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EVALUATION OF LIGHT EFFECT ON QUANTITATIVE AND QUALITATIVE CHARACTERISTICS OF CASPIAN BOX TREE (*BUXUS SEMPERVIRENS*) IN RESERVE ZONE (DOROSTKAR FOREST), IRAN

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Abstract- *Boxus* is as commercial main species in Guilan province (Guilan/Iran) that unfortunately because of irregular exploitation have devastated. In this research for quantitative and qualitative study of the *Boxus Hyrcana* 30 micro plot with area of 100 square meter is selected, in each micro plot quantitative and qualitative evaluations as well as the status of *Buxus Hyrcana'* regeneration were considered.
With photometry test in stand response of some quantitative & qualitative characteristics of *Buxus hyrcana* in different photos condition is investigated. For these purpose different degrees of stem quality, stem forking, crown vitality of *Buxus* has recorded in statistics application sheet, too.
The results showed that stem quality and crown vitality of *Buxus Hyrcana* seedling has affected by different photos conditions as in low light intensity the frequency of first grade stem quality was better and also the frequency of stem forking in this species has not affected.
The results of this research demonstrated that, some of the quantitative & qualitative characteristics of *Buxus Hyrcana* trees are changed in different photos condition. In relation to vitality and quality of stem first - grade it seems that decrease in high light intensity condition, Quantitative results showed that the study area with 6720 *Buxus Hyrcana* seedling in each hectares, is classified as good class and on the other hand more than 75 % of seedling include as perfect quality.
Key words: natural regeneration, crown vitality, stems quality, IRAN

Introduction

Iran is located in the North Temperate Zone between 25° to 40° latitude and 44° to 63° longitude, with a total area of approximately 1,650,000 km^2. The total forest area of Iran was estimated to be approximately 18 M ha about three decades [5]. Unfortunately, significant proportions of those forests have been destroyed [1]. The main native species of trees in Iranian forests are beech (*Fagus orientalis lipsky*), Hornbeam (Carpinus betulus), and oak (*Quercus castanefolia).* These species make up 32.7, 31 and 8.4% of the total volume and 27.7% other [14].

Fig1.Position of Guilan province in Iran

Buxus sempervirens L. (Buxaceae) is widely distributed in Eurasia, and North America.*Buxus Hyrcana pojark* (1954) is a geographic strain of *Buxus sempervirens*. It is an intolerant species that is a part of Euxino hyrcana elements and is allocated to sea weather. It accounts as one of destroying species which the danger of its annihilation is very likely [2]. Its best habitat is in the north of Iran at -20 to 400 meters height from the sea level but it also could be found up to 1200m height [12,15].

Fig2. The leaves of *Buxus sempervirens L.*

Materials and methods

Study site

The study area was located in a reserve zone (Dr. Dorostkar forest park) in Guilan province (north of Iran) with 203 hectares area which is in 42 kilometer of Anzali port main road to Astara in Tallish region. The old trees are present in higher stair of this protected forest which box trees live under their canopy. It seems that in this habitat in last two to three decades, some natural factors (wind, snow, storm, thunder) or man factors cause the elimination of higher floor and in some parts have deprived Box tree from this protection; in a way that apparently there is the possibility that some qualitative and quantitative characteristics of Box trees have changed. The goal of this article is to review the Buxus sempervirens Reserve zone and the effects of light intensity on some quantitative and qualitative traits of Box trees and their seedlings

Sampling method

30 sample plots with 1000m^2 areas were taken for conducting the experiment. In the center of each sample plot a 100 m^2 micro plot was considered. These plots were randomly selected from the suitable points in the forest with at least 500 m distance from pinking center of the park. In the sample plots the quantitative and qualitative characters of present trees and in the micro plots quantities and qualitative traits of box tree regeneration were analyzed.

Quality ranking of box tree seedlings is as below [17]:

Trunk Quality

Quality ranking of seedlings was made by using below division [4]:

Number 1- healthy trunk, without nod, rusting, intricacy, slight bending

Number 2- Trunk with nod not to be and in small numbers, case rusting, intricacy and acceptable bending.

Number 3- Trunk with many nods and rusting, intricacy and intense bending.

Branching Form

Since double branching is condition of genetic origin and/or is caused by the elimination of ending bud by some external factors.

Therefore in this experiment the conditions of the trunk of box tree seedlings are divided to two forms of double branch and single branch.

Canopy Freshness

With respect to the fact that box tree is an evergreen species, the index of box tree leaves was used for freshness evaluation utilizing the color, size and amount of leaves which 3 different conditions were considered for the stocks freshness:

Number 1 (Good): the number and the size of leaves in the end of branches are normal and their color is dark green.

Number 2 (medium): the number of leaves has decreased in the end of branches, their size is medium and their color is light green.

Number 3 (weak): the number of leaves in the end of branches has considerably decreased, their size is small and their color is yellowish green.

Canopy Symmetry

Another quality trait of the tree is canopy symmetry which demonstrates the situation of the tree in the mass, suitability of the distance and consequently the growth of the canopy. The more the distance of the trees is suitable the more tree canopy becomes symmetric and thus the wood quality increases. Because symmetry causes the balanced growth of the canopy in all the directions, so the diametric growth of the tree becomes better and it prevents out centering the wood which is one of its imperfections.

Symmetric canopy: less than 2.3 the canopy development is slanted to one of the sides.

Asymmetric canopy: more than 2.3 canopy development is slanted to one of the sides.

Fig3. The Quality of regeneration

Photometry

Photometry in the mass was conducted by a photometer which easily represents the light intensity with lux unit. The data taken in park region were in -011 lux light spectrum and 001 lux in the center of each plot which in the regions with high density trends to 001 and in the open parts it has been observed up to 017 or in the completely open parts it had reached 056.

To facilitate the analysis, light with 001-011lux was divided to 4 light ranks as below [14]:

001-003 lux	low intensity light
004-007 lux	medium intensity light
008-011 lux	high intensity light
More than 011 lux	very high intensity light

Fig4. The portable Photometry instrument

This forest is characterized by a very wet climate [6], there is heavy precipitation throughout the year and mists are frequent particularly in the spring and summer. The winters are cool and humid with annual precipitation 1557 mm. Most the rainfall is received during August to May. June and July (34.6 °C) are the hottest months whereas January and February (6.4°C) is the coldest (Taheri-Abkenar 2005).

The quality and quantity characteristics of regeneration were compared. When data followed a normal distribution and group variances did not differ, chi-square test used. SPSS 15 was used as analytical software**.**

Results

The light effect on the trunk quality of box tree seedlings

The abundance of different degrees of trunk quality in different light intensities for measured box tree stocks are outlined in table 1. Utilizing Chi square test showed that the value of Chi square in the table with freedom degree of 6 in 5% levels was 12.59 which was less than calculated chi square. Therefore, the correlation between these two variables is significant and independence hypothesis between the light and trunk quality is rejected.

In fact, the above data demonstrates that different light conditions are effective on trunk quality. Also with the mentioned test, it was determined that number 1 trunk quality is different in various light intensities; in a way that the maximum abundance of number 1 quality was observed in least light intensity.

Branching form

Table 2 outlines the abundance of observed double branching box trees in different light intensities. Considering that the value of calculated chi square with 5.033 was less than chi square of table with 7.89 at freedom degree of 3 in 5% levels, the correlation between two criteria is insignificant.

This shows the independence of different light conditions and double branching of box tree stocks. The results of the test analysis also demonstrated that the differences in abundance of double branching box trees in different light intensities are not considerable. This means that light does not affect double branching occurrence and resulted double branching either have genetic origin or are the result of ending bud elimination by external factors [3].

Fig5. The branching form

Canopy freshness

Table 3 shows the observed abundance of different degrees of canopy freshness in box tree seedlings in different light conditions using chi square test which the chi square value of the table with freedom degree of 6 in 5% level with 12.59 was less than calculated value, 57.22. Hence, the correlation of two variables is significant. This demonstrates a strong correlation between different light conditions and canopy freshness of box tree seedlings. Also analyses that have used K^2 showed that the maximum freshness of number 1 is obtained by the least light intensity.

Light effect on symmetry of box tree canopy:

Table 4 outlines the observed abundance of symmetry in box tree canopy in different light conditions. Chi- square test determined that the chi- square of table with freedom degree of 3 in 5% levels was 7.18 which this was more than calculated chi- square, 2.63. This insignificant correlation between these two variables shows that different light conditions and symmetry of canopy are strongly independent. Thus, at this habitat, light does not affect the symmetry of box tree canopy.

Light effect on height distribution of seedlings

Table 5 shows observed abundance of height distribution of box tree seedlings in different light conditions. The value of chi- square in the table with freedom degree of 3 at 5% level with 7.815 was less than calculated chi-square, 22.373. Therefore the correlation of two variables is significant. In fact this shows a strong dependency between different light conditions and the distribution of seedlings in determined heights.

Light effect on the number of seedlings on three different diameter floors

The observed abundance of box tree seedlings on three 0-7, 8-15 and 16-22 cm diameter floors that have been measured under different light conditions are shown in table 6. The value of chi- square test in the table with freedom degree of 6 at 5% level with 12.59 was more than calculated chi- square test with 7.406. The hypothesis of independency of seedlings number from the light intensity is acceptable. The above findings demonstrate that in different light conditions do not affect the seedlings number in different diameter floors [8].

Discussion

This study investigated the light effect on some qualitative traits of box tree seedlings. The analysis and statistical tests that have been utilized show a significant difference between different degrees of trunk quality in box tree seedlings (diameter less than 7 cm) in different light conditions. This means that the hypothesis of correlation between these two factors (light and trunk quality) is acceptable and different light conditions affect the trunk quality of seedlings. Also the chi square test determined that number 1 trunk quality varies in different light intensities. The maximum abundance of number 1 trunk quality is observed in the least light intensity and this is due the support of seedling by nearby trees [7].

Yammamato (2002) showed that trunk quality of Beech (*Fagus sp.*) Seedlings decreases by the increase of

direct light intensity [17]. Analysis of light effect on the branching of box tree seedlings confirms that there is not a strong correlation between various lights conditions and the number of double branching. Double branching happens in different heights of trunk which it could be due to the natural or human factors. The results of chi square test demonstrate that the difference of double branching abundance in box tree under different light conditions is insignificant. Kian (2003) in the forest of Sisangan Park determined that the elimination of upper floor increases double branching which this is also confirmed from forestry point of view but in the habitat of Kish khale, light does not affect double branching and double branching that have been less than 25% are either with genetically origin or are caused due to the elimination of end bud by external factors in trunk [11].

It was also shown that due to the effect of light on the freshness of box tree seedlings, there is a strong correlation between different light conditions and freshness of box tree seedlings [9]. The analysis of K^2 demonstrated that most frequency of number 1 freshness was observed in the least light intensity. It means that different light intensities cause difference in stocks freshness.

Fig6. The canopy and 2 stair structure in *Querco-Boxetum* association.

Kian (2003) showed that there is a significant correlation between the elimination of box tree upper floor and freshness of seedlings [11]. Yammamato (2002) concluded that the quality of Vitality of sciaphytes seedlings like *Fagus orientalis* and *Fagus sylvatica* decrease with the increase of light intensity. In fact, Beech seedlings face the dryness stress with the increase of direct light and the quality of their freshness declines [10].

The studies on the effect of light intensity on symmetry of box tree canopy explain that there is no correlation between the symmetry of box tree canopy and different light conditions. This means that light factor did not affect the symmetry or asymmetry of the trees. The reason for this could be due to the unequal distances between the stocks in a way that the conditions have favored the growth of the canopy in the present spaces. The main point that must be considered is that about 70% of the stocks having asymmetric canopy in different light conditions which this could affect the wood quality in the stocks.

Kian (2003) supported the hypothesis of independency of symmetry or asymmetry in box trees from the increase of the gap canopy area [11, 13].

The light effect on the distribution of the number of box tree seedlings in three different diameter floors was also tested for independency test [18]. Using chi-square test, it was determined that the independency hypothesis between light and the distribution of the number of seedlings in different diameter floors is accepted. Thus, it could be claimed that different light conditions do not affect the distribution of the number of seedlings in different diameter floors. In contrast, another test on the effect of light on distribution of the number of seedlings in two height floors with 0-50 and 50-1/30 cm height showed that there are considerable correlations between two variables. Actually, this demonstrates a strong correlation between different light conditions and the distribution of the number of seedlings in determined heights. This means that light has significant correlation with the seedling distribution in two height floors.

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Table 1- The different degrees of trunk quality in correlation with light conditions.

The different degrees of trunk quality			Light condition
No3.	No.2	No.1	
0	0	216	Low
1	0	83	Medium
0	2	37	High
0	0	16	very much
1	2	353	Total

Table 2- The abundance of observed double branching box trees in different light intensities

The abundance of observed double branching		Light condition
double branch	single branch	
22	194	Low
8	76	Medium
2	37	High
4	12	very much
36	319	Total

Table 3- The observed abundance of different degrees of canopy freshness in box tree \ seedlings in different light conditions

The observed abundance of different degrees of canopy freshness			Light condition
No3.	No.2	No.1	
0	19	197	Low
1	0	83	Medium
0	0	39	High
4	6	6	very much
5	25	325	Total

Table 4- The observed abundance of symmetry in box tree canopy in different light conditions

The observed abundance of symmetry in box tree canopy			Light condition
Total	unsymmetrical	symmetry	
20	9	11	Low
38	15	23	Medium
35	10	25	High
30	14	16	very much
123	48	75	Total

Table 5- The observed abundance of height distribution of box tree seedlings in different light conditions

The observed abundance of height distribution of box tree seedlings			Light condition
Total	Seedlings 50-130 cm	Seedlings 0-50 cm	
206	32	174	Low
75	28	47	Medium
40	16	24	High
16	6	10	very much
337	82	255	Total

Table 6-The Light effect on the number of seedlings on three different diameters

Diameter class			Light condition
16-22cm	7-15cm	0-7 cm	
3	7	216	Low
4	2	55	Medium
2	1	40	High
0	1	16	very much
9	11	327	Total