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# Green Legacy: Plant Introduction and Dendrological Collections in Yerevan Botanical Garden: From the Past to the Future

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**Abstract:** Botanical living collections within botanical gardens are a crucial global asset for plant diversity. Special attention should be directed towards dendrological collections due to their significant contribution to biodiversity conservation, support for scientific inquiry, enhancement of educational initiatives, and engagement of the public. Introducing plants, particularly woody species, poses a significant challenge in botanical science, one that is addressed through botanical gardens and arboretums. The establishment and development of dendrological collections in botanical gardens provide a means to comprehensively represent diverse plant species from various biogeographical regions and continents. The current paper presents, for the first time, the establishment, development, status, and future perspective of dendrological collections at the Yerevan Botanical Garden, particularly in relation to the introduction of woody plants in Armenia.

**Keywords:** botanical garden; plant introduction; woody plants; biodiversity; Armenia

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## 1. Introduction

The purpose of this article is to present a comprehensive analysis of the establishment of dendrological collections with diverse geographical origins and taxonomic affiliations in the Yerevan Botanical Garden. It encompasses the authors' multi-year research on the ecological adaptation of individually imported trees, as well as the changes in the dendrological collections over the last 43 years (1980–2023), with the aim of identifying the obstacles and factors contributing to these changes and losses. This analysis will serve as a foundation for considering these factors in future endeavors and conducting plant import activities with greater purposefulness.

### *1.1. Establishment of Yerevan Botanical Garden and Dendrological Collection*

The introduction of woody plants in Armenia is mainly attributed to the efforts of botanical gardens such as those in Yerevan, Vanadzor, and Sevan, along with several dendrological parks across the republic, including Ijevan and Stepanavan. Among these, the Botanical Garden of the Institute of Botany, founded in Yerevan in 1935 and spanning approximately 80 hectares, has played a significant role. It has contributed immensely to the advancement of both theoretical and practical aspects of plant introduction and acclimatization, as well as the establishment of scientific and exhibition collections.

The soil and climatic conditions of the Yerevan Botanical Garden, nestled within a semi-desert zone, offer a favorable environment for the cultivation of numerous native and introduced plants, particularly xerophilic and xero-mesophilic species. Characterized by a continental climate, the garden experiences an average annual temperature of

+11 °C, with extremes reaching up to +40 °C in summer and as low as −25 °C in winter. The frost-free period spans around 205 days, while annual precipitation typically ranges from 350 to 360 mm, with the majority falling during the spring months. Despite these favorable conditions, certain challenges arise due to the garden's location. Situated in a basin devoid of cold air masses and elevated 200–250 m higher (1200–1250 m above sea level) than the average elevation of Yerevan city, the garden faces more severe weather conditions compared to the surrounding area, including Yerevan and the Ararat Valley. This geographical setting may not be optimal for attracting heat-loving and mesophilic highly ornamental plants, posing a challenge for diversifying the garden's plant collection in this regard: *Albizia julibrissin* Durazz., *Lonicera japonica* Thunb., *Euonymus japonicus* Wall., *Ginkgo biloba* L., *Diospyros lotus* L., *Chamaecyparis lawsoniana* (A. Murray bis) Parl., *Cupressus arizonica* Greene, etc., which grow well in Yerevan.

In the initial years following the opening of the Botanical Garden of the Academy of Sciences of Armenia, intensive efforts were initiated to establish scientific and exhibition dendrological collections. During this period, the primary objective was to comprehensively represent the diversity of dendrological compositions from various botanical and geographical regions within the Northern Hemisphere temperate zone.

Thanks to the dedicated efforts and meticulous work of several generations of specialists, the Yerevan Botanical Garden, along with its two mountain departments, has amassed a rich and diverse dendrological collection. Significant experience has been gained in the introduction and cultivation of plants, leading to the publication of numerous valuable works. These include publications such as "*Scientific Bases of Afforestation and Landscape Greening of the Armenian SSR*" [1], the *Annotated Catalog of Trees and Shrubs of Botanical Gardens and Arboretums of the Armenian SSR*, 1985 [2], and "*Scientific Bases for the Introduction of Woody Plants in Armenia*" [3], among others. These publications serve as essential resources for botanical research and conservation efforts in Armenia.

Currently, botanical gardens are exploring various methods to enhance the resilience of introduced species. Simultaneously, significant opportunities arise for introducing new economically valuable and highly ornamental species, thereby enriching the local flora with foreign plants. Plant introduction typically occurs through three main methods: folk, spontaneous, and scientific (planned) introductions. Each approach plays a role in diversifying plant collections and contributing to botanical research and conservation efforts.

### *1.2. Theoretical Aspects of Introduction of Woody Plants in Armenia*

Folk introduction has been intertwined with human history since ancient times.

In spontaneous introductions, plants are inadvertently transported to new regions through human activities, often resulting in the spread of weeds. Seeds of these plants hitch a ride with various cargoes or seed materials of cultivated plants. Due to their vigorous nature, these species can outcompete native endemic plants. According to the findings of A.M. Barseghyan and A.G. Abrahamyan [4], the area surrounding the Yerevan Botanical Garden alone harbors 78 species of alien plants previously absent from the flora of Yerevan. Among woody plants, Ailanthus altissima is notable, as it was introduced to the dry subtropical zone of Northern Armenia through various cargoes originating from the Kazakh and Tovuz regions of Azerbaijan, subsequently spreading throughout the republic.

Scientific introduction involves the deliberate attraction of valuable and useful plants using theoretically substantiated methods, which rely on specialized technical approaches. This undertaking is primarily conducted by botanical gardens, arboretums, and other specialized support points and stations. These institutions employ rigorous scientific principles and methodologies to introduce and cultivate plants for various purposes, including research, conservation, and practical applications.

At present, folk and spontaneous introductions hold relatively little significance in the overall process of plant introduction. Consequently, the term "introduction" typically refers to scientific planned introduction, which enables the deliberate and purposeful attraction and introduction of valuable plant species.

The purposeful process of scientific introduction in the botanical garden typically involves the following stages:

- Preliminary study and selection of source material for introduction.
- Mobilization of source material for introduction.
- Development of plants during introduction.
- Summarizing the introduction.

Based on the primary test analysis, it becomes possible to assess the prospects of the introduced species. If the species, growing in new conditions for several generations, successfully withstands competition from native species and reproduces naturally, it is considered naturalized and has become a "local resident". Examples of such species include Acer negundo, Ailanthus altissima, Amorpha fruticosa, and Robinia pseudoacacia, which thrive in many arid forest conditions of the South Caucasus without human intervention, gradually expanding their range. Similar observations can be made regarding *Cryptomeria japonica* (L.f.) D. Don in Adjara, *Fraxinus pennsylvanica* Marshall, *Quercus robur* Pall., *Pinus pallasiana* Lamb., *Caragana arborescens* Lam. for many regions of Armenia, *Acer negundo* L., *Ailanthus altissima* (Mill.) Swingle, *Amorpha fruticosa* L. and *Robinia pseudoacacia* L.

The acclimatization process is a lengthy one, often requiring several generations to reveal the completion period for ancient plants. Despite this, we frequently observe acclimatization changes, including the formation of new botanical forms within the given population.

## 2. Materials and Methods

*Principles and Methods Used for Introduction of Woody Plants in Yerevan Botanical Garden*

In pursuit of establishing scientific collections of woody plants, local specialists across different generations have relied on and adhered to methodical recommendations and criteria for assessing the outcomes of plant introduction work [3,5–10].

During the preliminary study and selection of source material, specialists have utilized various methods to assess target value and feasibility. These include the use of climatic and agro-climatic analogues [11–15], ecological and historical studies of flora [16], floro-genetic analyses [17], and introduction by generic complexes [18,19], among others.

Studies on seasonal development and plant growth rhythms have been conducted following methodological instructions provided by P.I. Lapin and C.V. Sidneva [20], G.N. Zaitsev [21], N.E. Buligin [22], and Zh.H. Vardanyan [23].

Each of these methods possesses its own set of advantages and limitations, and depending on the circumstances, all have been successfully employed in the introduction of woody plants into the botanical gardens of Armenia. Moreover, the preliminary study and selection of plants for introduction invariably entail a comprehensive analysis of literature encompassing the taxonomy, geography, and ecology of all species within the generic complex.

The mobilization of source material for plant introduction involves various methods, including collecting material during expeditions, obtaining seeds through "Delectus Seminum" or seed exchange lists, and purchasing material from trading companies and nurseries, among other approaches.

The development of introduced species encompasses several key approaches: growing plants in open ground while considering their environmental properties; implementing artificial changes in biomorph, such as grafting onto resistant rootstocks or grafting to accelerate the transition to the generative phase of development; influencing the development of plants at different stages of ontogenesis to enhance their stability and productivity; and applying agrotechnical methods of influence, as well as microbiological, physiological, and biochemical interventions such as growth stimulants and hormones

Summarizing the results of plant introduction entails assessing the viability of a given species. Some plants demonstrate the ability to naturalize and reproduce without human assistance, while others require cultivated conditions to complete their full development cycle and produce viable offspring. Fruit production may vary, with some species ex-

hibiting annual or almost annual fruiting, irregular fruiting, or even single instances of fruiting. Additionally, some plants may fail to produce normal flowers or fruits under certain conditions.

The primary principle guiding the creation of expositional dendro collections at the outset of a botanical garden is traditionally eco-geographical. Accordingly, expositional collections showcasing dendroflora from regions such as the Caucasus, Crimea, Euro-Siberia, North America, and East Asia were established in the Yerevan Botanical Garden, encompassing approximately 16 hectares. These collections serve as focal points within the garden, housing the main dendrological collection, which boasts around 1000 species and varieties belonging to 135 genera from 59 families.

Subsequently, following the 1970s, scientific collections were established based on entirely different principles. These collections focused on specific categories such as conifers, beautifully flowering shrubs and garden forms, woody lianas, as well as a variety of highly decorative and species-rich genera—*Syringa*, *Sorbus*, *Lonicera*, *Spiraea*, etc. [19,24–28].

The assessment of the potential of species and forms from different eco-geographic regions by genera was primarily based on the performance of introduced alien dendroflora representatives in the conditions of the Yerevan Botanical Garden, as well as their level of ecological adaptation in urban green plantations of Yerevan [29,30]. Accordingly, three distinct groups were identified: High adaptability—This group comprised species and forms where 60–80% showed high adaptability in the conditions of the Yerevan Botanical Garden. Average adaptability—Species and forms falling within this group exhibited adaptability levels where 60–80% showed high adaptability. Low adaptability—This group encompassed species and forms where only 40% or less demonstrated high adaptability.

## 3. Results and Discussion

### *3.1. Past and Current Status of Dendrological Collections in Yerevan Botanical Garden*

Long-term research has demonstrated that species from various dendrofloristic regions, each with its distinct floristic origin, respond differently within the environment of the Yerevan Botanical Garden. Trees and shrubs originating from dry subtropical regions, particularly evergreen species, are adversely affected by frost, alkaline soil conditions, low relative air humidity (particularly during winter dry spells), and high temperatures. Similarly, species from mesophilic forests in certain regions of the South Caucasus exhibit poor tolerance to high temperatures and relative air humidity [31,32].

In the Yerevan Botanical Garden, xerophilous plants and those originating from desert environments are scarcely affected. Plants of boreal and Caucasian origin also demonstrate significant resilience, particularly representatives of certain genera, i.e., *Acer*, *Ulmus*, *Sorbus*, *Lonicera*, *Betula*, *Berberis*, *Viburnum*, etc.

Certain genera, particularly those of boreal origin, are susceptible to the dry summer air and heat conditions in Yerevan, for instance, *Fagus orientalis* Lipsky, *Carpinus betulus* L., *Corylus colurna* L., *Tilia caucasica* Rupr. and *T. cordata* Mill., *Sambucus nigra* Marshall, *Populus tremula* L. Early leaf shedding often commences in August due to the combination of dry air and heat.

Hence, the primary factors influencing plant introduction in the Yerevan Botanical Garden are the low negative temperatures during winter and the high positive temperatures during summer, along with low relative air humidity and alkaline soil conditions.

To address and alleviate the impact of unfavorable and limiting conditions, several measures have been implemented to enhance the growth and development of various plant species. These measures include the selection of ecotypes, seed and seedling hardening, controlling seedling density, providing shading and irrigation, and other techniques.

Long-term studies have affirmed that woody plants exhibit significantly lower ecological plasticity and adaptability compared to herbaceous plants. Within the evolutionary spectrum spanning from trees to perennials, the adaptive response to unfavorable environmental conditions consistently increases. In the introduction of trees and shrubs, photoperiodism plays a crucial role, ensuring that the seasonal development rhythm of

introduced species aligns with the climatic rhythms of their new habitat. Generally, woody plants tend to be more challenging to propagate than herbaceous ones. The majority of species require special pre-sowing preparation for their difficult-to-germinate seeds: stratification (representatives of the family *Rosaceaea*), hydrothermal treatment (representatives of the family *Fabaceae*), treatment with various acids (representatives of the family *Juniperus*), stimulators, and ultrasonic methods [33]. Representatives of certain genera (such as *Salix* and *Populus*) and cultivated varieties typically reproduce vegetatively with high success rates [28]. Woody plants often enter the fruiting period late, which can pose challenges in new habitats—under introduction conditions, they may produce non-germinating seeds, complicating their reproduction and practical introduction (*Salix*, *Populus* etc.).

It has been observed that woody plants from southern regions exhibit vigorous growth in the conditions of Yerevan. In contrast, representatives of North American dendroflora typically initiate their growing season later in the spring and conclude earlier *(Acer saccharinum* L., *Crataegus macracantha* Lodd. Ex Loudon) in fall than species introduced from East Asia (*Berberis amurensis* Rupr., *Lonicera maackii* (Rupr.) Herder) and particularly those from the Caucasus region (*Lonicera caprifolium* Schousb.). This resilience makes them rarely susceptible to late spring and early autumn frosts [34,35]. Unlike previous groups, representatives of ancient flora exhibit a more consistent seasonal rhythm of growth and development.

Introduced plants of northern and high-mountainous origin (such as *Betula litwinowii Doluch.*, *Padus racemosa (Lam.) Gilib*, and *Ulmus laevis Pall.*) in Yerevan typically start bearing fruit at a younger age compared to their natural habitats. Moreover, the fruiting productivity of boreal species in Yerevan is notably higher than that of species originating from more southern regions. Many of the latter (including *Vitex agnus-castus* L., *Campsis radicans* (L.) *Seem.*, *Catalpa ovata G. Don*., and others) often fail to fully ripen their seeds due to the shorter growing season. Additionally, boreal mesophilic species (like *Tilia cordata*, *Aesculus hippocastanum* L., and *Quercus robur*) in Yerevan are affected by dry air and soil conditions, which also negatively impacts seed quality.

Among the array of climatic factors negatively impacting introduced woody species, lowered temperatures, low relative air humidity, unstable snow cover, warm southern winds, alkaline soil reaction, and late spring and early autumn frosts play decisive roles.

It has been observed that in winter-resistant species, the vegetative period typically ends 10–60 days before the onset of frost due to a combination of climatic factors negatively affecting introduced tree species. Among these factors, low temperatures, low relative air humidity, unstable snow cover, warm southern winds, alkaline soil reaction, and late spring and early autumn frosts play decisive roles (*Quercus robur*, *Tilia cordata*, *Ulmus laevis*, *Acer tataricum* L., *Padus racemosa*, etc.). Heat-loving introduced plants typically experience a very late end to the vegetative period. However, their leaves are often damaged by early autumn frosts, resulting in fallen leaves with a higher percentage of carbohydrates (*Quercus castaneifolia* C.A.Mey, *Diospyros lotus* L., *Parrotia persica* (DC.) C.A. Mey, *Punica granatum* L., etc.). Regulated watering under introduction conditions can increase the degree of shoot lignification and decrease the amount of carbohydrates in the leaves. Additionally, the winter resistance of introduced species can be significantly enhanced through agricultural practices.

While discussing the botanical-geographical regions of Euro-Sibiria, the Caucasus, Eastern Asia, and Northern America regarding the assessment of their dendroflora as potential sources for introducing woody plants into the Yerevan Botanical Garden, it was revealed (Table 1) that:

- Out of nearly 2100 species of Euro-Siberian dendroflora, approximately 560 species hold promise for introduction into Armenia's botanical gardens. Particularly notable are the following families: *Betulaceae*, *Caprifoliaceae*, *Fagaceae*, *Fabaceae*, *Pinaceae*, *Rosaceae*, and *Salicaceae*.
- From a floristic standpoint, the Caucasus stands out as one of the richest and most distinctive regions worldwide. It hosts over 840 species of woody plants. In terms

of introduction potential, nearly 350 species are deemed promising. Families such as *Cupressaceae*, *Aceraceae*, *Fagaceae*, *Rosaceae*, *Salicaceae*, and *Oleaceae* boast the highest richness in valuable introduced species.

- The Chinese Japanese floristic region serves as a key hub for the introduction and augmentation of cultural dendroflora collections. Approximately 370 dendroflora representatives from continental and temperate provinces of this region, along with inhabitants of high-mountainous areas in subtropical provinces, hold promise for further introduction. The most promising sources of introduced species come from families such as *Pinaceae*, *Celastraceae*, *Betulaceae*, *Rosaceae*, *Salicaceae*, *Aceraceae*, *Fabaceae*, *Caprifoliaceae*, and *Tiliaceae*.
- The dendroflora of North America is notable for its rich and diverse species composition, comprising around 845 species. Among these, nearly 500 species of woody plants hold promise for Armenia. These species belong to families such as *Cupressaceae*, *Aceraceae*, *Anacardiaceae*, *Betulaceae*, *Fabaceae*, *Fagaceae*, *Oleaceae*, *Rosaceae*, and *Salicaeae*.

**Table 1.** The potential of various foreign dendroflora can be assessed based on the presence of taxa at different levels: families, genera, and species.

| Names of the Foreign Dendroflora | Number of Taxa Intorduced/Subject to Introduction | | | | Name of Larger Taxa | | Number of Species | Prospectiveness of the Genera (I-High, II-Avarage, III-Low) | |
|---|---|---|---|---|---|---|---|---|---|
| | Number of Introduced Species | Family | Genus | Species | Family | Genus | | Region | Grade |
| 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 |
| Eurosibirian | 179 | 37 | 85 | 560 | *Pinaceaea* | *Pinus* | 14 | Eurasian-Arctic | III |
| | | | | | *Betulaceae* | *Betula* | 9 | European | I |
| | | | | | *Caprifoliaceae* | *Lonicera* | 15 | Atlantic-European | III |
| | | | | | *Rosaceae* | *Cotoneaster* | 8 | Pontiac | II |
| | | | | | | *Crataegus* | 6 | Russian | II |
| | | | | | | *Rosa* | 15 | Eastern-Siberian | III |
| | | | | | | *Sorbus* | 5 | Eastern-Siberian | III |
| | | | | | | *Spiraea* | 5 | Atlantic-Sayansk | I |
| | | | | | *Rhamnaceae* | *Rhamnus* | 8 | Daurik | II |
| | | | | | *Salicaceae* | *Salix* | 15 | Chukotskaya | III |
| Caucasus and Crimea | 208 | 50 | 112 | 350 | *Cupressaceae* | *Juniperus* | 7 | Pre Caucasusian | II |
| | | | | | *Aceraceae* | *Acer* | 9 | Pre Caucasusian | II |
| | | | | | *Betulaceae* | *Betula* | 5 | Pre Caucasusian | II |
| | | | | | *Caprifoliaceae* | *Lonicera* | 6 | Dagestanian | I |
| | | | | | *Fagaceae* | *Quercus* | 13 | Dagestanian | I |
| | | | | | *Oleaceae* | *Fraxinus* | 5 | Western Transcaucasus | II |
| | | | | | *Rhamnaceae* | *Rhamnus* | 5 | Western Transcaucasus | II |

**Table 1.** *Cont.*

| Names of the Foreign Dendroflora | Number of Taxa Intorduced/Subject to Introduction | | | | Name of Larger Taxa | | Number of Species | Prospectiveness of the Genera (I-High, II-Avarage, III-Low) | |
|---|---|---|---|---|---|---|---|---|---|
| | Number of Introduced Species | Family | Genus | Species | Family | Genus | | Region | Grade |
| Caucasus and Crimea | 208 | 50 | 112 | 350 | *Rosaceae* | *Crataegus* | 11 | Eastern Transcaucasus | I |
| | | | | | | *Pyrus* | 14 | Eastern Transcaucasus | I |
| | | | | | | *Rosa* | 17 | Eastern Transcaucasus | I |
| | | | | | | *Sorbus* | 11 | Eastern Transcaucasus | I |
| | | | | | *Salicaceae* | *Populus* | 7 | Eastern Transcaucasus | I |
| | | | | | | *Salix* | 21 | Eastern Transcaucasus | I |
| | | | | | *Tiliaceae* | *Tilia* | 5 | Talish | II |
| | | | | | *Ulmaceae* | *Ulmus* | 5 | Talish | II |
| Eastern Asia | 156 | 38 | 78 | 370 | *Celastraceae* | *Euonymus* | 9 | Northern Chinese | II |
| | | | | | *Betulaceae* | *Betula* | 18 | Province of North coastal zone of China | I |
| | | | | | *Rosaceae* | *Spiraea* | 10 | Northern Japanese | I |
| | | | | | | *Sorbus* | 7 | Northern Japanese | I |
| | | | | | *Salicaceae* | *Salix* | 14 | Central Chinese | II |
| | | | | | *Aceraceae* | *Acer* | 19 | Eastern Chinese | II |
| | | | | | *Fabacea* | *Caragana* | 8 | Nagorno-Yunnan | II |
| | | | | | *Caprifoliaceae* | *Lonicera* | 10 | Southern Chinese | III |
| | | | | | | *Sambucus* | 5 | Southern Chinese | III |
| | | | | | *Saxifragaceae* | *Ribes* | 8 | Southern Japanese | III |
| | | | | | *Tiliaceae* | *Tilia* | 8 | Himalayan | III |
| Northern America | 220 | 53 | 118 | 500 | *Pinaceae* | *Picea* | 5 | Canadian | II |
| | | | | | *Cupressaceae* | *Juniperus* | 11 | Canadian | II |
| | | | | | | *Thuja* | 11 | Canadian | II |
| | | | | | *Aceraceae* | *Acer* | 15 | Canadian | II |
| | | | | | *Anacardiaceae* | *Rhus* | 15 | Appalachian | I |
| | | | | | *Caprifoliaceae* | *Lonicera* | 8 | Atlantic Lowland | I |
| | | | | | | *Sambucus* | 5 | Atlantic Lowland | I |
| | | | | | | *Symphoricarpos* | 7 | Atlantic Lowland | I |
| | | | | | *Fabaceae* | *Amorpha* | 10 | North American prairie | II |
| | | | | | | *Robinia* | 12 | North American prairie | II |
| | | | | | *Fagaceae* | *Quercus* | 9 | North American prairie | II |
| | | | | | *Juglandaceae* | *Juglans* | 5 | Sitka-Oregon | III |
| | | | | | *Oleaceae* | *Fraxinus* | 10 | Sitka-Oregon | III |

**Table 1.** *Cont.*

| Names of the Foreign Dendroflora | Number of Taxa Intorduced/Subject to Introduction | | | | Name of Larger Taxa | | Number of Species | Prospectiveness of the Genera (I-High, II-Avarage, III-Low) | |
|---|---|---|---|---|---|---|---|---|---|
| | Number of Introduced Species | Family | Genus | Species | Family | Genus | | Region | Grade |
| Northern America | 220 | 53 | 118 | 500 | *Rosaceae* | *Crataegus* | 14 | Rocky mountains | II |
| | | | | | | *Rosa* | 9 | Rocky mountains | II |
| | | | | | | *Spiraea* | 14 | Rocky mountains | II |
| | | | | | *Saxifragaceae* | *Philadendron* | 19 | Californian | II |
| | | | | | | *Ribes* | 10 | Californian | II |
| | | | | | *Ulmaceae* | *Celtis* | 10 | Nagorno-Mexican | III |
| | | | | | *Vitaceae* | *Vitis* | 12 | Nagorno-Mexican | III |

We also conducted an assessment of the prospects for introducing some valuable and rich genera representatives already present in the dendrological collections of Yerevan Botanical Garden. The data for this assessment are presented in Figure 1.

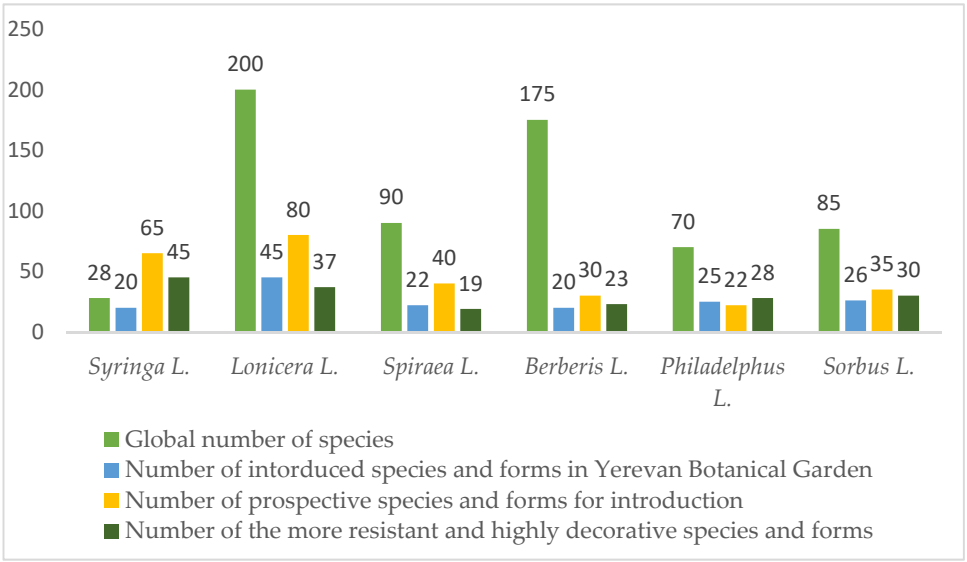



**Figure 1.** Assessment of the potential of some highly decorative genus representatives.

An analysis of the taxonomic composition of the dendrological collections of the Yerevan Botanical Garden over the last 40 years was conducted. According to the results, the collection reached its peak richness in the 1980s. However, due to the socioeconomic crisis in Armenia from 1990 to 1995, significant damage was inflicted upon the dendrological collections of the republic's botanical gardens, particularly the Yerevan Botanical Garden. Consequently, the dendrological composition experienced a sharp decrease of 25–30%, with only 23 out of 82 genera remaining unaffected (see Table 2).

**Table 2.** The change (reduction) in the taxonomic composition of the dendrological collections of the Yerevan Botanical Garden over the last 43 years (1980–2023).

| Families with More Than 10 Species and Garden Forms | Genus | Number of Species by 1980 | Number of Species by 2023 | Number of Lost Species from the Collection | Names of Lost Species and Garden Forms | Percentage of Decrease in the Dendrocollection |
|---|---|---|---|---|---|---|
| *Cupressaceae* | *Biota* | 7 | 4 | 3 | *orientalis* L. "Filiformis" | 42.9 |
| | | | | | *orientalis* Endl. "Nana" | |
| | | | | | *orientalis* Endl. "Rosedalis compacta" | |
| | *Cupressus* | 1 | - | 1 | *arizonica* Greene | 100.0 |
| | *Juniperus* | 23 | 15 | 8 | *chinensis* L. | 34.8 |
| | | | | | *foetidissima* Willd. "Squarrosa" | |
| | | | | | *horizontalis* Moench "Glomeratta" | |
| | | | | | *turkestanica* Kom. | |
| | | | | | *virginiana* L. "Aureo-spicata" | |
| | | | | | *virginiana* L. "Glauca" | |
| | | | | | *virginiana* L. "Pyramidalis" | |
| | | | | | *virginiana* L. "Venusta" | |
| | *Thuja* | 11 | 7 | 4 | *occidentalis* L. "Douglasii Pyramidalis" | 36.4 |
| | | | | | *occidentalis* L. "Elwangeriana" | |
| | | | | | *occidentalis* L. "Filiformis" | |
| | | | | | *occidentalis* L. "Hoveji" | |
| *Pinaceae* | *Abies* | 3 | 1 | 2 | *cilicica* Carr. | 66.7 |
| | | | | | *pinsapo* Boiss. | |
| | *Cedrus* | 1 | - | 1 | *deodara* (D. Don.) G. Don fil. | 100.0 |
| | *Larix* | 5 | 1 | 4 | *decidua* Mill. | 80.0 |
| | | | | | *laricina* (Du Roi) C. Koch | |
| | | | | | *leptolepis* Gord. | |
| | | | | | *polonica* Racib. | |
| | *Pinus* | 7 | 3 | 4 | *banksiana* Lamb. | 57.1 |
| | | | | | *excelsa* Wall. | |
| | | | | | *jeffreyi* Grev. et Balf. ex Murr. | |
| | | | | | *ponderosa* Dougl. | |
| | *Picea* | 9 | 5 | 4 | *abies* (L.) Farst. "Pyramidata" | 44.4 |
| | | | | | *engelmanii* Engelm. | |
| | | | | | *engelmanii* Engelm. "Glauca" | |
| | | | | | *glauca* (Moench) Voss. | |

**Table 2.** *Cont.*

| Families with More Than 10 Species and Garden Forms | Genus | Number of Species by 1980 | Number of Species by 2023 | Number of Lost Species from the Collection | Names of Lost Species and Garden Forms | Percentage of Decrease in the Dendrocollection |
|---|---|---|---|---|---|---|
| *Aceraceae* | *Acer* | 22 | 10 | 12 | *ginnala* Maxim. | 54.5 |
| | | | | | *hyrcanum* Fisch. et Mey. | |
| | | | | | *ibericum* Bieb. | |
| | | | | | *mono* Maxim. | |
| | | | | | *negundo* L. "Pseudo-californicum" | |
| | | | | | *negundo* L. "Violaceum" | |
| | | | | | *pseudoplatanus* L. "Gandyeryi" | |
| | | | | | *saccharinum* L. | |
| | | | | | *saccharinum* L. "Laciniatum" | |
| | | | | | *saccharum* Marsh. | |
| | | | | | *trautvetteri* Medw. | |
| | | | | | *velutinum* Boiss. | |
| *Berberidaceae* | *Berberis* | 11 | 6 | 5 | *aggregate* Schneid. | 45.5 |
| | | | | | *canadensis* Mill. | |
| | | | | | *densiflora* Boiss. et Buhse | |
| | | | | | *integerrima* Bunge | |
| | | | | | *orientalis* Schneid. | |
| | *Mahonia* | 2 | 1 | 1 | *repens* (Lindl.) G. Don | 50.0 |
| *Betulaceae* | *Alnus* | 3 | 2 | 1 | *sinuata* (Regel) Rydb | 33.3 |
| | *Betula* | 8 | 4 | 4 | *ermanii* Cham. | 50.0 |
| | | | | | *lutea* Michx. f. | |
| | | | | | *populifolia* Marsh. | |
| | | | | | *pubescens* Ehrh. | |
| *Caprifoliaceae* | *Lonicera* | 21 | 9 | 12 | *alpigena* L. | 57.1 |
| | | | | | *canadensis* Bartr. ex Marsh. | |
| | | | | | *dioica* L. | |
| | | | | | *edulis* Turcz. ex Freyn | |
| | | | | | *etrusca* Senti | |
| | | | | | *giraldii* Rehd. | |
| | | | | | *henryi* Hemsl. | |
| | | | | | *implexa* Ait. | |
| | | | | | *microphylla* Willd. ex Schult. | |
| | | | | | *sempervirens* L. | |

**Table 2.** *Cont.*

| Families with More Than 10 Species and Garden Forms | Genus | Number of Species by 1980 | Number of Species by 2023 | Number of Lost Species from the Collection | Names of Lost Species and Garden Forms | Percentage of Decrease in the Dendrocollection |
|---|---|---|---|---|---|---|
| *Caprifoliaceae* | *Lonicera* | 21 | 9 | 12 | *tatarica* L. "Grandiflora" | 57.1 |
| | | | | | *xylosteum* L. | |
| | *Sambucus* | 6 | 5 | 1 | *canadensis* L. | 16.7 |
| | *Symphoricarpos* | 6 | 3 | 3 | *Symphoricarpos albus* (L.) Blake "Variegatus" | 50.0 |
| | | | | | *S. occidentalis* Hook. | |
| | | | | | *S. orbiculatus* Moench "Variegatus" | |
| | *Viburnum* | 4 | 4 | - | - | 0.0 |
| | *Weigela* | 7 | 5 | 2 | *Weigela hortensis* C. Koch. "Albiflora" | 28.6 |
| | | | | | *W. praecox* (Lemoine) Bailey "Florea" | |
| *Cornaceae* | *Cornus* | 13 | 4 | 9 | *amomum* Mill. | 69.2 |
| | | | | | *baileyi* Coult. et Evans | |
| | | | | | *foemina* Mill. | |
| | | | | | *glabrata* Benth. | |
| | | | | | *obliqua* Raf. | |
| | | | | | *officinalis* Siebold et Zucc. | |
| | | | | | *pubescens* Nutt. | |
| | | | | | *stolonifera* Michx. | |
| | | | | | *stolonifera* Michx. "Flaviramea" | |
| | *Swida* | 2 | 2 | - | - | 0.0 |
| *Fabaceae* | *Albizzia* | 1 | - | 1 | *julibrissin* Durazz. | 100.0 |
| | *Amorpha* | 5 | 1 | 4 | *croceolanata* P. Wats. | 80.0 |
| | | | | | *fruticosa* var. *angustifolia* Pursh | |
| | | | | | *glabra* Poir. | |
| | | | | | *paniculata* Torr. et Gray | |
| | *Astragalus* | 6 | 1 | 5 | *aureus* Willd. | 83.3 |
| | | | | | *karabaghensis* Bunge | |
| | | | | | *lagurus* Willd. | |
| | | | | | *sosnowskyi* Grossh. | |
| | | | | | *strictifolius* Boiss. | |
| | *Caragana* | 3 | 3 | - | - | 0.0 |
| | *Cercis* | 3 | 3 | - | - | 0.0 |

**Table 2.** *Cont.*

| Families with More Than 10 Species and Garden Forms | Genus | Number of Species by 1980 | Number of Species by 2023 | Number of Lost Species from the Collection | Names of Lost Species and Garden Forms | Percentage of Decrease in the Dendrocollection |
|---|---|---|---|---|---|---|
| *Fabaceae* | *Colutea* | 3 | - | 3 | *arborescens* L. | 100.0 |
| | | | | | *cilicia* Boiss. Et Bal. | |
| | | | | | *orientalis* Mill. | |
| | *Genista* | 1 | - | 1 | *germanica* L. | 100.0 |
| | *Gleditsia* | 4 | 3 | 1 | *sinensis* Lam. | 25.0 |
| | *Gymnocladus* | 1 | 1 | - | - | 0.0 |
| | *Halimodendron* | 1 | 1 | - | - | 0.0 |
| | *Laburnum* | 2 | 2 | - | - | 0.0 |
| | *Onobrychis* | 1 | - | 1 | *cornuta* (L.) Desv. | 100.0 |
| | *Robinia* | 10 | 5 | 5 | *Robinia pseudoacacia* L. "Bella-rosea" | 50.0 |
| | | | | | *R. pseudoacacia* L. "Inermis" | |
| | | | | | *R. pseudoacacia* L. "Fusco-rosea" | |
| | | | | | *R. pseudoacacia* L. "Pyramidalis" | |
| | | | | | *R. pseudoacacia* L. "Unifoliola" | |
| | *Sophora* | 2 | 1 | 1 | *japonica* L. "Pendula" | 50.0 |
| | *Spartium* | 1 | - | 1 | *junceum* L. | 100.0 |
| | *Wisteria* | 3 | 1 | 2 | *floribunda* (Willd.) DC. | 66.7 |
| | | | | | *frutescens* (L.) Poir. | |
| *Fagaceae* | *Fagus* | 1 | - | 1 | *orientalis* Lipsky | 100.0 |
| | *Quercus* | 13 | 7 | 6 | *ilex* L. | 46.2 |
| | | | | | *imeretina* Stev. Ex Woronow | |
| | | | | | *longipes* Stev. | |
| | | | | | *petraea* (Mattuschka) Liebl. | |
| | | | | | *petraea* (Mattuschka) Liebl. "Mespilifolia" | |
| | | | | | *rubra* L. | |
| *Hydrangaceae* | *Deutzia* | 13 | 5 | 8 | *discolor* Hemsl. | 61.5 |
| | | | | | *grandiflorus* Willd. | |
| | | | | | x *lemoinei* Lemne ex Boiss. | |
| | | | | | x *rosea* (Lemne) Rehd. | |
| | | | | | x *rosea* (Lemne) Rehd. "Eximia" | |
| | | | | | x *rosea* (Lemne) Rehd. "Reflexa" | |
| | | | | | *scabra* Thunb. "Rubra" | |
| | | | | | *scabra* Thunb. "Fl. Pl. pendula" | |

**Table 2.** *Cont.*

| Families with More Than 10 Species and Garden Forms | Genus | Number of Species by 1980 | Number of Species by 2023 | Number of Lost Species from the Collection | Names of Lost Species and Garden Forms | Percentage of Decrease in the Dendrocollection |
|---|---|---|---|---|---|---|
| *Hydrangaceae* | *Philadelphus* | 20 | 10 | 10 | *californicus* Benth. | 50.0 |
| | | | | | *cordifolius* Lange | |
| | | | | | *floribundus* Schard. | |
| | | | | | *hirsutus* Nutt. | |
| | | | | | *microphyllus* A. Gray. | |
| | | | | | *satsumanus* Miq. | |
| | | | | | *sericanthus* Koehne. | |
| | | | | | *subcanus* Koehne. | |
| | | | | | *tomentosus* Wall. ex Royle | |
| | | | | | *verrucosus* Schard. | |
| *Oleaceae* | *Fontanesia* | 1 | 1 | - | - | 0.0 |
| | *Forsythia* | 1 | 1 | - | - | 0.0 |
| | *Forresteria* | 1 | - | 1 | *neomexicana* A. Gray | 100.0 |
| | *Fraxinus* | 14 | 5 | 9 | *americana* L | 64.3 |
| | | | | | *americana* var. *juglandifolia* (Lam.) Rehd. | |
| | | | | | *excelsior* var. *nana globosa* Hort. | |
| | | | | | *excelsior* var. *Pendula* Ait. | |
| | | | | | *lanceolata* Borkh. | |
| | | | | | oxycarpa Whild. | |
| | | | | | *sogdiana* Bunge | |
| | | | | | *syriaca* Boiss. | |
| | | | | | *velutina* Torr. | |
| | *Jasminum* | 1 | 1 | - | - | 0.0 |
| | *Ligustrina* | 1 | 1 | - | - | 0.0 |
| | *Ligustrum* | 7 | 1 | 6 | *acutissimum* Koehne | 85.7 |
| | | | | | *ciliatum* Sieb. “Tschonoskii” | |
| | | | | | *ibota* Sieb. | |
| | | | | | *quihoui* Carr. | |
| | | | | | *vulgare* L. “Clorocarpum” | |
| | | | | | *vulgare* L. “Pyramidale” | |

**Table 2.** *Cont.*

| Families with More Than 10 Species and Garden Forms | Genus | Number of Species by 1980 | Number of Species by 2023 | Number of Lost Species from the Collection | Names of Lost Species and Garden Forms | Percentage of Decrease in the Dendrocollection |
|---|---|---|---|---|---|---|
| *Oleaceae* | *Syringa* | 25 | 14 | 11 | *chinensis* Willd. "Duplex" | 44.0 |
| | | | | | *emodi* Wall. | |
| | | | | | *japonica* Nichols. | |
| | | | | | *komarowi* Schneid. | |
| | | | | | *microphylla* Diels | |
| | | | | | *sweginzowii* Koehne | |
| | | | | | *tomentella* Bur. et Franch. | |
| | | | | | *villosa* Vahl | |
| | | | | | *vulgaris* L. "Mr. Edward Harding" | |
| | | | | | *wolfi* Schneid. | |
| | | | | | *yunnanensis* Franch. | |
| *Ranunculaceae* | *Atragene* | 2 | - | 2 | *alpine* L. | 100.0 |
| | | | | | *sibirica* L. | |
| | *Clematis* | 25 | 3 | 22 | *apiifolia* DC. | 88.0 |
| | | | | | *brevicaudata* DC. | |
| | | | | | *campaniflora* Brot. | |
| | | | | | *cirrhosa* L. | |
| | | | | | *flammula* L. | |
| | | | | | *fusca* Turcz. "Manschurica" | |
| | | | | | *glauca* Willd. | |
| | | | | | *glauca* Willd. "Angustifolia" | |
| | | | | | x *jackmanii* 'Ernest Markham' | |
| | | | | | x *jackmanii* 'Madam Van houtte' | |
| | | | | | x *jackmanii* 'Romantika' | |
| | | | | | *ligusticifolia* Nutt. Ex Torr. Et A. Gray | |
| | | | | | *montana* Buch.-Ham. Ex DC. | |
| | | | | | *paniculata* Thunb. | |
| | | | | | *serratifolia* Rehd. | |
| | | | | | *songarica* Bunge. | |
| | | | | | *tangutica* (Maxim.) Korsh. | |
| | | | | | *viorna* L. | |
| | | | | | *virginiana* L. | |
| | | | | | *viticella* L. | |
| | | | | | *viticella* L. "Nana" | |

**Table 2.** *Cont.*

| Families with More Than 10 Species and Garden Forms | Genus | Number of Species by 1980 | Number of Species by 2023 | Number of Lost Species from the Collection | Names of Lost Species and Garden Forms | Percentage of Decrease in the Dendrocollection |
|---|---|---|---|---|---|---|
| *Ranunculaceae* | *Clematis* | 25 | 3 | 22 | *viticella* L. "*Purpurea*" | 88.0 |
| *Rosaceae* | *Amelanchier* | 1 | 1 | - | - | 0.0 |
| | *Amygdalus* | 3 | 3 | - | - | 0.0 |
| | *Armeniaca* | 2 | 1 | 1 | *mandshurica* (Maxim.) Skvorts. | 50.0 |
| | *Aronia* | 1 | 1 | - | - | 0.0 |
| | *Cerasus* | 5 | 4 | 1 | *tomentosa* (Thunb.) Wall. | 20.0 |
| | *Chaenomeles* | 2 | 2 | - | - | 0.0 |
| | *Cotoneaster* | 7 | 4 | 3 | *Cotoneaster lucidus* Schlecht. | 42.9 |
| | | | | | *C. saxatilis* Pojark. | |
| | | | | | *C. suavis* Pojark. | |
| | *Crataegus* | 18 | 8 | 10 | *armena* Pojark. | 55.6 |
| | | | | | *arnoldiana* Sarg. | |
| | | | | | *crus-galli* L. | |
| | | | | | *douglasii* Lindl. | |
| | | | | | *flabellate* (Bosc) C. Koch | |
| | | | | | *maximowiczii* Schneid. | |
| | | | | | *mollis* (Torr. Et Gray Scheele) | |
| | | | | | *nigra* Waldst. et Kit. | |
| | | | | | *oxyacantha* L. | |
| | | | | | *turkestanica* Pojark. | |
| | *Cydonia* | 1 | 1 | - | - | 0.0 |
| | *Exochorda* | 1 | 1 | - | - | 0.0 |
| | *Malus* | 10 | 4 | 6 | *coreana* hort. | 60.0 |
| | | | | | *domestica* Borkh. | |
| | | | | | *pumila* Mill. | |
| | | | | | *pumila* Mill. "Pendula" | |
| | | | | | *pumila* Mill. "Translucens" | |
| | | | | | *spectabilis* (Ait.) Borkh. | |
| | *Mespilus* | 1 | 1 | - | - | 0.0 |
| | *Padus* | 4 | 2 | 2 | *maackii* (Rupr.) Kom. | 50.0 |
| | | | | | *serotina* (Ehrh.) Agardh. | |
| | *Persica* | 1 | 1 | - | - | 0.0 |
| | *Physocarpus* | 5 | 3 | 2 | *capitatus* (Pursh) Kuntze | 40.0 |
| | | | | | *monogynus* (Torr.) A. Nelson | |

**Table 2.** *Cont.*

| Families with More Than 10 Species and Garden Forms | Genus | Number of Species by 1980 | Number of Species by 2023 | Number of Lost Species from the Collection | Names of Lost Species and Garden Forms | Percentage of Decrease in the Dendrocollection |
|---|---|---|---|---|---|---|
| *Rosaceae* | *Prunus* | 3 | 3 | - | - | 0.0 |
| | *Pyracantha* | 1 | 1 | - | - | 0.0 |
| | *Pyrus* | 11 | 9 | 2 | *regelii* Rehd. | 18.2 |
| | | | | | *ussuriensis* Maxim. | |
| | *Rosa* | 12 | 6 | 6 | *acicularis* Lindl. | 50.0 |
| | | | | | *arvensis* Huds. | |
| | | | | | *beggerana* Schrenk | |
| | | | | | *blanda* Ait. | |
| | | | | | *multiflora* Thunb. | |
| | | | | | *odorata* Sweet | |
| | *Rubus* | 3 | 2 | 1 | *laciniatus* Willd. | 33.3 |
| | *Sorbaria* | 2 | 1 | 1 | *olgae* Zinserl. | 50.0 |
| | *Sorbus* | 21 | 12 | 9 | *aucuparia* L. "Pendula" | 42.9 |
| | | | | | *hybrida* L. | |
| | | | | | *intermedia* (Ehrh.) Pers. | |
| | | | | | *latifolia* (Lam.) Pers. | |
| | | | | | *mougeottii* Soy.-Will. Et Godr. | |
| | | | | | *pohuaschanensis* (Hance.) Hedl. | |
| | | | | | *serotina* Koehne | |
| | | | | | *sibirica* Hedl. | |
| | | | | | *tamamshjanae* Gabr. | |
| | *Spiraea* | 19 | 7 | 12 | x *bumalda* Burvenich | 63.2 |
| | | | | | *cantoniensis* Lour. | |
| | | | | | *chinensis* Maxim. | |
| | | | | | *gemmate* Zbl. | |
| | | | | | *japonica* L. "Macrophylla" | |
| | | | | | *latifolia* (Ait.) Borkh. | |
| | | | | | *longigemis* Maxim. | |
| | | | | | x *margaritae* Zab. | |
| | | | | | *menziesii* Hook. | |
| | | | | | x *microthyrsa* Zab. | |
| | | | | | *nipponica* Maxim. "Tosaensis" | |
| | | | | | *pyramidata* Greene | |

**Table 2.** *Cont.*

| Families with More Than 10 Species and Garden Forms | Genus | Number of Species by 1980 | Number of Species by 2023 | Number of Lost Species from the Collection | Names of Lost Species and Garden Forms | Percentage of Decrease in the Dendrocollection |
|---|---|---|---|---|---|---|
| *Salicaceae* | *Populus* | 13 | 8 | 5 | *balsamifera* L. | 38.5 |
| | | | | | *candicans* Ait. | |
| | | | | | *deltoides* Marsh. "Eugenii" | |
| | | | | | x *schischkinii* Grossh. | |
| | | | | | *simonii* Carr. "Fastigiata" | |
| | *Salix* | 10 | 7 | 3 | *excelsa* S. G. Gmel. | 30.0 |
| | | | | | *triandra* L. | |
| | | | | | *viminalis* L. | |
| *Ulmaceae* | *Celtis* | 6 | 3 | 3 | *mississippiensis* Bosc. | 50.0 |
| | | | | | *occidentalis* L. | |
| | | | | | *reticulate* Torr | |
| | *Ulmus* | 11 | 5 | 6 | *americana* L. | 54.5 |
| | | | | | *foliacea* Gilib. "Umberaculifera" | |
| | | | | | *parvifolia* L. | |
| | | | | | *pumila* L. | |
| | | | | | *scabra* Mill. | |
| | | | | | *scabra* Mill. "Pendula" | |
| | *Zelkova* | 1 | 1 | - | - | 0.0 |
| *Vitaceae* | *Ampelopsis* | 4 | 2 | 2 | *megalophylla* Diels et Gilg | 50.0 |
| | | | | | *vitifolia* (Boiss.) Planch. | |
| | *Parthenocissus* | 4 | 4 | - | - | 0.0 |
| | *Vitis* | 8 | 3 | 5 | *candicans* Engelm. et Gray | 62.5 |
| | | | | | *champinii* Planch | |
| | | | | | *labrusca* L. | |
| | | | | | *riparia* Michx. | |
| | | | | | *vulpina* L. | |

The primary portion of valuable and highly decorative introduced species, represented by dendroflora from North America and East Asia, was lost. This loss was attributed to unsatisfactory maintenance and low ecological adaptability to the new conditions of existence.

Based on our own observations, all 262 lost species were assessed, and we attempted to determine the main factors that led to their loss under the conditions of the Yerevan Botanical Garden. Almost all species (96%) suffered from insufficient or irregular watering, leading to drought stress and ultimately the death of plants in the arid conditions of Yerevan

Botanical Garden. Additionally, around 40% of species were also damaged by extreme levels of humidity and inadequate soil conditions.

Since the 2000s, a scientific inventory of all collections at the Yerevan Botanical Garden has been conducted, and purposeful efforts to restore particularly valuable dendrological collections have been initiated (see Table 3).

**Table 3.** Introduced species for the restoration of dendrological collections in Yerevan Botanical Garden.

| Families | Name of Species and Forms | Restored Species and Forms from Previous Collections | New Species and Forms for Yerevan Botanical Garden |
|---|---|---|---|
| *Pinaceae* | *Abies nordmanniana* (Steven) Spach | | + |
| *Araliaceae* | *Aralia mandshurica* Rupr. & Maxim. | + | |
| | *Acanthopanax sesiliflorus* Seem. | | + |
| | *Eleutherococcus senticosus* Maxim. & Rupr. | | + |
| | *Kalopanax septemlobus* Koidz. | | + |
| *Betulaceae* | *Betula platyphylla* Sukaczev | + | |
| | *Ostrya virginiana* (Mill) K.Koch. | | + |
| *Caprifoliaceae* | *Weigela praecox* L.H.Bailey | + | |
| | *Viburnum alnifolium* Marshall | + | |
| | *Viburnum corylifolium* Hook.f. & Thomson | | + |
| | *Viburnum mongolicum* Rehder | | + |
| *Celastraceae* | *Celastrus loesenerii* Rehder & E.H.Wilson | + | |
| | *Euonymus alatus* (Thunb.) Rupr. | + | |
| | *Euonymus nanus M. Bieb* | + | |
| | *Euonymus verrucosus* Scop. | + | |
| | *Euonymus japonicus* Wall. | | + |
| | *Euonymus japonicus* Wall. *"Aureo-variegata"* | | + |
| *Corylaceaea* | *Carpinus caroliniana* Walter | + | |
| *Fabaceae* | *Caragana pygmaea* (L.) DC. | + | |
| | *Laburnum alpinum* J. Presl | + | |
| | *Maackia amurensis* Maxim. & Rupr. | | + |
| *Hydrangeaceae* | *Deutzia glabrata* Kom. | + | |
| | *Deutzia gracilis* Siebold & Zucc. | + | |
| | *Philadelphus pekinensis* Rupr. | + | |
| | *Philadelphus schrenkii* Rupr. | | + |
| *Lamiaceae* | *Caryopteris incana* Miq. | | + |
| *Loganiaceae* | *Buddleja japonica* Linden | | + |
| *Oleaceae* | *Fontanesia fortune* Carriere | + | |
| | *Forsythia suspensa* (Thunb.) Vahl | + | |
| | *Forsythia giraldiana* Lingelsh. | | + |
| | *Fontanesia phillyreoides* Labill. | | + |
| | *Ligustrum vulgare* L. *"Aureum"* | | + |
| *Rutaceae* | *Phellodendron sachalinense* Sarg. | | + |

**Table 3.** *Cont.*

| Families | Name of Species and Forms | Restored Species and Forms from Previous Collections | New Species and Forms for Yerevan Botanical Garden |
|---|---|---|---|
| *Rosaceae* | *Aronia melanocarpa* (Michx.) Elliott | + | |
| | *Malus floribunda* Siebold ex Van Houtte | + | |
| | *Pyrus browiczii* Mulk. | | + |
| | *Pyrus daralaghezi* Mulk. | | + |
| | *Pyrus demetrii* Kuth. | | + |
| | *Pyrus elata* (G. Klotz) M.F.Fay & Christenh | | + |
| | *Pyrus feodorovii* Mulk. | | + |
| | *Pyrus gergerana* Gladkova | | + |
| | *Pyrus hyrcana var. yeghegisi* | | + |
| | *Pyrus megrica* Gladkova | | + |
| | *Pyrus turcomanica* Maleev | | + |
| | *Pyrus zangezura* Maleev | | + |
| | *Rosa foetida* Bastard | | + |
| | *Rosa sjuniki* Jarosch. | | + |
| | *Sorbus orbicularis* (Gabrieljan) Gabrieljan | | + |
| | *Spiraea alba* Du Roi | + | |
| | *Spiraea betulifolia* Pall. | + | |
| | *Spiraea media* F. Schmidt | + | |
| | *Spiraea sargentiana* Rehder | + | |
| | *Spiraea salicifolia* L. | + | |
| | *Spiraea tomentosa* L. | + | |
| | *Spiraea trichocarpa* Nakai | + | |
| | *Spiraea alpine* Pall. | | + |
| | *Spiraea blumei* G. Don | | + |
| | *Spiraea pubescens* Lindl. | | + |
| | *Spiraea rosthornii* E. Pritz. Ex Diels | | + |
| | *Spiraea virgate* Raf. | | + |
| | *Spiraea fritschiana* Schneid. | | + |
| | *Spiraea japonica L.* "Little princess" | | + |
| | *Spiraea mongolica Maxim.* | | + |
| *Salicaceae* | *Salix fragilis* L. | | + |
| *Tamaricaceae* | *Tamarix octandra* Bunge | | + |
| *Tiliaceae* | *Tillia platyphyllos* Scop | | + |
| *Thymelaeaceae* | *Daphne transcaucasica* Pobed. | + | |

A total of 68 species and forms from 17 genera and 10 families were used to restore and enrich the dendrological collections of the Yerevan Botanical Garden. Of these, 39% were from the list of species lost during the last 43 years, while 46 completely new species and forms from 22 genera and 15 families were introduced from different regions of the world to enrich the dendrocollection of the botanical garden.

Considering that the dendroclimatic conditions of the Yerevan Botanical Garden exhibit marked originality—strict terrestrial conditions, extremely low relative humidity of the air in the summer season, and a thin soil layer (35–40 cm)—we significantly differ from conditions of neighboring botanical gardens (characterized mainly by subtropical (Tbilisi, Baku) and humid subtropical (Batumi) climatic conditions). It was impossible to compare the results of our studies and analyses of dendrocollections with similar data from other regions. Moreover, this analysis is unique not only for Armenia, but also for the entire South Caucasus region.

### *3.2. The Current Development and Future Prospects of Dendrological Collections at the Yerevan Botanical Garden*

In the last two decades, the process of restoring and enriching the collection at the Yerevan Botanical Garden has gained momentum, with new species from different regions being introduced. However, efforts have been particularly concentrated in the last five years, with various international programs, cooperation, and special attention from the country's government driving work in this direction on various scales. The largest ongoing initiative is financed by the Government of Armenia. In the 1980s, plans were made to transform a 30–35-hectare section of the garden into a large recreational space by planting drought-resistant and other tree species. However, during the 1990s socioeconomic crisis, the entire botanical garden suffered greatly from anthropogenic pressures, including illegal logging and poor maintenance. In response, the RA government initiated a recovery and development program for the Yerevan Botanical Garden in 2021. This initiative aims to revitalize the garden, restore lost biodiversity, and enhance its role as a green space for both leisure and scientific study. The aim is to establish an urban forest grove/park, providing recreational and public benefits while enhancing nature-based solutions in the local semi-desert ecosystem. The restoration program involves revitalizing the existing dendrological collections and reinstating the valuable diversity of woody plants lost over the decades by planting over 34 species of woody plants previously presented in the garden's collections. Additionally, plans include implementing a drip irrigation system and other infrastructures to ensure high-level maintenance and conservation of the dendrological collections.

## 4. Conclusions

The results of the current study shed light on the present state of the dendrocollections, losses incurred, and future directions, emphasizing the high potential of the Yerevan Botanical Garden. Currently, the Yerevan Botanical Garden is immersed in an active process of restoration and development. Collaborations with esteemed botanical institutions worldwide, such as the Kunming Institute of Botany of the Chinese Academy of Sciences, the Korea Institute of Arboretum and Botanical Gardens, the Singapore Botanic Garden, the Berlin Botanical Garden and Museum, are underway to align the Botanical Garden's restoration initiatives with international standards. A priority for further strategic development and infrastructural enhancement at the Yerevan Botanical Garden is the formulation of a new master plan adhering to high-quality standards. The strategic priorities for the garden's development encompass the introduction of new species and forms from various regions of the world, enrichment of the dendrocollections, and the expansion of research-based projects concerning the introduction and adaptation of alien woody plants in the conditions of the Yerevan Botanical Garden.

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