plants used in landscaping studies, color are very important in terms of aesthetics. Plants with green color in different shades as well as leaves in different colors are also important for aesthetic purposes. The amount of chlorophyll is that determines the green color tone of the plants[20, 31-33].In this study, the variation of the amount of chlorophyll in some landscape plants was examined on species basis. The study was carried out in Samsun city center, and the amount of chlorophyll was identified by measurements made on leaves of 28 different plant species. The data obtained in the study were evaluated by variance analysis and Duncan test and the results were interpreted in comparison with similar studies.

MATERIAL AND METHOD

In this study, it was aimed to determine the change of chlorophyll amount in some plants which are used extensively in landscape studies in Rize city center. Rize province is the highest rainfall area in Turkey and the meteorological data of Rize province are given[34] in **Table 1.**

In the study, plant species used in landscaping studies in Rize citycenter; *Buxussemipervirens, Yuccagloriosa, Mahonia aguifolium, Prunus ceracifera, Tilia platyphyllos, Cotonoaster horizantalis, Malus floribunda, Nerium oleander, Berberis thunbergii, Ulmus glabra, Populus alba, Ficus carica, Citrus reticulata, Punica granatum, Chamaerops excelsa, Ailantus altissima* Chlorophyll measurements were made leaves of these species.

Measurements are on each individual, in the middle of the leaves, in areas free of veins by 5 repetitions. Measurements were performed with Apogee CCM-200 brand chlorophyll meter and results were obtained in the Chlorophyll Concentration Index (cci) unit. In the same way, indoor plants [35] and in landscape plants[20] various studies have been conducted.

Table 1: Average Values in Rize between 1950 and 2015

	January	February	March	April	May	June	July	Aug.	Sept.	Octo.	Nov.	Dec.
Average temperature (°C)	6,6	6,6	8,0	11,7	16,0	20,3	22,9	23,1	20,0	15,9	11,7	8,4
Average Maximum Temperature (°C)	10,7	10,8	11,9	15,4	19,3	23,6	26,1	26,6	24,0	20,3	16,3	12,8
Average Minimum Temperature (°C)	3,6	3,5	4,9	8,4	12,6	16,6	19,6	19,9	16,8	12,9	8,7	5,4
Average in solation period (hour)	2,2	3,1	3,4	4,3	5,4	6,4	5,2	5,2	5,0	4,2	3,0	2,1
Average Number of Rainy Days	15,1	14,1	16,0	15,3	14,7	14,4	13,8	14,6	15,0	15,5	14,1	14,7
Monthly Total Rainfall Average (kg/m^2)	225,8	178,4	156, 5	91,9	97,4	136, 2	143, 9	189,4	249,7	291,1	250,7	234,3

At the end of the study, the minimum, maximum and average chlorophyll amount values were determined for each species and also standard deviations were calculated. The results are shown graphically and variance analysis and Duncan test were applied to the data, and the differences in chlorophyll content of the species were statistically calculated and the results were interpreted.

RESULTS

According to the measurement by types; the highest, lowest and average values and standard deviation values are given in Table 2.

When the table values are examined, it can be seen that the average values change between 17, 40 cci and 129, 04 cci, the lowest value is measured on *Prunus ceracifera* and the highest value is measured on *Citrus reticulata*. The average chlorophyll content of the species evaluated in the study was calculated as 47, 45 cci. The lowest values after *Prunus ceracifera* were also determined in *Berberis thunbergii* (17, 80 cci) and *Malus florib* (18, 64 cci). The highest values after *Citrus reticulata* were *Punica granatum* (94.86 cci) and *Cotonoaster horizantalis* (85.40 cci). According to these values; *Citrus reticulata* has chlorophyll content is around 7.4 times of chlorophyll content of *Prunus ceracifera.* A graph showing the average, minimum and maximum chlorophyll levels of the species prepared in order to better evaluate the data in **Table 1** is given in **Figure 1**.

Table 1: Chlorophyll Amounts of Species

	Minimum	Maximum	Average	Standard deviation
Buxus sempervirens	30,2	50,5	41,52	7,72
Yucca gloriosa	30,3	46,0	40,34	6,23
Mahonia aguifolium	64,3	87,5	74,88	9,87
Prunus ceracifera	14,7	19,3	**17,40**	1,92
Tilia platyphyllos	42,6	56,5	47,32	6,00
C. horizantalis	66,4	101,3	**85,40**	12,91
Malus floribunda	16,2	22,0	**18,64**	2,37
Nerium oleander	40,2	91,4	62,30	21,37
Berberis thunbergii	10,1	30,0	**17,80**	9,17
Ulmus glabra	14,5	24,4	20,70	4,04
Populus alba	20,8	46,1	31,66	10,64
Ficus carica	17,8	36,0	22,90	7,45
Citrus reticulata	105,9	163,0	**129,04**	23,29
Punica granatum	71,6	117,0	**94,86**	21,79
Chamaerops excelsa	28,0	31,7	30,00	1,41
Ailantus altissima	17,6	38,5	24,42	9,50
AVERAGE			47,45	

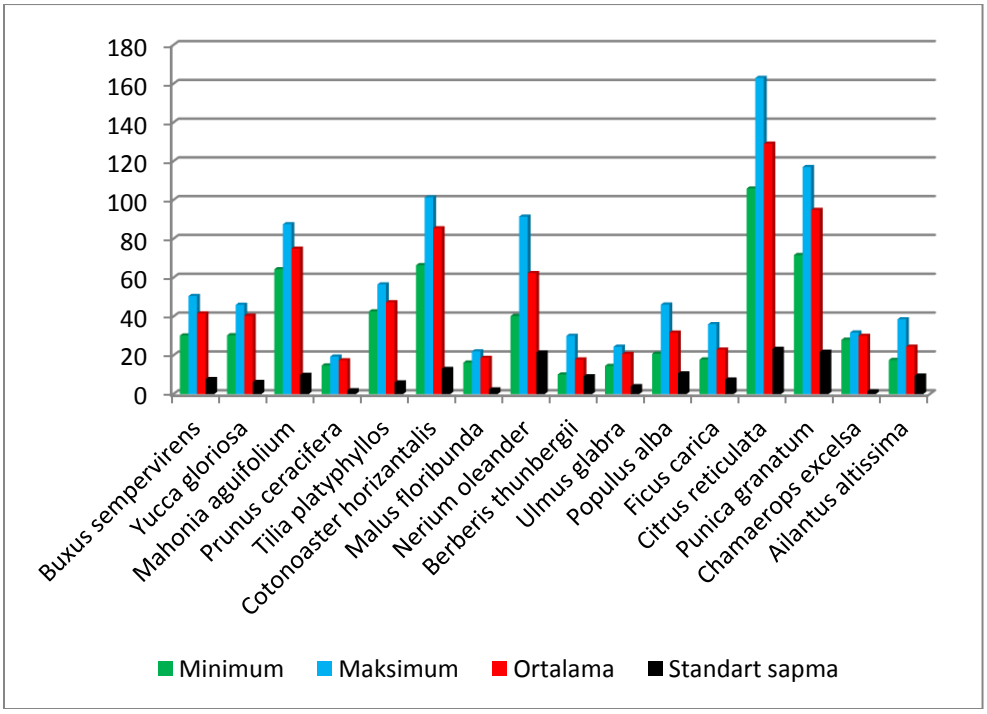

Figure 1: Amount of Chlorophyll in Species

Variance analysis was performed to determine whether there was a statistically significant difference in chlorophyll content between the species studied and the results are given in **Table 2**.

Table 2: Results of Variance Analysis

	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	82097,950	15	5473,197	38,622	,000
Within Groups	9069,600	64	141,713		
Total	91167,550	79			

As seen in **Table 2**, there is a statistically significant difference in the level of chlorophyll between species by 99.9% confidence level. The Duncan Test was applied to determine how the species are grouped in terms of chlorophyll content and the results are given in Table 3.

Table 3: Duncan Test results

Species	Groups								
Prunus ceracifera	17,4								
Berberis thunbergii	17,8								
Malus floribunda	18,6								
Ulmus glabra	20,7								
Ficus carica	22,9								
Ailantus altissima	24,4	24,4							
Chamaerops excelsa	30,0	30,0	30,0						
Populus alba	31,7	31,7	31,7	31,7					
Yucca gloriosa		40,3	40,3	40,3					
Buxus sempervirens			41,5	41,5					
Tilia platyphyllos				47,3	47,3				
Nerium oleander					62,3	62,3			
Mahonia aguifolium						74,9	74,9		
C. horizantalis							85,4	85,4	
Punica granatum								94,8	
Citrus reticulata									129,0

When the Duncan test results are examined, it is seen that the species were collected in 9 homogenous groups, *Prunus ceracifera*, *Berberis thunbergii*, *Malus floribunda*, *Ulmus glabra*, *Ficuscarica* only in the first homogeneous group. *Citrus reticulata* alone forms the last homogeneous group. The homogeneous group with the largest number of species is the first homogeneous group and there are 8 species in this group.

CONCLUSIONS AND RECOMMENDATIONS

The results of the study show that the amount of chlorophyll varies considerably between species. According to the results of the Variance Analysis, it was determined that there were significant differences in species between 99.9% confidence level and chlorophyll level of the studied species were collected in 9 homogenous groups according to Duncan Test results.

The average chlorophyll content of the species evaluated in the study was calculated as 47, 45 cci. The lowest values were determined on *Prunus ceracifera* (17, 40 cci), *Berberis thunbergii* (17, 80 cci) and *Malus floribunda* (18, 64 cci), while the highest values were determined on *Citrus reticulata* (129,04 cci) *Punica granatum* (94.86 cci) and *Cotonoaster horizantalis* (85.40 cci). As a result of the study, the highest value of *Citrus reticulata* had a chlorophyll content of about 7.4 times the chlorophyll content of the lowest value *Prunus ceracifera*.

When the studies related to the subject are examined, it can be said that about 7.4 times the difference between *Citrus reticulata* and *Prunus ceracifera* is normal. As a matter of fact, similar results have been obtained in studies carried out on different species[20]. In a study of indoor plants, the average amount of chlorophyll in *Begonia coccinea* was 11,86 cci and that of *Ficus elastic* was 145,12 cci and he noted that there were more than 10 times differences among these species. It is noted by several researchers that the amount of chlorophyll in the leaves is affected by a number of environmental factors, mainly environmental conditions [35-38]. Among these factors, growth conditions and especially the factors related to light come to the forefront. Similar results have been obtained in agriculture, and in the case of studies carried out on landscape plants [39-41].

Studies have shown that chlorophyll contents in plants change depending on edaphic factors as well as climatic factors. In these studies, it was determined that the amount of chlorophyll is related to materials such as magnesium, iron, humicacid, nitrogen, mercury, copper, cadmium and lead in the soil [42-46].

Chlorophyll content; Edaphic, and climatic factors, as well as the genetic makeup [47.]Therefore, the amount of chlorophyll varies between species as well as within species [48, 49]. Besides these, it is stated that leaf structure is one of the important factors determining the amount of chlorophyll. Tepe *et al*.[50], indicate that the amount of chlorophyll in polyploidy plants is higher than that of the diploids, and therefore the leaves of these plants are dark green.

It is also stated that the amount of chlorophyll in the plants also varies depending on the time during the vegetation period[35, 51]. These changes are the changes that plants show during normal life. Apart from these, the amount of chlorophyll in plants can vary depending on various factors. At the beginning of these factors are stress factors. Stress factors can cause important changes in the physiological, morphological and anatomical structures of plants. Stress factors such as drought stress, salt stress, frost stress, air pollution can affect the other characters and physiology of plants as well as chlorophyll content significantly[23-, 26,; 52-56].

As is known, the rapid change process in the world causes the destruction of nature, the pollution of air, water and soil, and the destruction of ecological balance [57, 58]. Plants from this process have also been significantly affected and many species have faced the danger of extinction. Therefore, studies on plant health and comfort have gained importance recently. Studies carried out up to this day show that the determination of the amount of chlorophyll that can be practically carried out in a short time can be used in many fields in practice [20]. Determination of plant water stress [59], determination of cold tolerance [60, 61], detection of ozone damage [62] these are some of the application areas. However, the amount of chlorophyll

varies depending on many factors as described above, and therefore it is necessary to increase the number of studies in this area, to continue the development and diversification and to make it separately for each region where the ecological conditions are changed in order that the change in chlorophyll content can be used effectively.

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