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Quercus ilex L. – Holm Oak (Holm Oak Tree), a Species Recommended for Urban Greening

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ABSTRACT

This species belongs to the beech family (Fagaceae Dumort.) and the oak genus (Quercus L.). Approximately 600 species of this genus are distributed in the Northern Hemisphere, in tropical regions, and in countries of the temperate zone. These species are mainly found in North America and Southeast Asia. *Quercus ilex* was introduced to Azerbaijan from the Mediterranean flora in the mid-20th century.

In the flora of Azerbaijan, 12 species of oak are recorded, of which 9 species occur in the native flora and 3 species are cultivated. They differ from one another primarily in leaf shape. The native range of the holm oak includes the Mediterranean coast, Southern Europe, North Africa, and Asia Minor.

Holm oak is cultivated for urban greening in Absheron, Ganja, Shamkir, and other regions. The largest and oldest specimens were recorded in Baku National Park (4 individuals). It is an evergreen tree characterized by a massive trunk and a broad crown.

Each species has its own biological characteristics, which, to varying degrees, shape its adaptation to climatic and soil conditions. Seasonal changes, as well as climatic and soil conditions, do not affect their biological properties; only the species develops a mechanism for adapting to its environmental conditions, all of which are shaped by changes in energy and metabolic processes.

To determine the age of the studied species *Quercus ilex* L., use the binocular microscope Lintab 6 and to study the general synthesis of chlorophyll, use the Chlorophylometer SPAD and Photometer APEL AP-120.

Our research has shown that holm oak has high resistance to environmental factors and can be widely used in urban landscaping.

KEYWORDS: stone oak, plant, leaves, urban greening, development, use

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INTRODUCTION

Quercus ilex L. (stone oak) is one of the most valuable species of trees, both from the point of view of benefits for the ecosystem and from the point of view of economic significance.

Its use is widely spread in various areas. The leaves and fruits of the stone oak are used in animal husbandry, especially for feeding pigs. In Spain, the famous "Iberian pig" is fed with the acorns of the stone oak. Since the wood is very hard and durable, it is used in the production of furniture, floor coverings, railway sleepers and shipbuilding. Thanks to its high-energy properties and long burning, wood is widely used in the production of firewood and charcoal. It plays an important role in protecting the soil from erosion due to its resistance to harsh climate and powerful root system.

Quercus ilex L. (holm oak, stone oak) is one of the most valuable tree species, both in terms of its ecological benefits and its economic importance. Its applications are widespread in various fields.

The leaves and fruits of the holm oak are used in animal husbandry, especially for feeding pigs. In Spain, the famous "Iberian pig" is traditionally fed on the acorns of *Quercus ilex*. Due to its very hard and durable wood, the species is widely used in the production of furniture, flooring, railway sleepers, and in shipbuilding. Owing to its high energy value and long burning time, the wood is also commonly used as firewood and for charcoal production.

MATERIALS AND METHODS

Study Area and Species Selection

The research was conducted on the Absheron Peninsula, specifically focusing on specimens of Quercus ilex L. situated within Baku National Park and urban greening zones in Ganja and Shamkir. A 101-year-old specimen, planted circa 1919, was selected as the primary subject for intensive biometric and dendrochronological analysis due to its representative health and maturity in an urbanized environment.

Dendrochronological Analysis

To determine the age and growth dynamics of the studied species, tree-ring measurements were performed using the Lintab 6 linear measuring stage (Rinntech, Germany) coupled with a high-resolution binocular microscope. Graphical analysis and cross-dating of the growth rings were executed via the TSAP-Win software suite, allowing for a precision of 0.01 mm in determining annual radial increments and identifying the specific planting date.

Physiological and Pigment Assessment

Chlorophyll synthesis was evaluated using a dual-method approach to correlate relative greenness with absolute pigment concentration.

- Non-destructive Measurements: Relative chlorophyll content was recorded in situ using a Chlorophyllometer SPAD-502 (Konica Minolta, Japan), which measures the ratio of light transmission at 650 nm and 940 nm.
- Quantitative Analysis: For precise synthesis dynamics, leaf samples were analyzed using a Photometer APEL AP-120. Pigment extraction was performed according to standard spectrophotometric protocols to determine the concentration of total chlorophyll per 5 mm^2 of leaf area, expressed in mg/g.

Biometric and Environmental Evaluation

Biometric parameters, including trunk diameter at breast height (DBH) and crown morphology, were recorded following standard forestry protocols. The adaptive capacity of the species was assessed through visual and biometric monitoring of individuals exposed to varying levels of anthropogenic pressure and atmospheric pollutants within the Baku urban ecosystem. Statistical trends in chlorophyll dynamics were correlated with seasonal climatic shifts characteristic of the Absheron Peninsula.

RESULTS AND DISCUSSIONS

Quercus ilex plays an important role in soil protection against erosion due to its resistance to harsh climatic conditions and its powerful root system. It is planted as an ornamental tree in parks and gardens because of its tolerance to drought and environmental pollution.

The species is also widely used in medicine. Due to the high content of tannins in its leaves and bark, it possesses antiseptic and anti-inflammatory properties and is used in certain traditional medicinal practices. Tannins found in the leaves and bark promote wound healing; bark decoctions are used to treat diarrhea and stomach disorders, as well as inflammation of the oral cavity, and may serve as a mouth rinse.

The acorns of the oak are also used as food; in some regions they are roasted or ground into flour. They are a nutritious feed source for pigs and cattle. In addition, the wood is considered high-quality because of its strength and hardness, making it suitable for furniture production, construction materials, and fuel. Thanks to its powerful root system, the species is widely used for preventing soil erosion and is cultivated in gardens and parks as an ornamental plant.

The bark of young trunks is smooth and dark gray in color, while the bark of mature trunks is irregularly fissured. The shoots are grayish and felted. The leaves are small (up to 8 cm long), variable in shape, leathery, dark green on the upper surface, with yellowish or whitish hairs on the lower surface. The buds are gray and densely covered with bristles. Leaf petioles are densely pubescent and 1–2 cm long.

The leaves are oval or elliptic in shape. The upper surface is green, glabrous or sparsely bristly, whereas the lower surface is densely covered with gray tomentum. The leaves are firm and leathery. The leaf base is rounded; lateral veins occur in 8–12 pairs and are straight or slightly curved. Leaf length ranges from 2 to 7 cm and width from 1 to 3 cm.

The acorns are 1.5–3 cm long and borne on peduncles approximately 1–3 cm in length. The cupule scales are narrow, lanceolate, and densely covered with gray hairs. Acorns mature in the second year and measure 1.5–3 cm in length and 1–3 cm in width.

The leaves remain on the plant for more than one year and are shed only after new leaves emerge, which makes the species evergreen. Because of this characteristic, together with its majestic appearance, it is often cultivated as an ornamental plant. Due to its extremely hard wood, which sinks in water, the tree is known as the stone oak or hard oak.

Quantitative changes in the pigment apparatus of plant leaves may occur in response to variations in environmental conditions [2]. It has been shown that environmental factors have a greater influence on the chlorophyll content of leaf biomass than on the qualitative composition of pigments [4]. In general, light is known to be the main factor regulating pigment composition. Under shaded conditions, the amount of chlorophyll per unit leaf mass increases, the proportion of carotenoids decreases, and the proportion of chlorophyll *b* increases [5,7]. Changes in ambient temperature and humidity can also cause variations in pigment content in plant leaves [2].

Despite the considerable and diverse interest in the plant pigment complex, many questions regarding the patterns of its adaptation to living conditions remain unresolved. This is especially relevant for studies conducted under natural conditions, where the limited available data are often contradictory.

It is well known that the effects of light and climatic factors vary with seasonal changes, a process that is further intensified by climate change. Quantitative changes in the pigment apparatus of plant leaves may arise in response to external environmental factors, including anthropogenic influences.With the change of seasons, the lighting and climat change.

In some tree and shrub species introduced to the Absheron Peninsula, including *Quercus ilex* L., an increase in light intensity and temperature (depending on the season) leads to enhanced chlorophyll synthesis. In contrast, in evergreen species, pigment synthesis may be weakened due to the negative effects of natural and anthropogenic factors (Figures 1).

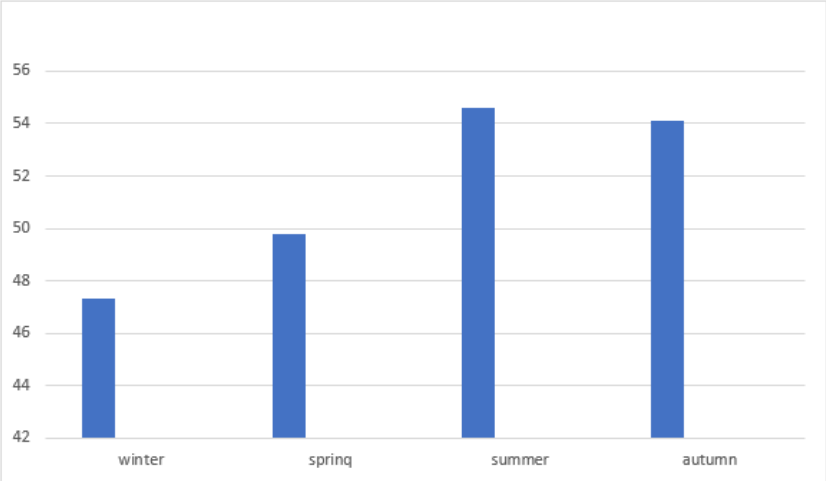

Fig.1 Dynamicsof total chlorophyll synthesis per 5 mm² area, mg/g

The influence of environmental variability on oak development in the studied area was assessed. The species was evaluated based on the results of both visual and biometric analyses. The impact of atmospheric pollutants is clearly evident in urbanized ecosystems, particularly in urban environments where anthropogenic pollution is most intense.

Quercus ilex L. is a species resistant to various degrees of natural and anthropogenic pollution. The holm oak was assessed based on its size, trunk height, and high tolerance to unfavorable environmental factors.

During the study, the trunk diameter of the holm oak was measured at 206 cm. Biometric analysis indicated that the planting date of the species was determined to be 1919. Using graphical analyses conducted with a Lintab 6 binocular microscope, data were obtained on the growth dynamics and internal condition of this 101-year-old specimen. The species exhibits a very strong and healthy trunk structure (Table 1).

Table 1. Parameters of the studied species

Kind	Territory	Diameter of tree trunk	Date of sample collection	Date of planting	Age of the tree
Quercus ilex L.	Baku	206 см	14.01.2020	1919 год year	101

Our visual observations indicate that *Quercus ilex* L. (holm oak, stone oak) is highly resistant to drought, shade, strong winds, and frost, tolerating temperatures as low as –20 °C without damage. With a well-developed root system, the roots extend both in depth and width, supplying the tree with nutrients and groundwater.

The species features a tall, smooth, dark-gray trunk and a broad, rounded, drooping crown. Being evergreen and able to grow individually in parks and gardens without causing harm to the surrounding environment, it provides a highly decorative appearance. The tree can also be used for greening parks, private gardens, and roadside areas. Holm oak planted for ornamental purposes on the Absheron Peninsula has thrived for many years, even in areas with high environmental pollution. Therefore, using this species for monitoring polluted areas can yield more reliable results than many other plants.

Since it is a relatively slow-growing tree, it is recommended to use more mature specimens (4–5 years old) for landscaping purposes. Due to its evergreen foliage, the tree can hold a large amount of snow, yet its branches are strong enough to withstand the weight without breaking.

CONCLUSION

The study revealed that the holm oak (*Quercus ilex* L.) was planted in 1919 and is currently 101 years old. Considering its age, it could be certified as a historical monument. The species features a large trunk, broad crown, evergreen foliage, and strong, healthy wood. It is capable of regulating the air regime in the surrounding area. The roots of mature specimens can reach depths of 8–10 meters, providing protection against adverse environmental factors, particularly strong winds and the weight of heavy snowfall in winter.

The tree's noble stature and tall growth reflect its high resistance to unfavorable external influences. Both the trunk and branches are very robust. Our visual observations show that holm oak, with a well-developed root system and growing in dry, rocky soils on the Absheron Peninsula, is highly resistant to drought, shade, strong winds, frost, dry and rainy conditions, and various soil types. This longevity is partly due to its hard, leathery leaves.

The tall, smooth, dark-gray trunk and broad, rounded, drooping crown, combined with its evergreen foliage, make it highly decorative when planted individually in parks and gardens without causing harm to the environment. Holm oak can also be used in group plantings along avenues, in parks, and streets. Its strong wood allows it to serve as a living hedge in gardens. Moreover, due to its powerful root system, it can be planted in landslide-prone areas and on shallowly eroded slopes to prevent soil erosion. Overall, the species is highly valuable as an ornamental plant and plays an important ecological role in urban and landscape greening.

DISCLOSURE

The author reports no conflicts of interest in this work.

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