ARTICLE

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INFLUENCE OF ECOLOGICAL FACTORS ON THE GROWTH AND DEVELOPMENT OF SOME SPECIES OF *MAGNOLIA* L. AND *LIRIODENDRON* L. GENUS

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The article examines the effect of environmental factors on the growth and development of some species belonging to the genus *Magnolia*. As a result of the influence of abiotic factors, the development differences of plants in the Absheron Peninsula and Oguz region were studied. Indicators of average annual temperature and relative humidity during the research years, biomorphological indicators of *Magnolia grandiflora* L. introduced in Absheron peninsula and Oguz region (2018), morphometric indicators of *Magnolia grandiflora* L. introduced in different geographical areas, *Magnolia* L. and Chemical characteristics of soils of the introduced experimental area of *Liriodendron* L. species, mg / l, frost resistance of *Magnolia grandiflora* L. and *Liriodendron tulipifera* L. introduced in Absheron peninsula and Oguz region, degree of damage of studied *Magnolia* L. species in percent. The species are resistant to heat, drought and salinization. In the Absheron Peninsula, the adaptation period of *Magnolia grandiflora* L. and *Liriodendron tulipifera* L. is relatively weak compared to the conditions of Oguz region. Since the species of the genus *Magnolia* L. have evolved to adapt to frost and low temperatures, it is easier to introduce evergreen species. We do not recommend the planting of *Magnolia* L. and *Liriodendron* L. in large and industrial cities in man-made contaminated areas and alongside of highways.

Keywords: *Magnolia*, **abiotic factors, frost resistance, light, drought resistance, radiation**

One of the main properties of plants is their height and development. They are an integral part of the biological system and the biological cycle, which are inseparable from the environment. Depending on the environmental conditions, the growth and developmental stages of plants regulate the metabolism of each species in order to continue their life, forming morphological features. As the external environmental factors change, a certain variability is formed in them, adaptive species continue to develop, and non-adaptive species disappear. There are biotic and abiotic variations in the ecological environment. From this point of view, the effect of abiotic factors on plants is deeper, and the main factor determines their life. There are many abiotic factors, including light, soil, water, temperature, salinity, and man-made air pollutants, and their effects are not the same for different types of plants.

Materials and methods of research

Researches were conducted in the Oguz region and Absheron peninsula on the species studied in the article. The experimental field of the Institute of Dendrology of ANAS was selected and seedlings of the same age were used in the territory of the Oguz region. Assignments were made on soil samples of these areas in the "Centralized Experimental" laboratory. The research was conducted to determine the winter hardiness of magnolia and liriodendron species introduced during 2017-2021. The percentage of leaf and shrub damage at high temperatures was determined by F.F. Machkov's method [1]. During the study, the winter hardiness of the species grown in Absheron conditions was studied. identified. Chemical characteristics of the soils of the introduced experimental field of *Magnolia* L. and *Liriodendron* L. species were obtained by the British-made Palintest Soil device [2, 3].

It is clear from Table 1 that the pH of different soil samples according to a geographical location is weakly alkaline, the electrical conductivity is relatively high, and such a high level is formed due to metal ions in the soil. The amount of chlorine (Cl -) in the soils of the Absheron Peninsula, and sulfate (SO_4^{2-}) ions in the soils of the Oguz region is very close to the standard indicators, these soils can be attributed to the saline soil type. There is a need for irrigation when introducing rare ornamental plant species into such soils. With the presence of K + and P3 + (potassium and phosphate) ions in the soil and the relatively high content of ammonium (NH^4 +), the predominance of these ions in the soils of the Oguz region have a positive effect on the growth and development of *Magnolia grandiflora* L. and *Liriodendron tulipifera* L. Potassium ions provide conductivity in the cells of the root system, phosphate ions provide optimal flowering of *Magnolia grandiflora* L. and *Liriodendron tulipifera* L., fruit and seed formation. Magnesium (Mg^2 +) ions in the soil are very close to the standard values and are actively involved in the synthesis of chlorophyll in the leaves. The active involvement of magnesium ions in the process of photosynthesis, the synthesis of chlorophyll «a» and «b» in the leaves, accelerate the growth and development of plants. The optimal accumulation of ammonium ions in the soil is characteristic of the soils of the Oguz region, as it confirms that these soils are rich in organic residues, ie humus layer.

Table 1

Chemical characteristics of soils of the introduced experimental field of species belonging to the species *Magnolia* L. and *Liriodendron* L

The area where samples were taken	Depth	pH	Electric conductivity	N^-	K^+	NH^4+	Cu^{2+}	Mg^{2+}	SO_4^{2-}	P^{3+}	Ca^{2+}	Cl^-	Al^{3+}	Fe^{2+}	Mn^{2+}
Standard	_	7,0	_	0-25	0-450	0-75	0-25	0-500	0-300	0-150	0-2500	0-1000	0-25	0-25	0-25
Buzovna	35	8,0	1280	<<	420	32	10,2	375	130	63	1470	1455	0,3	17	4,0
Mardakan	35	8,4	1070	4,7	437	34	17,3	400	147	62	1800	1300	0,6	18	5,3
Institute of Dendrology	35	8,6	1250	4,5	472	30	19,4	401	153	67	2050	1610	0,5	16	6,4
Oguz district	35	7,7	1140	6,3	510	43	23,5	470	175	75	1910	1435	0,1	13	5,0
Oguz district yard area	35	7,9	1134	7,1	537	49	26,1	435	210	83	1985	1310	0,1	12	5,4

Table 2

Morphological features of *Magnolia grandiflora* L. and *Liriodendron tulipifera* L. depending on ecological areas (2018)

Areas	Species	Number of 1-year-old shoots, in numbers	Number of leaves on 1-year-old shoots, in numbers	Length of one leaf, in cm	The age of a leaf mass, in gr	Dry a leaf mass, in gr	Flowering Period
Absheron peninsula	*Magnolia grandiflora* L.	3	7	18,0	2,62	1,14	V-VI
	Liriodendron tulipifera L.	2	6	21,7	4,I3	1,39	V-VI
Oguz district	*Magnolia grandiflora* L.	4	8	26,3	6,17	2,13	VI-VII
	Liriodendron tulipifera L.	5	7	29,2	12,3	4, 21	VI_VII

Table 3

Degree of the damage of the studied species, %

The nature of the damage	Point	Groups	*Magnolia. grandiflora* L.		*Magnolia liliiflora* Desr.		*Magnolia kobus* DC.		*Liriodendron tulipifera* L.	
			Point	*Group*	*Point*	*Group*	*Point*	*Group*	*Point*	*Group*
No freezing	25	1	+	+	_	_	+	+	+	+
50% of 1-year-old branches freeze	20	2	_	_	_	_	+	+	_	_
50% – 100 of 1-year-old branches freeze	15	3	_	_	_	_	_	_	_	_
Not only 1-year-old but also old branches freeze	10	4	_	_	_	_	_	_	_	_
The surface freezes up to the snow cover	5	5	_	_	_	_	_	_	_	_
The surface is completely frozen	3	6	_	_	_	_	_	_	_	_
The plant is completely destroyed	1	7	_	_	_	_	_	_	_	_

Table 2 presents the properties of growth and development processes of *Magnolia grandiflora* L. and *Liriodendron tulipifera* L. introduced in the territories of Absheron peninsula and Oguz region in different ecological conditions. It should be noted that some morphological parameters formed during the year in different ecological areas showed that *Magnolia grandiflora* L. and *Liriodendron tulipifera* L. are poorly adapted to the new ecological environment. Because various ecological factors of the new area affect them as stress. Only from the 2nd and 3rd years do they form adaptation mechanisms and the plants continue to grow optimally. It is also clear from this table that the adaptation period of *Magnolia grandiflora* L. and *Liriodendron tulipifera* L. in the Absheron Peninsula is relatively weak compared to the conditions of the Oguz region. *Magnolia grandiflora* L. 3 and *Liriodendron tulipifera* L. only 2 new shoots are growing in the Absheron peninsula. New shoots of Liriodendron tulipifera L. 5, and *Magnolia grandiflora* L.4 are formed in the territory of the Oguz region and their optimal development is superior to the lands of Absheron. Interestingly, *Magnolia grandiflora* L. and *Liriodendron tulipifera* L. bloom in late May and early June in the Absheron region. In the Oguz region, both species begin in late June and early July. This symptom was caused by the high temperature in the Absheron Peninsula. The main principle of the problem is the adaptation of plants to low temperatures. However, the mechanism of evolutionary resistance to cold or frost is much higher than that of plants in temperate climates, and the degree of adaptation of different species is quite variable [4, 5, 6]. Many exotic plants, including magnolia and liriodendron, grow successfully in cold climates, at temperatures of -20, -22, -36^0 C – in the suburbs of Moscow, Kaliningrad, St. Petersburg, Novosibirsk [7, 8]. It is easier to introduce evergreen species because species have evolved to adapt to frost and low temperatures.

Studies have been conducted to determine the winter hardiness of magnolia and liriodendron species introduced in 2017-2021. During the study, the winter hardiness of the species grown in the conditions of Absheron was studied. II – only 50% of annual branches freeze; III – annual branches freeze from 50% to 100%; IV – not only unity but also older branches freeze; V – the surface of the plant freezes until the snow cover; VI – the surface of the plant freezes; VII – the plant is completely destroyed. The assessment of frost resistance of trees and shrubs was determined by the freezing index and the obtained data were compared with the following formula proposed by REA BBB. The freezing index is calculated by the following equation:

$$The\ freezing\ Index = \frac{100 \times L \times C}{H \times C}$$

L – length of the frozen part of the sprouts (m); c – diameter of the frozen part of the branch (m); H – height of the plant; C – diameter of the body (m).

The frost resistance index of tree species was compared on the scale of REA BBB: 0 – the plant did not freeze; 0.1-0.9 plants freeze weakly; 1,0-7,9 plants freeze moderately; 8.0-69.9 plants freeze significantly; 70.0-100.0 plants completely freeze. Here 0-100.0 is the value of the freezing index and is expressed in%. *Magnolia grandiflora* L., *Magnolia liliiflora* Desr., *Magnolia kobus* DC. and older individuals of *Liriodendron tulipifera* L. species were visually identified after wintering in Absheron and low temperature resistance was assessed. The results of the study are given in Table 3.

It has become clear from the data of some authors that the resistance of species to heat, drought and salinization is not the same depending on the environment. Due to its rigidity and thickness, the small number of pores per 1 mm^2 area prevents water evaporation and reduces water consumption, significantly reduces the heating of leaves in hot summer months, prevents them from reaching lethality [9, 10]. The presence of leaves of species *Magnolia* L. (2-3 mm) and the reflection of light rays falling on the leaf surface, and the leaf is protected. It is clear from Table 4 that *Magnolia* L. species spends the summer season optimally both in the Absheron Peninsula and in the Oguz region and tolerates heat even when the temperature is 39.2-42.0^{0}C and continues to grow optimally even when the temperature is high. *Magnolia grandiflora* L., *Magnolia nightmare* DC., *Liriodendron tulipifera* L. fruit formation continues in summer and no signs are observed. However, due to the hot summer winds observed in the Absheron Peninsula in the summer, drying was observed in 20% of the area of the magnolia leaves. When plants are irrigated in a timely manner, damaged areas can be soon restored.

It is clear from the data in Table 5 that *Magnolia grandiflora* L. tolerates hot temperatures of the Absheron Peninsula up to -50.0 ºC, *Magnolia nightshade* DC. -48.0 ºC, *Liriodendron tulipifera* L. up to 40 ºC.

Table 4

Heat resistance of *Magnolia* L. species in summer, ºC

Areas	Species	Summer temperature, ºC			Sustainability
		June	July	August	
Absheron peninsula	*Magnolia grandiflora* L.	37,4	39,2	41.4	+
	Magnolia liliiflora Desr.	38,3	40,4	42,5	+
	Magnolia kobus DC.	36,9	41,0	40,6	+
	Liriodendron tulipifera L.	37,0	40,,9	40,2	+
Oguz district	*Magnolia grandiflora* L.	35,4	41,2	42,0	+
	Magnolia liliiflora Desr.	37,2	42,0	41,3	+
	Magnolia kobus DC.	39,1	40,7	40,9	+
	Liriodendron tulipifera L.	36,3	39,7	41,3	+

Table 5

Lethal temperature indicators of leaf organs of different studied *Magnolia* L. species

Areas	Species	Lethal temperature, with ºC
Absheron peninsula	*Magnolia grandiflora* L.	50,0 ± 3,0
	Magnolia liliiflora Desr.	45,0 ± 2,3
	Magnolia kobus DC.	48,0 ± 2,8
	Liriodendron tulipifera L.	48,0 ± 2,4
Oguz district	*Magnolia grandiflora* L.	46,4 ± 2,2
	Magnolia liliiflora Desr.	44,8 ± 2,0
	Magnolia kobus DC.	46,0 ±2,3
	Liriodendron tulipifera L.	47,0 ±2,6

These indicators confirm that the species *Magnolia* L. and *Liriodendron* L. are highly resistant to the hot and dry subtropical climate of Absheron, and no damage was observed in their leaf organs. The same species has a low temperature of 3.6ºC, 40ºC and 20ºC in the territory of the Absheron Peninsula in the territory of Oguz region, ie *Magnolia grandiflora* L. 46.4ºC, *Magnolia nightmare* DC, respectively. To 46.0 ºC, *Magnolia liliiflora* Desr. 44.8°C, *Lyriodendron tulipifera* L. tolerates up to 47.0°C. We recommend dividing the research objects into 3 groups according to their drought resistance:

1. *Magnolia grandiflora* L. (50,0 ºC ± 3,0), which is resistant to high temperatures.

2. *Medium tolerant*, *Magnolia nightmare* DC, *Liriodendron tulipifera* L. (48.0 ºC ± 2.8)

3. *Magnolia liliiflora* Desr.aid.

Results of the research and discussions

1. In the saline soils of the Absheron Peninsula and Oguz region, as a result of the effect of chloride ions on magnesia species in the Absheron Peninsula and sulfate ions in the Oguz region, early shedding of their leaves was observed.

2. It is not advisable to plant *Magnolia liliiflora* Desr for the Absheron Peninsula, where there is a shortage of water and drought. It is recommended to plant *Magnolia grandiflora* L. and *Liriodendron tulipifera* L. in this area.

3. When introducing *Magnolia* L. and *Liriodendron* L. species in high temperature, low relative humidity and saline soils, in order to reduce the negative impact of salt ions and atmospheric techno-gases, agro-technical maintenance and irrigation of these species should be carried out regularly.

Conclusion

The article studies the developmental differences in the size and development of the influence of environmental factors on some species belonging to the genus *Magnolia* in the Absheron Peninsula and Oguz region. *Magnolia* L. and *Liriodendron tulipifera* L. species spend the summer season optimally both

in the Absheron Peninsula and in the Oguz region, and even withstands temperatures of 39.2-42.0 ^{0}C and continue to grow optimally. The presence of K^+ and P^{3+} (potassium and phosphate) ions in the soil and the relatively high content of ammonium ($NH4^+$), the predominance of these ions in the soils of Oguz region have a positive effect on the growth and development of *Magnolia grandiflora* L. and *Liriodendron tulipifera* L.

In the Absheron Peninsula, the adaptation period of *Magnolia grandiflora* L. and *Liriodendron tulipifera* L. is relatively weak compared to the conditions of Oguz region. Since the species of the genus *Magnolia* L. have evolved to adapt to frost and low temperatures, it is easier to introduce evergreen species.

As heat-resistant species *Magnolia grandiflora* L., moderately tolerant species as *Magnolia kobus* DC; *Liriodendron tulipifera* L, species grow in weak acidic soils, in relatively unstable and high humidity conditions is *Magnolia liliiflora* Desr and et al. When different species of *Magnolia* L. and *Liriodendron* L. were introduced in the Absheron Peninsula and Oguz region, they did not suffer any damage in the winter. In the Absheron Peninsula and Oguz region, it is expedient to introduce *Magnolia* L. and *Liriodendron* L. species for landscape architecture, and they attract attention with their greatness.

In the soils of the Absheron Peninsula and Oguz region, when salinity is higher than 1%, leaf damage and premature shedding were observed in *Magnolia* L. and *Liriodendron* L. species. These species have been confirmed to be resistant to drought and high temperatures. *Magnolia* L. and *Liriodendron* L. species as the object of research, bloom in April and May in the Absheron Peninsula and Oguz region, they gave 75-80% of germination and new plants were grown from seeds. When using *Magnolia* L. and *Liriodendron* L. species for landscaping in the territory of Absheron peninsula and Oguz region, it is expedient to introduce *Magnolia* species in rows and *Liriodendron* species in groups.

We do not recommend the planting of *Magnolia* L. and *Liriodendron* L. in large and industrial cities in man-made contaminated areas and alongside of highways.

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