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ABSTRACT

of the dissertation submitted for the degree of Doctor of Philosophy

INTRODUCTION AND ACCLIMATIZATION OF SOME SPECIES BELONGING TO GENERA *MAGNOLIA* L. AND *LIRIODENDRON* L. FROM THE FAMILY *MAGNOLIACEAE* JUSS. IN ABSHERON CONDITIONS

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Introduction

Relevance and degree of development of the topic. The protection of the environment and natural resources and their efficient use is one of the most important problems of our time and one of the urgent issues, the solution of which is considered important[1]. That is why it is necessary to continue the necessary measures in the direction of protecting biodiversity, restoring green areas, effectively protecting and using available resources, increasing the species diversity of trees and shrubs, expanding the use of plant species and varieties that are resistant to adverse environmental factors against the background of global climate change.

In recent times, extensive works have been carried out to expand and diversify the greenery in order to improve the environment of the Absheron Peninsula, including the city of Baku, to ensure that the citizens of the country live in a healthy environment, and at the same time to create favorable conditions for the development of tourism in our country. Among these plants there are decorative and exotic species belonging to the genera *Magnolia* L. and*Liriodendron* L..

Recently, in different regions of our Republic (Baku, Sheki, Zagatala, Lankaran-Astara, etc.), *M.liliiflora*, which attracts attention with its large pink flowers, *M.grandiflora* and *M.kobus* with bright, dark green leaves and white flowers, and *Liriodendron tulipifera* L., which is called "yellow poplar" in its homeland are used individually in greening[2]. Thus, the little study of the biological characteristics of species belonging to the Magnolia and Liriodendron genera, and their resistance to environmental factors, does not allow for its wide application. Therefore, it is urgent to study the possibilities of introduction and acclimatization, bioecological and decorative

[1] Azərbaycan Respublikasında bioloji müxtəlifliyin qorunmasına və davamlı istifadəsinə dair 2017-2020-ci illər üçün Milli Strategiya [Elektron resurs] //Azərbaycan Respublikası Prezidentinin 2016-cı il 3 oktyabr tarixli 2358 nömrəli Sərəncamı ilə təsdiq edilmişdir, – Bakı: Qanun, – 2016. http://www.e-qanun.az/framework/33817

[2] Məmmədov T.S. Abşeronun ağac və kolları / T.S.Məmmədov,- Bakı Elm və Təhsil nəşr.-2010. -468 s.

properties of some species belonging to the genera *Magnolia* L. and *Liriodendron* L. in the Absheron peninsula with a dry-subtropical climate and to determine their fields of application and possibilities of use (preparation of medicines, cosmetology and perfume industry) is a relevant issue and of great importance.

The object and subject of the research. The object of the research work was some species belonging to the genera *Magnolia* L. (*Magnolia grandiflora* L., *Magnolia kobus* DC. and *Magnolia liliiflora* Desr.) and *Liriodendron* L. (*Liriodendron tulipifera* L.) from the *Magnoliaceae* Juss. family, and the subject of the research was a complex study of the bioecological characteristics, application areas and possibilities of use of the studied species under the conditions of introduction.

The purpose and objectives of research. The main purpose of the research is the introduction of some species belonging to the *Magnolia* L. and *Liriodendron* L. genera from the *Magnoliaceae* Juss. family, studying their bioecological characteristics, agrotechnics and possibilities of use in the conditions of Absheron.

To achieve the set goal, the following tasks were performed:

- Description of the biological characteristics of the researched species - the morphology of the sprouts, the investigation of the regularities of the seasonal growth rhythm of 1-3-year-old plants, the determination of the development stages and the vegetation period depending on climatic factors;
- Determination of pollen morphology, pollination characteristics, fruit and seed productivity;
- Study of propagation methods, favorable sowing and planting time, the effect of regulatory growth substances, agrotechnical rules, disease and pest control measures;
- Study of essential oils and component composition obtained from the flowers of some species of the genus *Magnolia* L. adapted to Absheron conditions;
- Determination of the tolerance of the species belonging to the genera *Magnolia* L. and *Liriodendron* L. to environmental factors, the possibilities of use in greening and other areas for the purpose of protecting the urban ecosystem.

Research methods. Classical and modern methods were used in the study of morphological characteristics, objective assessment scales, reproduction, resistance of plants to heat and cold, identification of pests, acquisition of essential oil and investigation of component composition, study of the morphology of pollen during the dissertation work.

Main main provisions submitted for the defence.

- Introduced species belonging to the genera *Magnolia* L. and *Liriodendron* L. are suitable for the dry subtropical climatic conditions of Absheron;
- The long vegetation period of species belonging to the genera *Magnolia* L. and *Liriodendron* L., introduced for the first time in Absheron conditions, creates the basis for the use of these species in greening;
- The species studied in Absheron conditions are promising based on biometric, decorative and vitality indicators;

Scientific novelty of the research. For the first time in the conditions of Absheron, new species belonging to the genera *Magnolia* L. and *Liriodendron* L. were introduced, as a result of studying their biological and decorative properties, it was determined that they are resistant to environmental factors in the dry subtropical climate.

For the first time, the vegetation period of the studied plants, the growth of above-ground and underground organs, seasonal growth rhythm, fruit and seed productivity during this period were studied. For the first time, effective methods of reproduction and agricultural technology for growing the species were studied, diseases and pests were identified, and suitable control methods were determined. The essential oils and component composition of some species of the research material were investigated for the first time. Cultivated plants according to introduction perspectivity were evaluated as highly promising (3 species - *Magnolia grandiflora, Magnolia kobus, Magnolia liliiflora*), promising (1 species - *Liriodendron tuliipifera*) species. It was found that the species do not belong to the low-promising (IV), unpromising (V) and useless (VI) groups and do not change their life forms in *ex situ* conditions.

Theoretical and practical significance of research: For the first time, bioecological characteristics of new species introduced in Absheron were investigated and studied on scientific basis. A collection area consisting of species belonging to the genera *Magnolia* L. and *Liriodendron* L. was created at the Institute of Dendrology, MSE RA.

Quality planting materials for use in greening can be obtained with suitable propagation methods of species belonging to genera *Magnolia* L. and *Liriodendron* L. It is appropriate to use the species which are considered promising in the decoration and greening of parks and gardens in Absheron, Baku and surrounding settlements.

Approbation and application. The scientific results obtained from the dissertation work were presented at various scientific symposiums, republican and international scientific practical conferences, as well as at the international scientific conference on "The impact of climate change on plant biodiversity" (Institute of Dendrology, ANAS, Baku, September 19-21, 2017); "Conservation of cultural heritage and biodiversity in the context of urbanized industrialization" international scientific-practical conference (Ganja, April 29-30, 2017); The 4th Interntional Symposium on EuroAsian Biodiversity (Kyiv, 03-06 July 2018); "Actual problems of modern natural and economic sciences" international scientific conference (Ganja, May 04-05, 2018); The ^{6}th International Symposium on EuroAsian Biodiversity (Baku, 06-08 September 2023).

Nine articles and three theses were published on the subject of the dissertation. Among them, three articles were published in international indexed journals.

The name of the institution where the dissertation work was performed. The research work was carried out at the Institute of Dendrology of the Ministry of Science and Education of the Republic of Azerbaijan.

Structure and scope of work. The dissertation consists of an introduction, 7 chapters, results, practical recommendations and a list of 208 references. The total volume of the work consists of 203 pages and 248574 characters (Introduction- 6917 characters, Chapter I - 48092 characters, Chapter II -24502 characters, Chapter III – 60262

characters, Chapter IV - 39260 characters, Chapter V – 45871 characters, Chapter VI – 6872 characters, Chapter VII - 13714 characters, results- 2230 characters, practical recommendations - 854 characters). The dissertation contains 66 tables, 2 maps-schemes and 52 figures.

CHAPTER I. LITERATURE REVIEW (TAXONOMY OF SPECIES BELONGING TO *MAGNOLIA* L. AND *LIRIODENDRON* L. GENERA, HISTORY OF THEIR INTRODUCTION AND DISTRIBUTION AREA)

This chapter provides information on research work carried out in different periods on species of the genera *Magnolia* L. and *Liriodendron* L. that are little used in landscaping of Absheron, and also reflects an analysis of the results obtained.

CHAPTER II. NATURAL-CLIMATIC CONDITIONS, MATERIAL AND METHODOLOGY OF THE RESEARCH AREA

2.1. Material and methodology of research. As the object of the study, *Magnolia grandiflora* L. - southern big-flower magnolia, *Magnolia kobus* DC. - kobus magnolia, *Magnolia liliiflora* Desr. – lily magnolia and *Liriodendron tuliipifera* L. - tulip tree belonging to the genera *Magnolia* L. and *Liriodendron* L. of the family *Magnoliaceae* Juss. were used

Propagation of studied plants by seeds were studied according to the methods by N.V. Tsitsin[3], "ГОСТ 13056.6-97"[4], vegetative reproduction according to the methods by T.V. Khromov[5], morphological characteristics of sprouts according to the methods by

[3] Цицин, Н.В. Методические указания по семеноведению интродуцентов/ Н. В. Цицин. -М.: Наука, -1980. -64 с.

[4] Семена деревьев и кустарников. Метод определения всхожести/ -М.: Межгос. Совет по стандартизации, метрологии и сертификации. -1997. -31 с.

[5]Хромова, Т.В. Методические указания по размножению интродуцированных растений черенками / Т.В. Хромова, -М.: ГБС АН СССР, -1980. - 45с.

I.T.Vasilchenko[6], plant growth and development according to the methods by P.A.Molchanov and V.V.Smirnov[7], root system according to the methods by V.A.Kolesnikov[8], phenological observations according to the methods by I.N.Beydeman[9], pollen viability according to the methods by Z.P.Paushev[10]. The methods of L.A. Kameneva[11] were taken as a basis for seed productivity and productivity coefficient, the methods of I.A. Ivanova and N.M. Dudik[12] for seed morphometric indicators.

Cold resistance was studied according to Klimov[13], drought and heat resistance according to P.A. Genkel[14], determination of diseases and pests, measures to combat them according to A.S. Lelej[15].

Essential oils were obtained from the leaves of southern big-flower magnolia by hydrodistillation method. Physicochemical constants of

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[6] Васильченко, И.Т. Всходы деревьев и кустарников (определитель.) / И.Т. Васильченко, -М., Л.: Изд-во АН СССР, -1960. -302 с.

[7] Молчанов, А.А. Методика изучения прироста древесных растений/ А.А. Молчанов, В.В. Смирнов, -М.: Наука, -1967. - 95 с.

[8] Колесников, В.А. Методы изучения корневых системы древесных растений/ В.А. Колесников, -М.: Лесная промыш., -1971. -152 с.

[9] Бейдеман, И.Н. Методика изучения фенологии растений и растительных сообществ/ И.Н. Бейдеман, -Новосибирск: Наука, -1974. -156 с.

[10] Паушева, З.П. Практикум по цитологии растений/ З.П. Паушева, -М.: Агропромиздат, -1988. -271 с.

[11] Каменева, Л.А. Биологические особенности цветения и плодоношения интродуцированных представителей рода *Magnolia* L. (*Magnoliacea*e Juss.) в условиях Российского Дальнего Востока // Комаровские чтения. -2015. Вып. LXIII. -с. 199-213.

[12] Иванова, И.А., Дудик, Н.М. К методике описания морфологических признаков семян //Составление определений растений по плодам и семенам. - Киев: Наукова думка, -1974. -С. 43-54.

13 Климов С.В. Пути адаптации растений к низким температурам // Успехи современной биологии, -2001, том 121, №1, -с.3-22

14 Генкель, П.А. Физиология жаро- и засухоустойчивости растений/ П.А. Генкель, -М.: Наука, -1982. -280 с.

[15] Lelej, A.S. Discovery of the genus *Odontomutilla* Ashmead, 1899 (Hymenoptera: Mutillidae) in Myanmar with description of a new species// J. Far Eastern Entomologist, -2023. No 476, -p. 1-7.

essential oil were determined according to I.V. Lapko's[16] method, the component composition of the essential oil was determined by the gas-liquid chromatography method in the "Crystal 2000M and Shimadzu 15A"chromatograph. The quantity of the composition of components was calculated by the internal normalization method of the peak areas (GOST ISO 7609-2014[17]). In order to determine the decorative quality and perspectiveness of the species, the methods of Y.N. Karpun and V.A. Kunina[18], E.O. Isgandarov[19] were referred to.

2.2. Natural and climatic conditions of the area where the research was conducted. The researches were conducted in the laboratory "Introduction and acclimatization of trees and shrubs" of Institute of the Dendrology of the MSE RA located on the Absheron Peninsula and at the Institute of Botany. The dissertation provides extensive information about the natural and climatic conditions of the area.

CHAPTER III REPRODUCTION OF SPECIES BELONGING TO THE GENERA *MAGNOLIA* L. AND *LIRIODENDRON* L. IN ABSHERON CONDITIONS

3.1. Seed propagation of species belonging to genera *Magnolia* L. and *Liriodendron* L. During the research work, seeds collected from the territory of Azerbaijan and foreign countries were used (Fig. 1).

The seeds of magnolia species were sown in the fall in the second decade of October in open conditions, and the first sprouts appeared after 182-185 days in the second decade of April.

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[16] Лапко, И.В Эфирные масла: методы определения подлинности и выявления фальсификации. Обзор / И.В. Лапко Ю.Б. Аксенова, О.В. Кузнецова [и др.] //Аналитика и контроль. -2019. Т. 23, № 4, -с. 444-475.

[17] ГОСТ ISO 7609-2014. Масла эфирные. Анализ методом газовой хроматографии на капиллярных колонках. Общий метод/ Ред. колл., – М.: Стандартинформ, -2015. – 12 с.

[18] Карпун, Ю.Н., Кунина, В.А. Особенности породного состава декоративных древесных растений, массово распространённых в районе Сочи // Садоводство и виноградарство. - 2014. № 5, -с. 43-48.

[19] Искендеров, Э.О. Оценка перспективности интродукции редких и исчезающих древесных видов Кавказа в условиях Апшерона // Бюлл. ГБС. - 1993. Вып.169, -с.8-11

Figure 1. Seeds obtained from the Romanian Botanical Garden

60.0% sprout were obtained from the seeds of southern big-flower magnolia and 46.0% sprout from the seeds of kobus magnolia. It was found that the percentage of germination of tulip tree seeds is low (4-5%) (Tab. 1) (Fig. 2-3).

Table 1.

Germination of the seeds of the studied species in open conditions

Species	Quantity of seed, piece	Sowing Time	Obtaining the first sprouts	Period from sowing to obtaining the first sprouts, days	Obtaining the mass sprouts	Germination %	prouts urvival%
A u t u m u n s o w i n g							
Magnolia grandiflora	50	20.X.2016	22.IV.2017	182	05.V.2017	60.0	75.0
M.kobus	50	20.X.2016	25.IV.2018	185	10.V.2017	46.0	50.0
Liriodendron tulipifera	50	25.XI.2016	20.IV.2016	145	28.IV.2016	4.0	66.0
S p r i n g s o w i n g (stratified seeds)							
Magnolia grandiflora	50	10.III.2017	20.IV.2017	40	12.V.2017	80.0	90.0
M.kobus	50	10.III.2017	22.IV.2017	42	18.V.2017	68.0	52.0
Liriodendron tulipifera	50	15.III.2016	04.V.2016	49	13.V.2017	5.0	75.0

Figure 2. Appearance of the first sprout of *Magnolia kobus* (a) and *Liriodendron tulipifera (b)*


Figure 3. Appearance of single and mass sprouts of *Magnolia grandiflora* (under closed conditions)

3.2. Morphology of sprouts of research materials. The study established that in *Liriodendron tulipifera*, the upward growth of the epicotyl part of the seedling is activated with the beginning of the development of the second true leaf, and the true leaf is formed every 7-10 days along with the formation of the above-ground part, and lateral roots are also formed (Tab. 2).

Table 2.

Morphological indicators of sprouts in the studied species

Species	Seed lobe				Shedding time	Duration of life, days	Length, mm	
	Time of emergence of seed lobes from the soil	Length/ width, mm	Color	Form			Hypocotyl	Epicotyl
Magnolia grandiflora	28.IV-05.V	10,0-15,0 3,0-4,0	Light green	Ovoid	13.VI-10.VII	45-62	15,0-17,0	8,0-10,0
M.kobus	30.IV-12.V	15,0-18,0 10,0-14,0	Light green	Ovoid	20.VI-15.VII	50-63	20,0-25,0	18,0-25,0
Liriodendron tulipifera	25.IV-10.V	13,0-16,0 0,5-0,8	Green	Elliptical	25.VI-05.VII	55-70	8,0-12,0	15,5-20,0

It was determined that the lifespan of seed-lobes in the studied species is between 55-70 days in *Liriodendron tulipifera*, 50-63 days in *Magnolia kobus*, and 45-62 days in *Magnolia grandiflora*.

3.3. Growth and development of 1-3-year seedlings. During the research, it became clear that intensive growth in the studied species is observed in May-June and August-September. In the first year, the growth of *Liriodendron tulipifera* is 14 cm, *Magnolia grandiflora* - 18.5 cm, and *Magnolia kobus* - 15.0 cm. It was found that the annual growth rate of southern big-flower magnolia was higher than that of other species. During the research conducted on older specimens, it became clear that the height and diameter of *Magnolia kobus* is higher than other magnolia species.It was found that the growth and diameter of the stem in the taxon *Liriodendron tulipifera* were higher than other species. It was determined that the growth process started earlier in the *M.kobus* species than in other species - in the first decade of April, in the first decade of May in the *M.liliflora* species, and in the second decade of April in the *Liriodendron tulipifera* species. Observations have shown that intensive growth occurs in the months of May-June

even in older specimens. The rise in temperature and low humidity in July weakens the growth process. When comparing the growth and development of *Magnolia grandiflora* and *M.liliiflora* species in the Dendropark and Oghuz region, it was found that the climate and soil conditions of Oghuz region have a more positive effect on the growth and development of the studied species (Table 3).

Table 3.

Height and canopy diameter of *Magnolia grandiflora* and *M.liliiflora* cultivated in Absheron and Oghuz regions

Species	Absheron			Oghuz		
	Height, meters	Canopy diameter, cm	Diameter of stem, cm	Height, m	Canopy diameter, m	Diameter of stem, cm
Magnolia grandiflora	2,7±0,5	1,95±0,3	10,5±2,5	4±0,5	3±0,3	12±0,5
M.liliiflora	1±0,8	0,5±0,6	1,3±0,5	2±0,3	2,5±0,5	1,6±0,5

As a result of the research, it was found that the main factors affecting the annual growth of the studied species are the soil and climatic conditions of the area where the plant is grown.

3.4. Morphological characteristic of the root system. When studying the root system of *Magnolia grandiflora* and *M.kobus* species under Absheron conditions, it was determined that the root system of these species develops rapidly starting from the first month. It was found that the development of the root system in *Magnolia grandiflora* and *Magnolia kobus* species continues from April to the end of September.

In the 1st year, when the height of the above-ground part of the southern big-flower magnolia is 12.0-14.0 cm, it was determined that the root system goes to the depth of the soil up to 20.0-22.5 cm. It was recorded that the number of lateral roots of the first degree is 5-7, and the length is 12.0-15.5 cm (Tab. 4).

In the II vegetation year, the main root in the species *Magnolia grandiflora* is characterized by intensive development. In southern big-flower magnolia, the height of the aerial part is 22.0-28.0 cm, while the length of the main root reaches 32.5-35.0 cm.

Table 4.

Morphological indicators of above-ground and underground organs of some species belonging to the genus *Magnolia* L.

Species	Plant age, year	Main root		Lateral roots of the first degree		Horizontal spread of the root, cm	Plant height, cm
		Length, cm	Diameter, cm	Number, piece	Length, cm		
Magnolia grandiflora	1	20,0-22,5	1,5-1,8	5-7	12,0-15,5	5,0-15,0	12,0-14,0
	2	32,5-35,0	2,0-2,2	8-9	17,0-25,5	6,5-23,0	22,0-28,0
	3	42,5-48,0	2,3-2,5	10-11	28,0-35,0	12,5-38,0	35,0-37,0
M. kobus	1	16,0-18,5	1,0-1,3	4-6	10,0-14,5	4,0-14,5	10,0-12,5
	2	30,0-34,0	2,0-2,5	8-10	19,5-26,5	8,0-28,5	20,0-22,5
	3	42,0-48,5	2,5-2,8	12-14	30,0-37,5	14,5-45,5	38,0-44,0

The number of lateral roots formed on the main root is 8-9, their length is 17.0-25.5 cm. It was found that the main root and lateral roots develop intensively up to 3 years of age in both species and the soil has a decisive effect on the formation of the root system.

3.5. Vegetative reproduction of species belonging to the genera *Magnolia* L. and *Liriodendron* L. When studying the effect of growth substances on the rooting process of cuttings, cuttings were kept in 0.01% and 0.05% heteroauxin solution (indole-3-acetic acid - IAA) for 24 hours and then planted. The highest result was observed in cuttings kept in 0.05% IAA solution for 24 hours and planted in the open field in spring (Tab. 5). It was found that the cuttings of the taxa *M.liliiflora* and *M.kobus* produce normal roots within 2-3 months, and the cuttings of the species *M.grandiflora* and *Liriodendron* - within 4 months.

Table 5.

The effect of IAA on rooting of cuttings of *Magnolia* L. and *Liriodendron* L. genera species (in open conditions), in %

Species	24 hours		Control	24 hours		Control
	0,01%	0,05%		0,01%	0,05%	
	In spring			In autumn		
Magnolia grandiflora	35.0	52.0	22.0	20.0	23.0	18.0
M. kobus	20.0	30.0	14.0	15.0	28.0	10.0
M. liliiflora	26.5	45.0	18.0	16.0	20.0	12.0
Liriodendron tulipifera	10.0	20.0	4.0	4.0	6.0	2.0

Propagation of the researched plant species using stem shoots, by means of planting and other methods was studied and it was found that rooting of shoots in the propagation of *Magnolia grandiflora* species with shoots was higher (75.0%) than in the *M. liliiflora*[20].

CHAPTER IV. BIOLOGICAL CHARACTERISTICS OF SOME SPECIES BELONGING TO *MAGNOLIA* L. AND *LIRIODENDRON* L. GENERA IN ABSHERON CONDITIONS

4.1. Botanical description of the studied species. The botanical description of the species introduced to the research area, including their decorative qualities, color, shape, size of flowers, leaves and fruits, original photos of the species, as well as their natural habitats was studied.

4.2. Stages of phenological development of the studied species. The results of the study of seasonal growth rhythms of plants in Absheron conditions showed that the minimum active temperature total determines the beginning of their vegetation period[21]. This is observed when the average daily temperature exceeds 5^0 C for the beginning of the phenological development stage (Fig. 4).

[20] Məmmədov, T.S., Şıxəliyeva, P.S., Novruzov, V.M. *Liriodendron tulipifera* növünün Abşeron şəraitində çoxaldılması //AMEA-nın xəbərləri (biologiya və tibb elmləri), -2017. cild 72, №2, -s.77-81.

[21] Askerova, P. Stages of Phenological Development of the *Maqnolia* L. Some Species in Absheron// Bulletin of Science and Practice, - 2022. T. 8, №2, -p.47-54

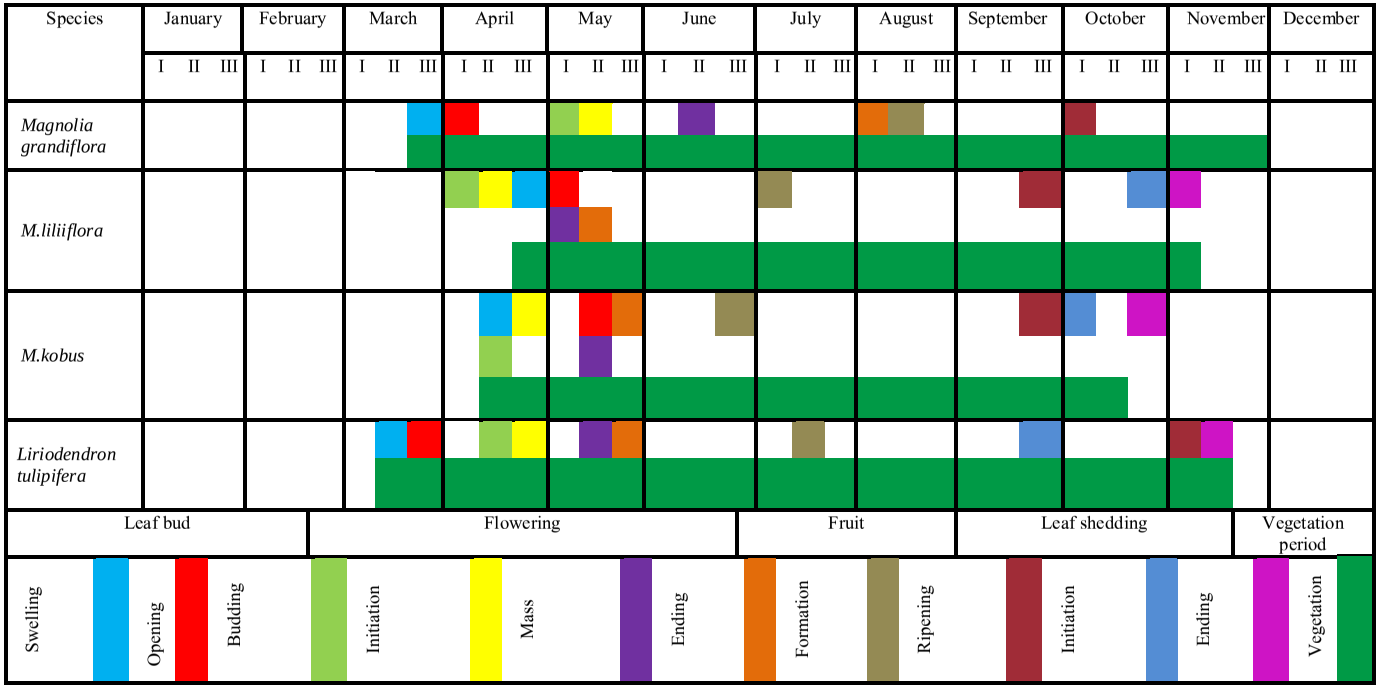

Figure 4. The phenospectrum of the seasonal development rhythm of the studied species

Observations have shown that in *Magnolia grandiflora* vegetative buds swell in the third decade of March, open in the first decade of April, buds appear in early May, and flowering occurs in the middle of May.

It has been found that flowering of southern big-flower magnolia lasts longer than other species and the life of a flower is 2-3, and sometimes 7-10 days, depending on the climatic conditions.

In *M.liliiflora* species, budding and flowering are observed before the leaf bud opens. The first flowers open in the second decade of April, and mass flowering occurs after 11-15 days.

In the species *Liriodendron tulipifera*, it was observed that the swelling of the leaf bud occurs in the middle of March, the opening of the leaves near the end of April due to the increase in temperature, and the budding occurs in the middle of April.

The studied species were divided into 2 groups according to the time of initiation of flowering (early blooming (*Magnolia liliiflora)* and late blooming (*M. grandiflora*, *Liriodendron tulipifera, M.kobus*).

4.3. Biology of flowering and fruiting. In Absheron conditions, the earliest flowering age was recorded for *Magnolia liliiflora* (7 years*), and* the latest *for Liriodendron tulipifera* (15 years). *Magnolia kobus* blooms between 10 to 13 years, and *M. grandiflora* - 10 to 15 years. During the study, the size and mass of the fruits and seeds of the studied species were determined (Table 6).

Table 6.

Morphometric characteristics of seeds and fruits of studied magnolia and liriodendron species

Species	Fruit			Seed			
	Length, mm	Width, mm	Mass, g	Length, mm	Width, mm	Mass of 1000 seeds with sarcotesta, g	Mass of 1000 seeds without sarcotesta,g
Magnolia grandiflora	80-90	30-50	100	5,0-12,0	2-3	115-125	80-90
M.liliiflora	30-50	10-20	50	8-12	2-2,5	150-180	120-150
M.kobus	40-50	20-30	100	7-10	4-5	200-230	170-200
Liriodendron tulipifera	60-80	20-25	10	3-4	2-3	50-60	20-30

4.4. Pollen viability of some species of *Maqnolia* L. and *Liriodendron* L. To determine the viability of pollen, a 5% iodine solution was added to the pollen in a glass and viewed under a microscope[22] (Fig. 5-6).

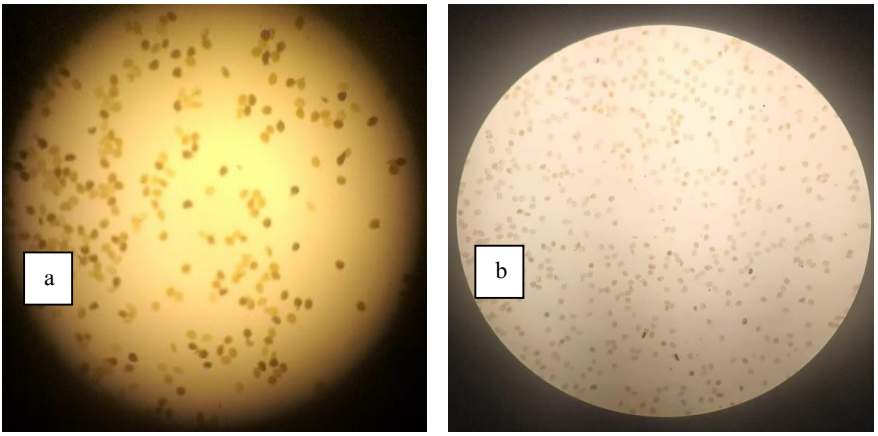

Figure 5. *Appearance of fertile (a) and sterile (b) pollen in Magnolia grandiflora*

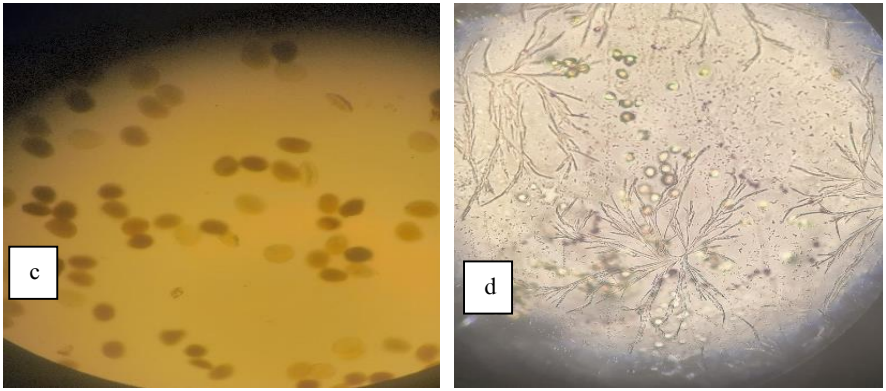

Figure 6. *Appearance of fertile (a) and sterile (b) pollen in Magnolia liliiflora*

[22] Əsgərova, P. *Maqnoliya* L. və *Liriodendron* L. cinsinin bəzi növlərinin tozcuqlarının həyatilik qabiliyyəti // Pedoqoji Universitetin Xəbərləri, -Bakı: -2023. C.71, No 2, -s.141-148.

It was found that the sterility of pollen of *Magnolia grandiflora* and *Liriodendron tulipifera* varies from 21.6 to 28.9%, the most sterile pollen was found in *Magnolia liliiflora* (72.7%) (Table 7).

Table 7.

Pollen form and development of introduced species of *Magnolia* L. and *Liriodendron* L. under different environmental conditions

Areas	Species	Pollen number	Pollen column length, µm	Pollen form	Pollen color	Sterile pollen by %	Fertile pollen by %
Absheron Peninsula	*Magnolia grandiflora*	10	6.8	Circular	Pink	21.6	78.4
	Magnolia liliiflora	10	4.2	Circular	Dark yellow	72.7	27.3
	Magnolia kobus	10	6.0	Oval	Yellow	21.4	78.6
	Liriodendron tulipifera	10	6.6	Oblong	Pink	28.9	71.1
Oghuz region	*Magnolia grandiflora*	10	7.1	Circular	Pink	21.4	78.6
	Magnolia liliiflora	10	4.6	Circular	Red	74.6	25.4
	Magnolia kobus	10	6.8	Oval	Yellow	20.3	79.7
	Liriodendron tulipifera	10	7.2	Oval	Light yellow	27.0	73.0

In both study areas, the least sterile pollen was determined in *Magnolia kobus* (20.3-21.4%). When studying pollen fertility, it was found to be between 78.4-78.6% in *Magnolia grandiflora* and 78.6-79.7% in *M. kobus*.

It was determined that the meridional diameter of the pollen of the studied species is between 30.2-40.3 µm, and the equatorial size is between 20.1-26.4 µm.

It was determined that the morphological structure of the pollen in the studied species is not the same. In some species, the layers of nexin and intin, and in others, the aperture zone are different in size. For

example, in *Magnolia grandiflora* the sexin layer is thick, and in *Liriodendron tulipifera* - thin (Tab. 8).

Table 8. Dimensions of pollen layers in species of the genera *Magnolia* L. and *Liriodendron* L., in µm

Species	The length of the polar axis	The length of long axis (E_1)	Short axis length(E_2)	Aperture zone width	Sexin layer	Nexin layer	Intin layer
Magnolia grandiflora	50.8	72.2	45.5	5.1	1.3	0.9	0.4
M. kobus	30.0	69.5	33.2	3.5	1.5	0.9	0.3
Liriodendron tulipifera	43.4	69.3	49.5	14.4	1.2	0.5	0.3

When studying the parameters of pollen and pollen tube development in various nutrient media of the studied species, it was found that pollen develops more actively in poor nutrient media (1:5) than in solid nutrient media (Fig. 7).

The length of the pollen tube of *Magnolia grandiflora* and *Magnolia kobus* species was 8.5-8.4 µm, *Liriodendron tulipifera* - 4.8 µm, and *Magnolia liliiflora* - 4.5 µm in nutrient medium in the ratio of 1:5.

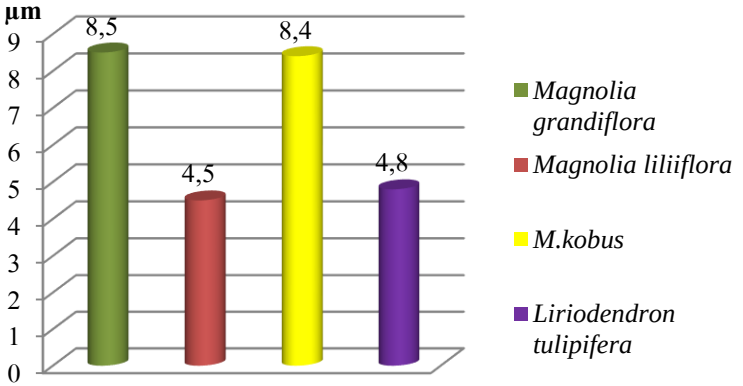

Figure 7. Length of plant pollen tube in 1:5 nutrient medium

4.5. Insects performing the pollination process in species belonging to the genera *Magnolia* L. and *Liriodendron* L. Observations have shown that the main pollinators of *Magnolia grandiflora* L. are beetles of the *Scarabaeida*family (Fig. 8). It became clear that the pollination period in the studied species was not the same, but different from each other. Different species of magnolia are not pollinated by the same bugs and insects, and each species does not have its own specific insect. *Cetonia aurata, Conotelus obskurus, Strangalina iuteicornis, Apis mellifera caucasica*, *Pieris brassicae* and *Anthonomus humeralis* insects have been known to pollinate most magnolia species.

Figure 8. Pollinator-insect in *Magnolia liliiflora* species

CHAPTER V RESISTANCE OF SPECIES OF THE GENERA *MAGNOLIA* L. AND *LIRIODENDRON* L. TO ENVIRONMENTAL FACTORS, AGRICULTURAL TECHNOLOGY, MEASURES TO COMBAT DISEASES AND PESTS

5.1 The effect of environmental factors on the growth and development of some species of the genus *Magnolia* L. To study the effect of soil on plant development, 2 different zones (Absheron, Oghuz) were taken and it was determined that the growth indicators

of the introduced southern big-flower magnolia in the soils of the Absheron peninsula and Oghuz region are significantly different. Thus, during the vegetation period, the growth indicator of the leaves was 8 cm in Absheron, and the leaves of the same species introduced in Oghuz region were 12 cm. In Oghuz region, the length of the leaves on a young shoot varies from 14.7 to 18.5 cm, and the width varies from 4.3 to 9.2 cm. Such regularity was also shown in the wet weight of the leaves and the length of the leaf stalk[23].

When studying the effect of soil on plant growth, it was found that the amount of K^+ (potassium) and P^{3+} (phosphate), NH_4^+ (ammonium) and SO_4^{2-} (sulfate) ions in the soils of Oguz region was relatively high in Absheron soils, and it was determined that this had a positive effect on the growth and development of the studied species.

When studying the attitude of the studied plants to light, it was established that all of them are light-loving and short-day plants.

5.2 Frost resistance of *Magnolia grandiflora* and *Liriodendron tulipifera* introduced in Absheron Peninsula and Oghuz region. After wintering in the conditions of Absheron and Oghuz, the condition of old individuals of *Magnolia grandiflora* and*M. liliiflora* species was visually observed and their cold resistance was assessed. Freezing was not observed in *M. grandiflora* species, and visually winter resistance of the plant was evaluated with 25 points and included in group 1. In the *M. kobus* species, freezing of the apical parts or 50% of the annual branches of the plant was recorded as a result of winter drought. The winter hardiness of the plant was evaluated with 20 points and included in the 2nd group. In the species *M. liliiflora* and*Liriodendron tuliiflora*, freezing was not observed, winter hardiness was estimated at 25 points and the studied species were included in the 1st group.

When studying the cold resistance of the studied plants in various environmental conditions, it was found that old specimens of the

[23] Askerova, P.S. Influence of ecologigal factors on the growth and development of some species of *Magnolia* L. and *Liriodendron* L. genus //European Journal of Natural History, -2022. №4, -p.3-7.

studied species developed without any damage during the winter months.

5.3. Heat and drought resistance of species belonging to the genera *Magnolia* L. and *Liriodendron* L. While studying the resistance of research materials to heat in different conditions, it was found that the epidermis layer of the leaves of these taxa is hard and thick (2-3 mm), which helps to protect it. It was established that the high temperature (39-42^{0}C) in the summer months in the Absheron peninsula and Oghuz region did not cause major damage to the morphological organs of the studied plants.

While studying the lethal effect of heat on the leaves of the studied plants, it was determined that on the Absheron peninsula, *Magnolia grandiflora* can withstand to +50,0^{0}C, *Magnolia kobus* to +48,0^{0}C, *Magnolia liliiflora* to +45^{0}C, *Liriodendron tulipifera* to+48^{0}C. The same species were studied in Oghuz region and it was determined that *Magnolia grandiflora* can withstand to+46^{0}C, *Magnolia kobus* to +46,0^{0}C *Magnolia liliiflora* to +44^{0}C, *Liriodendron tulipifera* species leaves to 47^{0}C. In the saline soils of the Absheron Peninsula and Oguz region, Magnolia species were observed to shed their leaves early as a result of the effects of chlorine ions in the Absheron Peninsula and sulfate ions in the Oghuz region.

5.4. Pests and pathogens on the investigated plants. During the research, plant specimens infected with pests and diseases were collected, their systematic determination was carried out using determination keys and cattony cushion scale (*Icerya purchasi* Mack), Chinese wax scale (*Ceroplastes sinensis* Guer.), twospotted spider mite (*Tetranychus urticae* Koch.), vineyard snail (*Helix pomatia* Lin.) and bacterial blast (*Pseudomonas syringae* Van Hall.) were determined[24] (Fig. 9).

During the study, the occurrence frequency of pests and pathogens identified on the *Magnolia grandiflora* plant was studied (Tab. 9).

[24] Аскерова, П.С. О вредителях и заболеваниях некоторых видов магнолии в условиях Абшерона //Вестник Нижневартовского Государственного Универстета, -2022. вып.1, -с.29-36.

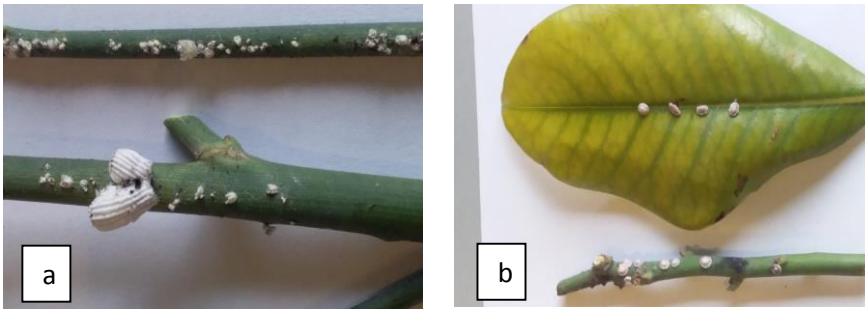

Figure 9. *Icerya purchasi* (a) and *Ceroplastes sinensis* (b) pest observed on shoot and leaves of southern big-flower magnolia

Table 9. Frequency of occurrence of insect pests and pathogens on southern big-flower magnolia plant in Absheron

Type of pest or pathogen	Plant organs				Frequency of occurrence
	Leaf	Shoot	Branch	Stem	
Cattony cushion scale	+		+	+	++
Chinese wax scale	+		+		+ +
Twospotted spider mite	+				+ + +
Vineyard snail	+	+	+	+	+ +
Bacterial blast	+				+

Conditional signs: "+" weak infection, "++" moderate infection, "+++" strong infection

As a result of the study, it was found that the southern big-flower magnolia plant is heavily infected with the twospotted spider mite.

The spread and density of some pest organisms on the southern big-flower magnolia plant were studied in *ex situ* conditions, and it was determined that the risk of infection with a number of dangerous pests and pathogens is high.

Infection of *Magnolia grandiflora* taxon with cattony cushion scale and Chinese wax scale was found to be 65.0, -71.0%, and its density was 1.8-2.1 points.

In the course of the research, golden-eyed lacewing and its eggs were observed on *Magnolia liliiflora* species in Oghuz region (Fig. 10).

Figure 10.Eggs laid by *Chrysoperla carnea* on the leaves of *Magnolia liliiflora* (Oghuz region)

The female golden-eyed lacewing once lays an oval-shaped, greenish or yellowish egg, which attaches itself to the leaves and stems of plants by a silk thread.

The pupa hatch out in three to six days, feed and grow. After hatching out, the pupa move to the leaf stalk or other secondary organs of the plant and start looking for their victims. They lead an active predatory lifestyle, at different stages of ontogenesis they feed mainly on aphid, but as an alternative food source they also feed on ticks and scale pupa, mature individuals and white butterflies**.**

The following pathogens were identified on the studied plants:

In the experimental area of the Institute of Dendrology, bacterial blast (*Pseudomonas syringae* Van Hall.) forms brown spots of irregular shape on the leaves of southern big-flower magnolia species. The bacterium enters the intercellular space from damaged tissues of the leaf parenchyma. The bacterium secretes a number of enzymes or toxic secretions, causing the destruction of the surrounding cells. At this time, spots of different colors and shapes appear on plant leaves.

In Absheron, chemical control measures were also carried out against the dangerous scale types that damage magnolia species. For this purpose, dentis (25% e.c.), desis (2.5% e.c.), fastak (10% e.c.) and polygor (40% e.c.) preparations were used. In order to study the

biological effectiveness of the preparations, pests were counted before and 15 days after spraying and evaluated.

During the research, it was found that as a result of the use of chemical preparations, the quantity of cattony cushion scale decreased up to 2 times compared to the control plants.

CHAPTER VI. COMPONENT COMPOSITION OF ESSENTIAL OILS OBTAINED FROM THE FLOWERS OF THE INTRODUCED *MAGNOLIA GRANDIFLORA* AND *M. LILIIFLORA* SPECIES

The component composition of the essential oils obtained from the flowers of the introduced *Magnolia grandiflora* and *M. liliiflora* species was comparatively studied.

The research work was carried out in the spring, during the mass flowering phase of plants, the hydrodistillation (Ginzberg) method was used to obtain essential oils.

Chromatography of the component composition of EO of *M. liliiflora* species is presented in figure 11.

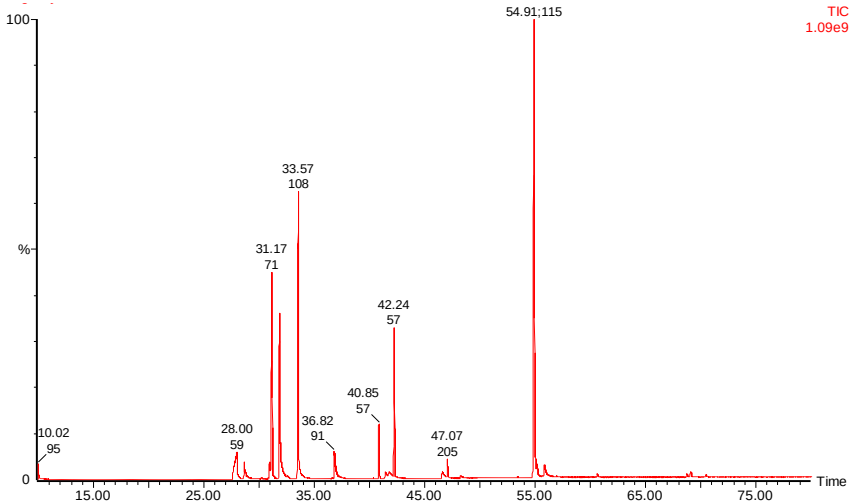

Figure 11. Chromatography of EO of *Magnolia liliiflora* species

Six main components of the essential oil of *Magnolia liliiflora* species were major components. They are propanol-2 (5,13%),

linalool (12,22%), phenylethyl alcohol (13,89%), phenylethyl acetate (19,45%), Octanol, 2-(phenylmethylene) (29,52), 4-tert-Butylcyclohexyl acetate (6,80%). Major components made up 87.01% of the total oil. 12.99% of the components in the oil were minor components. All components were found to be oxygen-containing compounds. The number of major components, which make up 84.7% of the essential oil of *M.grandiflora* , is 7: 1,8 cineol (eucalyptole) (28,5%), geranyl tiglate (12,5%), cyclohexanone, (11,1%), caryophyllene(9,5%), 2-Phenylethyl tiglate8,5%, linalol(8,2%), estrogole (6,4%). The quantity of remaining 16 minor components fluctuates between 0.1-2.1%. The terpenes in the oil are 17.4%. The essential oil of this species is dominated by oxygenated compounds and is 82.6% (Fig. 12).

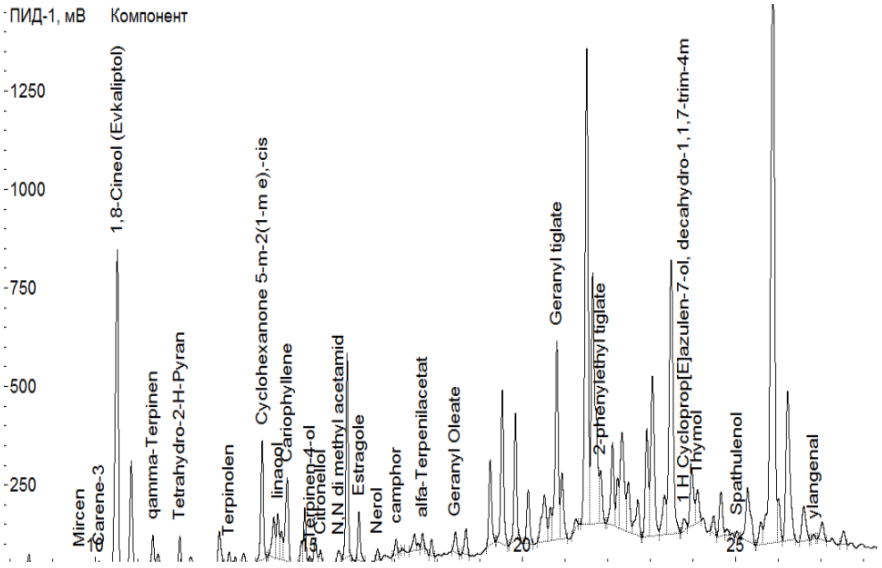

Figure 12. Composition of essential oil of *M. grandiflora* species

As one of the important issues during the application of the researched plants to production, the dynamics of changes in the amount of essential oils and physico-chemical indicators of *Magnolia grandiflora* and *Magnolia liliiflora* species were studied. The results of the studies showed that the dynamics of accumulation of EO in the

species *Magnolia grandiflora* and *Magnolia liliiflora* increases sharply from the pullulation and budding phases to flowering, and then decreases until the moment of fruit ripening. The maximum accumulation of EO occurs during the mass flowering phase, but, of course, there are differences in their quantity.

CHAPTER VII. ASSESSMENT OF PROSPECTS AND POSSIBILITIES OF USE OF THE STUDIED PLANTS IN ABSHERON CONDITIONS ACCORDING TO THEIR LIFE INDICATORS

7.1. The prospect of introduction of the studied plants. During the dissertation work, perspectivity of research materials belonging to the genera *Magnolia* L. and *Liriodendron* L. in all periods of the life cycle was studied in terms of vitality indicators in *ex situ* conditions (Tab. 10).

Table 10. Assessment of the prospects of plants studied in *ex situ* conditions

№	Species	Life form / Cultural conditions	Plant age, year	Indicators of vitality								General assessment	
				Shoot lignification	Drought resistance	Cold resistance	Maintenance of habitus	Shoot formation	Growth	Generative reproduction	Propagation in culture	Sum of vitality indicators	Promising group
Magnolia L.													
1.	*Magnolia grandiflora*	A	14	20	8	9	4	3	3	10	5	61	I
2.	*Magnolia kobus*	A	15	20	8	10	5	3	3	7	4	59	I
3.	*Magnolia liliiflora*	K	11	20	7	9	4	3	3	7	5	58	I
Liriodendron L.													
4.	*Liriodendron tuliipifera*	A	12	20	5	9	4	3	3	5	4	53	II

Since all the studied plants are young, those taxa are included in the group of young plants.

As can be seen from Table 10, species belonging to either *Magnolia* L., or *Liriodendron* L. genera were rated low (3) in terms of shoot formation and growth indicators.

From the results of the research, it was determined that the plants, perspectivity of which are studied have different sustainability characteristics depending on their individual biological and ecological characteristics.

According to the life indicators on the promising scale; it was found that 3 species (highly promising) were included in group I, and 1 species was included in group II (promising) by scoring somewhat less (53) than the representatives included in group I.

7.2. The main directions and practical importance of the use of studied plants. During the research, a 5-point assessment scale was used to determine the use of taxa belonging to the genera *Magnolia* L. and*Liriodendron* L. in landscape architecture[25].

The studied taxa received the highest score in terms of forms of use in single and group planting forms. When analyzing the indicators of single and group use of forms belonging to the *Magnolia grandiflora* species, it was found that *Liriodendron tuliipifera* taxon with high decorative qualities indicators was evaluated with the highest score (5 points) according to the indicator of single planting (Fig. 13). The rest of the taxa, as mentioned above, were evaluated with 4 points for their use in single and group form. When evaluating the studied plant species for planting in borders and creating topiary forms, it was found that these taxa received very few points (1).

When analyzing the methods of using research materials in landscape architecture (alleys, container plantings), it was found that all taxa in these forms of use give low results (2-3 points).

[25] Карпун, Ю.Н., Кунина, В.А. Особенности породного состава декоративных древесных растений, массово распространённых в районе Сочи // Садоводство и виноградарство. - 2014. № 5, -с. 43-48.

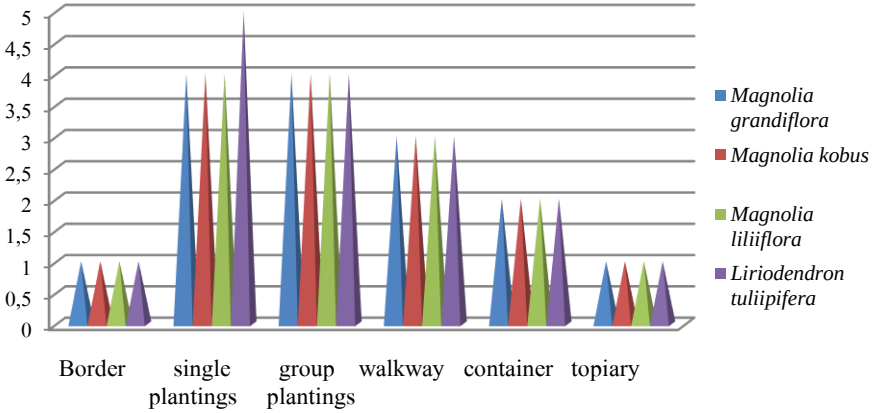

Figure 13. Assessment of the forms of use of the studied introduced species in greening

From the conducted analysis, it became clear that all research materials can be widely used individually and in groups in the parks and gardens of Baku city provided that agrotechnical measures are carried out. All these taxa are essential, medicinal and ornamental plants, and one species is melliferous.

RESULTS

1. For the first time, while studying the reproduction of *Liriodendron tulipifera and Magnolia grandiflora* species, 15-85% germination of stratified seeds was observed in *ex situ* conditions, respectively. During vegetative propagation of species, it was found that callus is formed in 20- 52,0% cuttings after 40-55 days.
2. For the first time, it was determined that pollen is more active in *Magnolia grandiflora* and *Magnolia kobus* species, and relatively weak in *Magnolia liliiflora* and *Liriodendron tulipifera* species, the optimal temperature for pollen tube and pollen germination - 25^0C, and the optimal nutrient medium (sucrose and agar-agar) ratio is 1:5.
3. It was found that all studied species are light and cold-resistant

according to their attitude to environmental factors in *ex situ* conditions, and are divided into 3 groups as high (1 species), medium (2 species) and low (1 species) according to heat resistance.

4. Five types of pests (*Icerya purchasi, Ceroplastes sinensis, Tetranychus urticae, Helix pomatia*), 1 type of disease-causing agent (*Pseudomonas syringa*) and 1 type of beneficial entomophagus (*Chrysoperla carnea*) were found on the studied plants. A number of promising insecticides have been tested against the young pupa of some pests and their effectiveness has been evaluated.
5. For the first time, while studying the component composition of essential oils of the species, 20 components (6 major) were identified in *Magnolia liliiflora* species, and 23 components (7 major) were identified in *Magnolia grandiflora* species, and the dynamics of EO accumulation in these species were studied.
6. According to the vitality indicators of the studied species, 3 species were evaluated as highly promising, 1 species was evaluated as promising, the taxa included in the low promising and no promising groups were not detected and it was determined that they did not change their life forms in *ex situ* conditions.

PRACTICAL RECOMMENDATIONS

1. Among the studied plants, the plant species included in the I-II promising group can be widely used in greening works in Absheron, as well as in other regions of Azerbaijan. Planting of *Magnolia* L. and *Liriodendron* L. species in man-made polluted areas and along highways in large industrial cities is not recommended.
2. Since lily magnolia has very low seed-bearing capacity among the studied species, it is recommended to propagate it by cutting and sprouting method.
3. For the purpose of greening, it is possible to use research materials belonging to the genera *Magnolia* L. and *Liriodendron* L. in the form of single and group planting. The species is not suitable for border, hedge, container and topiary forms.

4. Wide use of the researched species in various fields of the national economy, including the preparation of medicines, cosmetology, perfumery and etc., is considered one of the appropriate measures.

List of scientific works published on the subject of the dissertation

1.Şıxəliyeva, P.S. İriçiçək maqnoloya (*Magnolia grandiflora* L.) növünün Abşeron şəraitində çoxaldılması // "İqlim dəyişkənliyinin bitki biomüxtəlifliyinə təsiri" AMEA Biologiya və Tibb Elmləri bölməsi AMEA Dendrologiya İnstitutu, beynəlxalq elmi konfrans, -Bakı: -9-21 sentyabr, - 2017, - s.468-472.

2. Şıxəliyeva, P.S. *Magnoliaceae* fəsiləsinə aid bəzi növlərin Bakı şəhərinin landşaft memarlığı əsasında yaşıllaşdırılmasında rolu //"Urbanizasiyalı sənayeləşmə şəraitində mədəni irsin və biomüxtəlifliyin qorunması" Beynəlxalq elmi-praktiki konfrans AR Təhsil nazirliyi Azərbaycan Texnologiya Universiteti, -Gəncə: -I hissə, -2017, -s.308-311.

3. Məmmədov, T.S., Şıxəliyeva, P.S., Novruzov, V.M. *Liriodendron tulipifera* növünün Abşeron şəraitində çoxaldılması //AMEA-nın xəbərləri (biologiya və tibb elmləri), -2017. cild 72, №2, -s.77-81.

4. Шыхалиева, П.С. Некоторые биоекологические особенности виды *Magnolia* L. в условиях Апшерона// Научные Вести, -2018. №2/26, -с.60-64.

5. Shikhaliyeva, P. Introduction of *Maqnolia grandiflora* L. in Absheron Conditions, which is widely used in planting of Greenery//"The 4th Interntional Symposium on EuroAsian Biodiversity" -Kyiv: -July 03-06, -2018. -p.378.

6.Şıxəliyeva, P.S. *Magnolia grandiflora* L. növünün toxumlarının morfologiyası və botaniki təsvirin //Müasir təbiət və iqtisad elmlərinin aktual problemləri Beynəlxalq Elmi Konfrans, -Gəncə: 4-5 may, -2018. II hissə, -s.125-127.

7.Аскерова, П.С. О вредителях и заболеваниях некоторых видов магнолии в условиях Абшерона //Вестник Нижневартовского Государственного Универстета, -2022. вып.1,

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