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**INFLUENCE OF SOME ENVIRONMENTAL FACTORS ON THE PHANEROPHYTES IN *EX SITU* CONDITIONS**

***©Novruzov V.,*** *Ph.D., Institute of Dendrology of ANAS, Baku, Azerbaijan*
***©Iskender E.,*** *Dr. habil., Central Botanical Garden of ANAS, Baku, Azerbaijan*
***©Veliyeva L.,*** *Central Botanical Garden of ANAS, Baku, Azerbaijan*
***©Abbasov R.,*** *Central Botanical Garden of ANAS, Baku, Azerbaijan*
***©Rustamova F.,*** *Institute of Dendrology of ANAS, Baku, Azerbaijan*

**ВЛИЯНИЕ НЕКОТОРЫХ ЭКОЛОГИЧЕСКИХ ФАКТОРОВ НА ФАНЕРОФИТЫ В УСЛОВИЯХ *EX SITU***

***©Новрузов В. М.,*** *канд. биол. наук, Институт дендрологии НАНА, г. Баку, Азербайджан*
***©Искендер Э. О.,*** *д-р биол. наук, Центральный ботанический сад НАН Азербайджана, г. Баку, Азербайджан*
***©Велиева Л. С.,*** *Центральный ботанический сад НАН Азербайджана, г. Баку, Азербайджан*
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***©Рустамова Ф. Н.,*** *Институт дендрологии НАНА, г. Баку, Азербайджан*

*Abstract.* The article studied and analyzed the effects of wind, light and temperature on the phanerophytes used in landscaping the Absheron Peninsula (Azerbaijan). When studying the interaction of light with the studied plants, it was found that 311 species are heliophytes, and 51 are sciophytes. The study showed that 298 species unstable to wind and 64 wind resistant. In terms of heat resistance, the studied plants were divided into 3 groups: resistant to high (54–56 °C), moderate (52 °C) and low (48–50°C) temperature. The results of the study showed that these environmental factors are crucial and make a number of changes in the dynamics of plant development.

*Аннотация.* В статье изучено и проанализировано влияния ветра, света и температуры на фанерофиты, применяемые в озеленение Апшеронского полуострова (Азербайджан). При исследовании взаимодействия света с исследуемыми растениями было установлено, что 311 видов являются гелиофитами, а 51 — сциофитами. Исследование показало, что 298 видов были неустойчивыми к ветру а 64 — ветроустойчивыми. По жароустойчивости исследуемые растения были разделены на 3 группы: устойчивые к высокой (54–56 °C), умеренной (52 °C) и низкой (48–50 °C) температуре. Результаты исследования показали, что эти экологические факторы играют решающее значение и вносят ряд изменений в динамике развития растений.

*Keywords:* phanerophyte, environmental factors, light, temperature, morphology, ex situ.

*Ключевые слова*: фанерофит, факторы окружающей среды, свет, температура, морфология, ex situ.

## *Introduction*

Plants are exposed to a number of environmental factors that have different characteristics in the range they spread. These environmental factors affect the plants directly or indirectly. These factors affecting plants sometimes reduce the number of individual species, negatively affect to their reproduction and other developmental characteristics [1–2]. These factors affecting to the growth and development of plants are divided into two group of living and lifeless factors. In the research work has been reflected light, wind, heat as the affects of environmental factors to studied plants.

*Material and methods*

The study material was composed of 362 species of trees and shrubs used in the Absheron greenery. Research experiments were conducted in *ex situ* conditions.

During the research work there were used methods of K. A. Ahmatov [3], N. A. Basilevskaya [4], I. N. Beideman [5], P. A. Henkel [6], M. R. Kurbanov [7], A. A. Molchanov, V. V. Smirnov [8], G. P. Semyonova [9] and G. N. Zaitsev [10].

*Results and their discussions*

Light is one of the environmental factors that play an important role in the growth and development of plants. Light that affects plants is the visible part of the sun rays and it consits of 50% of it. The source of night light is the light from the moon and stars. The moonlight wave length is larger. The light spectrum from the stars depends on the color temperature and the same as the moonlight spectrum. Infrared radiation for the plants is not of great importance in terms of chemistry, it has an ecological heat transfer effect [11]. Specially, the light plays an important role in the growth of the plant body and the seed germination process [12–13]. In general, ultraviolet light rays play an important role in the physiological processes in some seedless plants. It plays an important role in the production of Anthocyanin pigment in high plants, in the production of phototrophic processes and with the effects of growth hormones plays an important role in stopping the body's growth [14–15].

Visible beams are important in the process of photosynthesis. Light is important in the formation of plant cover. As you know the leaves accept about 10% of the falling light. Light passing through the green parts of the plant without using a large parts of light moves away and depending on the plant cover it can change its properties. For example, in coniferous forests the properties of the light doesn’t changed, but during vegetation period in deciduous forests the percentage of red rays in the falling light is high, and the percentage of violet and blue rays is low. However there are not a large difference between the above-mentioned plant species in the lower part of tier. They differ according to light effect from each others by the height differences between distinct in mixed plant groups. While the upper part of the tall trees are absorbing more light however the low height trees are absorbing less. The sunlight is absorbed 1% by the leaves on the crown that falls into the dense forest and as a result the development of autotrophic plants under these trees are weaken.

One of the studied plants *Tilia caucasica* Rupr., *Quercus castaneifolia* C. A. Mey., *Platanus orientalis* L., *Zelkova carpinifolia* (Pall.) C. Koch and others. as well as growing in dry areas *Celtis caucasica* Willd., *Celtis australis* L., *Pyracantha coccinea* Roem., are one of the most light-receiving plants. As the results of the observations showed that, when these plants are planted in shady places, in cause of the lack of light most of them do not develop normally. If the light absorbed by the plant cover reaches 20%, it is ecologically important. Thus, the reduction of light can change soil moisture, temperature, and wind. Therefore, one-sided assessment of the effect of the light factor on the plants is incorrect. The light we see under the vegetation is called the shade of the vegetation and it consists of two parts. One of them is the light without being absorbed passing

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through the vegetation cover and the other one is being absorbed passing through the vegetation cover.

In a research work carried out by Goodfellow and J. P. Barkham in *Fagus sylvatica* L. forest as the crown of the plants is going thinner and growing, it is becoming the rise of the blue light waves in the light spectrum inside the forest and the decline in the blue light waves in the light spectrum was observed in cloudy days [16]. While in places where exists dense vegetation cover the spectral changes appear in the form of infrared rays. This process becomes more higher in deciduous forests as compared with coniferous forests and varies according to the season of vegetation. Light as we know affects the life of plants in different ways and it balances it. The most important part of the light in plants is photosynthesis.

As it is known plants according to light are divided into 2 groups (heliophytes, sciophytes). Heliophytes and sciophytes are also divided into 2 groups (facultative, obligatory). As a result of research work it was revealed that, from studied plants 311 species are heliophytes and 51 species are sciophytes (Figure 1). Limiting reasons of plants under different light conditions are variable. The results of the observations showed that, with the growth of light-loving plants in the shade obtains signs of adaptation with the suitable for shady-loving plant characteristics that are necessarily compliant. For example, some species of plants as (*Buxus hyrcana* Pojark. etc.) can grow in sunny or shady places.

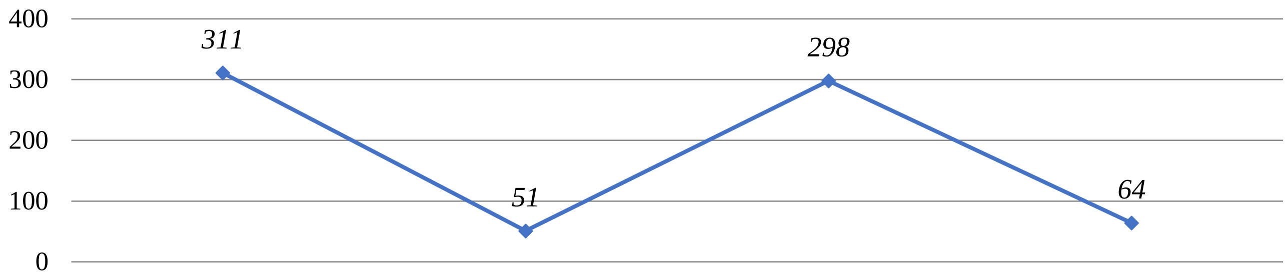


Figure 1. Light and wind attitude of the studied plants.

In all light-loving plants against light have been occurred less or more adaptations. They can resist the high light intensity. Shade-loving plants because they have low light potentials, they suffer from high light intensity. Because there are no adaptations to using high light intensity in them. In light-loving and shade-loving species light regulates its location and leaf arrangements in their plant grouping and provides stratification of species in moist conditions. In general, severe light in natural conditions is the most important factor in optimal intake of plants in tropical and subtropical regions. Therefore, the bottom leaves of a shade tree are of particular importance in the synthesis process [11, 17]. The observations have shown that in the studied plants some types of morphological changes have been observed in light-loving species. So that, the body of these plants are thick and tall, very branchy, the leaves are small and simple, veins are exceptionally hairy. In this type of plant species, flowering and fruiting are high, they have late leaves and they bloom quickly. These plants are resistant to heat and drought. Among the studied plant species the above mentioned features *Pinus* L., *Crataegus* L. genus species, *Celtis caucasica* Willd., *Acer velutinum* Boiss., *A.ibericum,* M. Bieb. *Juniperus foetidissima* Willd., *Pistacia mutica* Fich.et Mey., *Pyrus salicifolia* Pall., *Quercus iberica* Stev., *Rhus coriaria* L., et al. can be shown. As we know fall of leaf , flowering, sprouting, leaf splitting, pigment formation and so on. processes in plants are affected by the difference between the lengths of the night and day [11]. Plants are divided into short and long day plants due to the time of the falling light. Spread in different geographical areas

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plants have ecologically adapted to the light of their place of habitation throughout its development. As a result of the research studied plants are divided into two light-loving and shade-loving plants (Figure 1).

It occurs weakening in the development of these plants, including decline in flowering percentages, the increase in the number of side branches and thinning of leaves as a result of the observations carried out on the species growing in shady places *Acer campestre* L.*, Acer platanoides* L.*, Acer tataricum* L.*, Buxus hyrcana* Pojark.*, Camellia japonica* L.*, Corylus colurna* L.*, Danae racemosa* (L.) Moench.*, Albizia julibrissin* Durazz.*, Diospyros lotus* L.. Researchers have found that wind-resistance of plants need to be studied in these conditions because the research area almost windy in all seasons of the year. For this reason, it was determined that 64 species of wind-resistant taxons found in the study of the attitude of the studied plants to the wind. In the remaining 298 species affecting by the wind were observed deformation and damages in morphological organs.

One of the factors affecting plants is heat. Temperature (heat) — light energy is converted to heat after the fall of sunlight from the sun to the ground. These rays as backward waves after fallen appear in the form of heat. Therefore, the closest parts to the ground are warm and the upper layers are cooler. Physical and geographical conditions of the peninsula and the Caspian Sea, the Greater Caucasus Range play a key role in the formation of the climate of Absheron peninsula. The climate of the peninsula is subtropical as a result of the interaction of atmosphere processes with physical and geographical conditions. Summer in Absheron is dry and hot especially in its southern parts. High temperature of summer season often due to the strong northern winds are slightly moderated.

Mainly important for plants is the heat in their places of growing. One of the factors causing the change in the temperature is the structure and color of the soil. Light colored naked soils rays are reverted in a very strong way, but dark-colored soils are rich in vegetation, they are absorbing more sun rays, there are more heat in such soils.

In carried out one experiment has been studied daily heat-exchange. Purpose of the study was to learn affects of the temperature on plants due to the sharp increase in temperature fluctuations in recent months. The research were carried out in July on 56 woody plant species used in greening (Table).

The highest temperature is observed at the closest distance to the soil at 13–14 o'clock as the results of the experiments have shown by all studied the plants.

Table.

HEAT FLUCTUATIONS IN SOME WOODEN PLANT SPECIES USED
IN GREENING OF ABSHERON (July 2017)

| *№* | *Species* | *Altitude from the surface of the soil (trunk)* | | |
|---|---|---|---|---|
| | | *Temperature °C* | | |
| | | *0* | *Average* | *Crown* |
| 1. | *Albizia julibrissin* Durazz. | 31.0±1.5 | 27.0±1.3 | 24.0±1.2 |
| 2. | *Acer platanoides* L. | 30.0±1.5 | 26.0±1.3 | 24.0±1.2 |
| 3. | *Buxus hyrcana* Pojark. | 26.0±1.3 | 23.0±1.1 | 22.0±1.1 |
| 4. | *Buxus colchica* Pojark. | 27.0±1.3 | 24.0±1.1 | 23.0±1.1 |
| 5. | *Buxus microphylla* Sieb. | 28.0±1.3 | 24.0±1.1 | 23.0±1.1 |
| 6. | *Celtis caucasica* Willd. | 32.0±1.6 | 26.0±1.3 | 24.0±1.2 |
| 7. | *Celtis australis* L. | 31.0±1.5 | 26.0±1.3 | 24.0±1.2 |
| 8. | *Colutea cilicica* Boiss. et Bal. | 31.0±1.5 | 26.0±1.3 | 24.0±1.2 |
| 9. | *Colutea orientalis* Mill. | 30.0±1.5 | 27.0±1.3 | 25.0±1.2 |
| 10. | *Colutea arborescens* L. | 30.0±1.5 | 27.0±1.3 | 25.0±1.2 |

| № | Species | Altitude from the surface of the soil (trunk) | | |
|---|---|---|---|---|
| | | Temperature °C | | |
| | | 0 | Average | Crown |
| 11. | *Cotoneaster lucidus* Schltdl. | 26.0±1.3 | 25.0±1.2 | 24.0±1.2 |
| 12. | *Cotoneaster horizontalis* Decne. | 26.0±1.3 | 25.0±1.2 | 24.0±1.1 |
| 13. | *Cotoneaster serotinus* Hutch. | 25.0±1.2 | 24.0±1.2 | 23.0±1.1 |
| 14. | *Cotoneaster melanocarpus* Load. | 26.0±1.3 | 25.0±1.2 | 24.0±1.1 |
| 15. | *Diospyros lotus* L. | 29.0±1.4 | 27.0±1.3 | 25.0±1.2 |
| 16. | *Diospyros kaki* L. | 28.0±1.4 | 26.0±1.3 | 26.0±1.3 |
| 17. | *Euonymus japonicus* Tunb. | 30.0±1.5 | 27.0±1.3 | 25.0±1.2 |
| 18. | *Euonymus europaea* L. | 31.0±1.5 | 30.0±1.5 | 26.0±1.3 |
| 19. | *Euonymus latifolia* (L.) Mill. | 31.0±1.5 | 30.0±1.5 | 26.0±1.3 |
| 20. | *Ficus hyrcana* A. Grossh. | 30.0±1.5 | 27.0±1.3 | 25.0±1.2 |
| 21. | *Gleditsia triacanthos* L. | 30.0±1.5 | 27.0±1.3 | 24.0±1.2 |
| 22. | *Ilex aquifolium* L. | 26.0±1.3 | 23.0±1.1 | 22.0±1.1 |
| 23. | *Laurus nobilis* L. | 27.0±1.3 | 22.0±1.1 | 21.0±1.1 |
| 24. | *Ligustrum japonicum* Thunb. | 26.0±1.3 | 22.0±1.1 | 21.0±1.1 |
| 25. | *Ligustrum ibota* Sieb. | 27.0±1.3 | 22.0±1.1 | 21.0±1.1 |
| 26. | *Ligustrum lucidum* Ait. | 26.0±1.3 | 23.0±1.1 | 22.0±1.1 |
| 27. | *Ligustrum vulgare* L. | 32.0±1.6 | 29.0±1.4 | 27.0±1.3 |
| 28. | *Padus mahaleb* Borkh. | 31.0±1.6 | 28.0±1.4 | 26.0±1.3 |
| 29. | *Parrotia persica* (DC.) C.A. Mey. | 27.0±1.3 | 26.0±1.3 | 24.0±1.2 |
| 30. | *Paulownia tomentosa* Stendel. | 30.0±1.5 | 23.0±1.2 | 21.0±1.1 |
| 31. | *Platanus orientalis* L. | 31.0±1.5 | 24.0±1.2 | 22.0±1.1 |
| 32. | *Platanus occidentalis* L. | 31.0±1.5 | 23.0±1.2 | 22.0±1.1 |
| 33. | *Persica vulgaris* Mill. | 33.0±1.6 | 27.0±1.3 | 24.0±1.2 |
| 34. | *Pistacia mutica* Fich et Mey. | 32.0±1.6 | 29.0±1.4 | 26.0±1.3 |
| 35. | *Pistacia vera* L. | 31.0±1.6 | 28.0±1.4 | 25.0±1.2 |
| 36. | *Populus hyrcana* Grossh. | 31.0±1.5 | 28.0±1.4 | 25.0±1.2 |
| 37. | *Populus euphratica* Olivier. | 32.0±1.5 | 29.0±1.4 | 26.0±1.2 |
| 38. | *Populus hybrida* M.B. | 30.0±1.5 | 27.0±1.3 | 24.0±1.2 |
| 39. | *Pyracantha coccinea* Roem. | 31.0±1.5 | 26.0±1.3 | 23.0±1.1 |
| 40. | *Pyracantha angustifolia* Franch. | 32.0±1.5 | 27.0±1.3 | 23.0±1.1 |
| 41. | *Pyrus caucasica* Fed. | 32.0±1.6 | 26.0±1.3 | 24.0±1.2 |
| 42. | *Pyrus communis* L. | 32.0±1.6 | 27.0±1.3 | 25.0±1.2 |
| 43. | *Pyrus salicifolia* Pall. | 33.0±1.6 | 29.0±1.4 | 27.0±1.3 |
| 44. | *Quercus iberica* Stev. | 30.0±1.5 | 27.0±1.3 | 24.0±1.2 |
| 45. | *Quercus ilex* L. | 30.0±1.5 | 28.0±1.4 | 25.0±1.2 |
| 46. | *Quercus macranthera* Fisch. M. | 30.0±1.5 | 27.0±1.3 | 24.0±1.2 |
| 47. | *Quercus castaneifolia* C. A. Mey. | 31.0±1.5 | 28.0±1.4 | 25.0±1.2 |
| 48. | *Robinia pseudoacacia* L. | 32.0±1.6 | 28.0±1.4 | 25.0±1.2 |
| 49. | *Robinia hispida* L. | 32.0±1.6 | 27.0±1.4 | 26.0±1.3 |
| 50. | *Rosa canina* L. | 33.0±1.6 | 28.0±1.4 | 26.0±1.3 |
| 51. | *Rosa damascena* Mill. | 33.0±1.6 | 29.0±1.4 | 26.0±1.3 |
| 52. | *Salix caucasica* Anderss. | 32.0±1.6 | 27.0±1.4 | 26.0±1.3 |
| 53. | *Salix babylonica* L. | 32.0±1.6 | 26.0±1.3 | 25.0±1.2 |
| 54. | *Tilia caucasica* Rupr. | 32.0±1.5 | 29.0±1.4 | 26.0±1.2 |
| 55. | *Ulmus minor* Mill. | 31.0±1.5 | 28.0±1.4 | 25.0±1.2 |
| 56. | *Zelkova carpinifolia* (Pall.) K. Koch. | 32.0±1.6 | 28.0±1.4 | 26.0±1.3 |

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It was observed decline in temperature on backwards away from the soil surface. It was found that, the the temperature depending on the species were between 25–33 °C on nearest area to the soil surface during the recorded temperature (Table).

Our observations have shown that, depending on the species the height from the soil surface to the crown parts of the plant the heat temperature is less in 5–9 °C from the area than near the surface of the soil.

Analysis of the experiments has shown that high temperatures in hot summer days cease the growth process in some of the studied plant species and cause burns on the plant leaves. By the lasting several hot summer weeks and occurance lack of moisture have broken down the protein in plants, as a result of accumulation amiac in plants the cell structure is being broken, the plant is being died [11, 15].

As you know, the Absheron Peninsula differs from other regions by the dry land in the summer. So that the annual precipitation is 250–350 mm and evaporation is about 1000–1200 mm. From this point of view, adaptation of plants in the Absheron peninsula to this climate factors is one of the important thing. Plants introduced in Absheron in dry hot summer months are in a very difficult position in terms of water needs. Observations on studied plants showed that, in cultural conditions in some parts of leaves are observed yellowing and falling of leaves. For example, can be showed *Parrotia persica, Populus hyrcana, Platanus orientalis, Euonymus latifolia, Albizia julibrissin, Acer platanoides* species et al. Growth in researched plants due to the increase of heat during the drought are being stopped. Sonradan In these plants are occurring leaves again later due to the reduction of heat. As a result of observations has been discovered that in some of the rare plants leaves are occured burns on hot summer days (*Acer platanoides, Diospyros lotus, Euonymus latifolia* et al.). These burns are originated from the edge of the leaves and are moving towards the center of the leaves. Later it covers the entire part of leaf blade, after which the leaf is fallen. It was observed burns in the leaves by the 35–40 °C temperature in July 2017.

Based on Ahmatov's method [3] were used thermos containers to study heat resistance of 362 researches species (Figure 2).

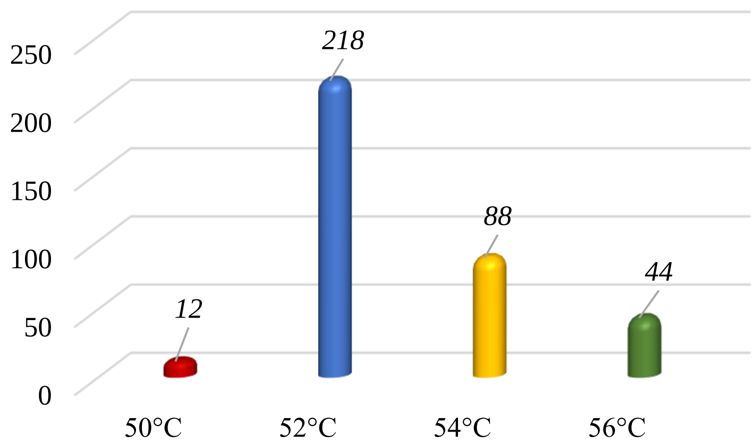


Figure 2. Lethal effects of the heat to the leaves of the studied plants.

As a result of the experiments, the heat resistance of the studied leaves is divided into three groups:

More durable species (54–56 °C) — *Cryptomeria japonica, Picea excelsa, Juniperus foetidissima, Amorpha californica, Colutea caucasica, Morus alba, Olea europaea, Danaea* *racemosa, Buxus colchica, Buxus hyrcana, Ficus hyrcana, Pistacia mutica, Pistacia vera, Pyracantha coccinea, Populus euphratica, Ruscus hyrcana, Ulmus laevis, Zelkova carpinifolia*;

Medium durable species (52 °C) — *Abelia grandiflora, Acacia dealbata, Acer ibericum, A. platanoides, Corylus colurna, Celtis caucasica, Diospyros lotus, Gleditsia triacanthos, Laurocerasus officinalis, Parrotia persica, Platanus orientalis, Pyrus caucasica, P. salicifolia, Quercus castaneifolia, Q. iberica, Q. pontica* et al.;

Low durable species (48–50 °C) — *Albizia julibrissin, Caesalpinia gilliesi, Cornus mas, Nedera helix, Hedera pastuchowii, Lirodendron tulipifera, Ligustrina amurensis* et al.

Studies have shown that, leaves of plants included in the research materials suffer from heat between 48 °C and 56 °C.

As a result of the analysis has shown that, the heat resistance of plants depends on their biological properties. From this point of view studied plants are characterized in cause of different characteristics in terms of heat and drought in cultural conditions.

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