https://doi.org/10.46341/PI2026015
UDC 582.594.2:581.4

CHRONICLE

Collections of tropical and subtropical plants as a strategic resource of Ukraine: from scientific and cultural heritage to fundamental research

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Received: 12.10.2026 | **Accepted**: 18.10.2026 | **Published**: 27.10.2026

Abstract

The paper summarizes information on the establishment and development of the Department of Tropical and Subtropical Plants, highlights the main results of its scientific research, and outlines prospects for further research and development. Information on the collection holdings of the Department of Tropical and Subtropical Plants is presented, with particular emphasis on the major taxonomic groups of plants represented in the collections.

Keywords: Department of Tropical and Subtropical Plants, M.M. Gryshko National Botanical Garden of the NAS of Ukraine, development history, plant introduction

Authors' contributions: Roman Ivannikov – Conceptualization, Formal analysis, Data curation, Writing — original draft, Writing — review & editing. Lyudmyla Buyun – Conceptualization, Methodology, Validation, Formal analysis, Writing – original draft, Supervision, Project administration, Funding acquisition. Lyudmyla Kovalska – Software, Validation, Data curation, Supervision. Alla Zhila – Validation, Formal analysis, Investigation, Writing – review & editing. Igor Kharchenko – Resources, Writing – original draft. Myroslava Maryniuk – Resources, Writing – original draft. Oleksandr Gyrenko – Data curation, Writing – original draft. Zhanna Yaroslavska – Validation, Investigation, Resources, Project administration. Volodymyr Vakhrushkin – Resources, Supervision.

Funding: This review was prepared as part of the implementation of research programs in accordance with the departmental research project No. 409-OR, "Induction of phenotypic plasticity in tropical and subtropical plants: search for predictive markers of resilience" (2023–2027), pursuant to the decision of the Bureau of the Division of General Biology of the National Academy of Sciences of Ukraine (Minutes No. 8, November 10, 2022).

Competing Interests: The authors declare no conflict of interest.

The year 2024 marked the 50th anniversary of the formal establishment of the Department of Tropical and Subtropical Plants as an independent structural unit within the M.M. Gryshko National Botanical Garden of the National Academy of Sciences of Ukraine (NBG). The years 2026–2027 are also significant anniversaries, as the formation of the current collection of tropical and subtropical plants began immediately following the end of the Second World War. The initial plant specimens used to restore the tropical plant collection, which had been destroyed during the war, were acquired from Germany as reparations in 1946–1947. This provides a substantial timeframe to take stock of the research and introduction of tropical plants at the NBG, and to outline prospects for future scientific inquiry.

Although more than half a century has passed since the formal establishment, the history of the tropical plant collection in our

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garden began much earlier. In the preface to the book "The botanical garden and its collections" (Gryshko & Sokolovskyi, 1951), the authors note that as of January 1, 1941, the greenhouse plant holdings comprised approximately 1,000 forms. "During the temporary occupation of Kyiv by fascist invaders, the garden's collections were destroyed, and the greenhouses and orangeries were demolished".

According to archival records, in 1946, P.S. Chaban, Head of the Floriculture Department, and D.F. Lykhvar, Head of the Cultivated Flora Department, brought a collection of plants from Germany (from Dresden and Crimmitschau) that comprised 540 species, forms, and cultivars (Cherevchenko & Maiko, 1986). "Among them are interesting specimens of bromeliads and orchids, a considerable number of succulent plant species, and a significant number of taxa of begonias, rhododendrons, azaleas, and camellias" (Gryshko & Sokolovskyi, 1951). The 1951 catalog lists nearly 50 cultivars of *Camellia japonica* L. and 35 cultivars of *Rhododendron indicum* L. This collection was housed in greenhouses with a total area of 115 m^2.

Archival records indicate that the construction of a small domed greenhouse and the 'Limonarium' (lemon house), covering a total area of 585 m^2, took place between 1949 and 1954. During this period, the tropical plant collections were tended by the agronomist H.B. Yanish and the gardener A.Y. Dreyman (Cherevchenko & Maiko, 1986). In 1951, S.M. Prykhodko, a Candidate of Biological Sciences, was appointed curator of the tropical and subtropical plants collection. She also headed the Tropical and Subtropical Plants Group, which was established as a laboratory-level unit within the Floriculture Department (Cherevchenko & Chuvikina, 2002). In effect, this marks the beginning of systematic introduction work with tropical and subtropical plants at our institution. Obviously, during this period, particular attention was paid to studying the regenerative capabilities of these plants within greenhouse conditions. By this time, the total area under glass had reached 700 m^2, and the collection comprised 1,216 species, forms, and cultivars. After that, the research focused on the breeding and cultivation of the Ericaceae Juss. family representatives.

By 1967, the collection of tropical and subtropical plants had grown to 2,132 taxa. The families Ericaceae, Gesneriaceae Rich. & Juss., and Moraceae Gaudich. were particularly well represented. The collection of Indian chrysanthemums included 420 cultivars. Research was also underway regarding the acclimatization potential of *Opuntia* Mill. plants in open-ground conditions, exploring it as a source of fodder, vitamins, and water storage. Unfortunately, in the winter of 1968, the heating system in the domed greenhouse failed, resulting in the loss of a significant portion of the collection; only 800 species, forms, and cultivars remained (Cherevchenko & Maiko, 1986).

This unfortunate event subsequently became one of the reasons for a decision to reorganize the internal structure of NBG (order No. 82, March 25, 1974). The Department of Floricultural and Greenhouse Plants, whose work focused on key objectives such as the introduction, breeding, and cultivation of valuable ornamental plants, as well as their integration into the national economy, was reorganized for operational reasons. It was split into two independent structural units: the Department of Indoor Plants and the Department of Floricultural and Ornamental Plants.

One of the primary reasons for this reorganization, as cited in the order, was the slow pace at which staff from the former department were utilizing new indoor growing spaces, specifically, the recently constructed small domed greenhouse, the 'Limonarium', and the cascade-style collection greenhouses.

Leadership of the Department of Indoor Plants was entrusted to T.M. Cherevchenko, a Senior Research Fellow and Candidate of Biological Sciences, who headed the department until 1992. The core objectives of the Department of Indoor Plants were defined as follows: developing advanced methods for the propagation of orchids and carnations; and addressing the theoretical and practical aspects of interior landscaping for industrial facilities; breeding of indoor flowering plants; and the expansion, maintenance, and study of greenhouse plant collections.

The structure of the Department of Indoor Plants was approved with the following composition: the Orchids Group (curator: T.M. Cherevchenko, Senior Research Fellow,

Candidate of Biological Sciences); the Subtropical Plants Group (curator position vacant); the Succulents Group (curator: T. Borysenko); the Heather/Ericaceous Plants Group (curator: S.M. Prykhodko, Senior Research Fellow, Candidate of Biological Sciences); the Commercial Floriculture Group (curator position vacant); and the Agrochemical Laboratory (curator: L.I. Artemieva, Junior Research Fellow).

In accordance with this order, the NBG's Department of Dendrology and Park Studies was instructed to transfer the equipment of the Agrochemical Laboratory, as listed in the order, to the Department of Indoor Plants, with the transfer formalized via an official handover document. The order was issued based on decisions made during a production meeting held by the NBG's directorate on March 18, 1974, and a decision by the Academic Council on April 2, 1974. The order was signed by the Director of the NBG, A.M. Grodzinsky, a Corresponding Member of the Academy of Sciences of the Ukrainian SSR.

Subsequently, three non-structural laboratories were established within the department: a laboratory for isolated tissue culture; a laboratory for the regulation of growth and development in tropical plants; and a laboratory for the diagnosis of mineral nutrition in tropical and subtropical plants grown indoors. This was a period of intensive accumulation of collection holdings and the development of new research directions: the department evolved into a mature scientific team conducting diverse research, not only in the field of biomorphology but also in physiology, biochemistry, ecomorphology, ecoanatomy, and the biotechnology of introduced plants.

From the very first years of the department's existence as an independent unit, primary efforts were directed toward the creation and refinement of its collections. The collection of tropical and subtropical plants was established as a foundational collection, designed to represent the floristic diversity of the tropics as comprehensively as possible. The development of this collection is guided by systematic, geographical, ecological, and morphological principles.

The expansion of the collection was facilitated by the participation of department staff in extended expeditions to various floristic regions within the Neotropical and Paleotropical realms. These included voyages aboard the research vessel Akademik Vernadsky (1977, 1979, 1981, 1986, and 1991) as well as an expedition to Cuba (1988). Participation in these expeditions enabled staff to study the biological and eco-coenotic characteristics of tropical plants in their natural habitats, an insight of critical importance for their subsequent introduction into greenhouse environments (Cherevchenko & Maiko, 1986; Cherevchenko et al., 1989).

The collection incorporated plant species representing various categories of useful plants (i.e., ornamental, medicinal, and fruit-bearing) as well as species that serve as dominants within specific tropical plant formations. These are essential for developing displays based on the botanical-geographical principle, arguably the most effective approach to showcasing the floristic diversity of the tropics. During this period, the collection was expanded to include plant species exhibiting interesting morphological adaptations: *Pachypodium lamerei* Drake, *Nolina recurvata* (K.Koch & Fintelm.) Hemsl., and specimens of endemics from Madagascar – *Didierea trollii* Capuron & Rauh, *Alluaudia ascendens* (Drake) Drake, and *A. procera* (Drake) Drake. These plant species are of significant interest, as they clearly illustrate the phenomenon of morphological convergence that occurred during the course of evolution.

By 1984, the area under glasshouses reached 5,000 m^2, and the number of species, forms, and cultivars in the collection exceeded 3,000. This number remained almost unchanged for the next 20 years. During this period, research was conducted on the introduction of species and cultivars from various groups of tropical plants (such as *Gerbera* L., *Pelargonium* L'Hér. ex Aiton, and members of the Gesneriaceae family). Constraints on expanding the range of species in the collection were generally linked to technical limitations in simulating specific ecological conditions.

Cooperation with the Institute of Tropical Biology (Ho Chi Minh City), part of the National Center for Natural Science and Technology of Vietnam, was initiated, and five expeditions to Vietnam were conducted between 1989 and 2004. As a result, a collection of plants native to Southeast Asia was established (focusing primarily on the families Araceae Juss.,

Asparagaceae Juss., and Orchidaceae Juss.). The objective was to study the developmental biology of these plants under greenhouse cultivation, develop methods for their mass propagation for *ex situ* conservation, and explore the possibility of their future repatriation.

Correspondingly, NBG houses the country's finest collections of tropical plants from the Araceae and Orchidaceae families, collections that are unique within Ukraine. It also holds one of the nation's largest collections of succulent plants, assembled using an ecological-systematic approach. The collection of various cultivars of Indian rhododendron (*Rhododendron indicum*) is also unique.

Currently, the collection of the Orchidaceae family comprises 450 natural species and varieties, along with approximately 200 cultivars. The collection of tropical orchids at the NBG was initiated by T.M. Cherevchenko, who also served as its first curator. She participated in nine expeditions to the natural habitats of orchids across various floristic regions of the globe. T.M. Cherevchenko's doctoral dissertation, titled "Tropical orchids: morphobiological study and introduction into greenhouse cultivation" (Cherevchenko, 1984), was the first work of its kind in Ukraine. It laid the foundation for a multifaceted study of orchids from tropical floras, from greenhouse environments to commercial floriculture, to ensure their *ex situ* conservation. For the first time in the Soviet Union, the biomorphological characteristics of the most ornamental tropical orchid species were studied to assess the feasibility of their cultivation under indoor (greenhouse) conditions.

Over the years, the research focus regarding the orchid collection has shifted to some extent. In the early 1980s, the primary objective was to expand the collection's varietal diversity; during this period, the collection was augmented with various cultivars of *Cymbidium* Sw., *Paphiopedilum* Pfitzer, *Phalaenopsis* Blume, × *Doritaenopsis* Guillaumin, × *Brassolaeliocattleya* J.G.Fowler, × *Laeliocattleya* Rolfe, *Miltonia* Lindl., *Odontoglossum* Kunth, and × *Odontonia* Rolfe. The availability of a large volume of varietal material made it possible to select the most productive cultivars for the development and optimization of methods for seed propagation and micropropagation (Cherevchenko et al., 1982; Cherevchenko & Kushnir, 1986).

During the 1980s, the department's primary objective was to study the developmental biology of plants under greenhouse conditions and to develop methods for mass propagation and cultivation technologies for four key orchid species: *Cymbidium hybridum* hort., *Phalaenopsis amabilis* (L.) Blume, *Dendrobium phalaenopsis* Fitzg., and *Calanthe vestita* Wall. ex Lindl. (Cherevchenko, 1984; Lavrentieva, 1985; Buyun, 1986; Zaimenko, 1987; Kovalska, 1992). Large batches of plants produced via biotechnological methods were supplied to floricultural enterprises in Ukraine, Russia, and the Baltic states.

In the early 1990s, the study of rare and endangered orchid species disappearing in the wild became a priority. This research is highly relevant, given the large-scale decline in natural orchid populations across the tropics, and aligns with international priorities in nature conservation (Yaroslavska, 1999; Cherevchenko et al., 2001; Cherevchenko & Buyun, 2004).

By analyzing the ecological and biological characteristics of the species under study, examining their reproductive biology, morphostructure, and developmental cycles within a greenhouse environment, and identifying the key stages of ontomorphogenesis *in vitro*, researchers were able to develop mass propagation methods for over 25 rare and endangered orchid species (including *Cattleya* Lindl., *Laelia* Lindl., *Paphiopedilum* Pfitzer, and *Dendrobium* Sw.) (Ivannikov, 2001; Cherevchenko & Buyun, 2004). This work constitutes an essential component of *ex situ* conservation strategies for global floral biodiversity.

Over the past 30 years, the orchid collection has been curated by L.I. Buyun (Doctor of Biological Sciences), L.A. Kovalska (Candidate of Biological Sciences), and V.S. Vakhrushkin (Candidate of Biological Sciences). Currently, a new generation of curators is emerging, with O.H. Gyrenko (Candidate of Biological Sciences) as a prominent representative.

The collection of tropical orchid species at the NBG falls under the regulatory scope of the Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES). It was registered with the Ministry of Environmental Protection of Ukraine

(Notification No. 6939/19/1-10, June 23, 2004) in accordance with the regulations governing the import of wild flora specimens into Ukraine.

The collection of Araceae comprises 234 species, varieties, and cultivars across 28 genera, representing all eight subfamilies. More than half of the specimens in the collection were gathered in their natural tropical forest habitats in Brazil and Southeast Asia. Since 1982, the collection has been curated by N.O. Denysievska (Candidate of Biological Sciences), who participated in specimen collection during an expedition to the tropical regions of South America (Cherevchenko et al., 1989; Denysievska, 1992). From 1993, N.O. Denisyevska was a member of the International Aroid Society. This collection is most comprehensively represented by the genera *Anthurium* L. (46 species, cultivars, and forms) and *Philodendron* Schott (54 species, cultivars, and forms).

All *Anthurium* species bloom annually, and 42 of them produce viable seeds after artificial pollination. Of particular value are the epiphytes, hemi-epiphytes, and lianas of the genus *Anthurium* (i.e., *A. cubense* Engl., *A. gracile* (Rudge) Lindl., *A. polyschistum* R.E.Schult. & Idrobo, *A. vittariifolium* Engl., and *A. warocqueanum* T.Moore), which were sourced from the humid tropical forests of the Amazon and represent various morphotypes within this genus.

The genus *Philodendron* is represented by the full spectrum of life forms found within the family. In the greenhouse collection, 43 species bloom annually; however, only a few (i.e., *P. bipinnatifidum* Schott ex Endl. and *P. megalophyllum* Schott) produce viable seeds.

The collection also features a wide range of species characterized by ontogenetic variability, manifesting in both leaf blade shape (heterophylly) and coloration. Examples include *Pothos scandens* L., *Rhaphidophora decursiva* (Roxb.) Schott, *R. celatocaulis* (N.E.Br.) Alderw., *Epipremnum pinnatum* (L.) Engl., *Scindapsus pictus* Hassk., *Rhektophyllum mirabile* N.E.Br., *Syngonium auritum* (L.) Schott, *S. podophyllum* Schott, *S. wendlandii* Schott, *Monstera acuminata* K.Koch, *M. deliciosa* Liebm., *M. dubia* (Kunth) Engl. & K.Krause, and others. All the mentioned species bloom under cultivation. However, only *Scindapsus pictus* and *Monstera deliciosa* produce fruit containing fertile seeds.

The collection of succulent plants comprises over 850 species, varieties, forms, and cultivars, representing 145 genera and 19 families. The first curator of this collection was T.I. Borysenko, who worked in the department from 1974 to 1985 and made significant contributions to its enrichment. The results of T.I. Borysenko's introduction work were summarized in the cacti reference book (Borysenko, 1986). Since 1989, O.V. Kuchynska has served as the curator of the collection of cacti and other succulents. Currently, the collection is managed by I.V. Marchuk, a Leading Engineer. The primary focus of work with this collection is the preservation of the existing cactus collection and the expansion of the species diversity across various succulent families. At present, the collection includes approximately 400 cactus taxa representing 95 genera, as well as about 400 succulent taxa from 50 genera. The collection features succulent plants from 18 families: Agavaceae Dumort., Aizoaceae Martinov, Apocynaceae Juss., Asclepiadaceae Borkh., Asphodelaceae Juss., Asteraceae Bercht. & J.Presl, Crassulaceae J.St.-Hil., Commelinaceae Mirb., Cucurbitaceae Juss., Didiereaceae Radlk., Asparagaceae, Euphorbiaceae Juss., Lamiaceae Martinov, Liliaceae Juss., Piperaceae Giseke, Portulacaceae Juss., and Vitaceae Juss. The families Crassulaceae (135 taxa) and Asphodelaceae (70 taxa) are the most comprehensively represented within the succulent collection.

Since 1976, O.V. Kuchynska has also served as the curator of the collection of ornamental-foliage plants, which comprises species from tropical families such as Acanthaceae Juss., Begoniaceae C.Agardh, Lamiaceae, Marantaceae R.Br., Melastomataceae Juss., Piperaceae, and others. This collection currently includes over 300 taxa. The genera *Begonia* L. (56 taxa) and *Peperomia* Ruiz & Pav. (80 taxa) are the most extensively represented.

The collection of bulbous and rhizomatous plants, established by L.M. Aksionova in the 1970s, contains 215 species, varieties, and cultivars from 13 families within the order Liliales. The family Amaryllidaceae J.St.-Hil. is the most extensively represented in this collection (98 species, cultivars, and forms). The genera *Hippeastrum* Herb. (50 taxa) and *Crinum* L. (12 taxa) account for the highest number of taxa. The genus *Hippeastrum*

is represented primarily by *Leopoldii*-type hybrids, double-flowered hybrids, several species, and miniature hybrids. The family Asparagaceae is represented by 16 species, forms, and cultivars, with the South African genus *Protasparagus* Oberm. being the most prominent (Zhyla, 1993). Currently, the collection of short-rhizomatous irises (family Iridaceae Juss. comprising 14 genera and 28 species) is being actively expanded.

Southeast Asia is represented quite comprehensively by the subfamily Convallarioideae Herb. (Asparagaceae), including the genera *Aspidistra* Ker Gawl. (eight species), *Liriope* Lour. (four species), and *Ophiopogon* Ker Gawl. (six species), as well as one species each from the genera *Peliosanthes* Andrews, *Rohdea* Roth, and *Tupistra* Ker Gawl. Currently, significant attention is focused on members of the subfamily Scilloideae Burnett (Asparagaceae), which are represented in the collection by seven genera and 21 species. The genus *Eucomis* L'Hér. is the most extensively represented.

Since 1985, the collection has been curated by A.I. Zhyla, Candidate of Biological Sciences, whose research interests focus on the ontogenesis and morphogenesis of short-metameric rhizomatous and bulbous plants, specifically, the genus *Veltheimia* Gled. (Asparagaceae).

The collection of plants from the family Bromeliaceae Juss. comprises 105 species, varieties, and cultivars belonging to 20 genera across three subfamilies: Pitcairnioideae Harms, Tillandsioideae Burnett, and Bromelioideae Burnett. Since 1998, the collection has been curated by Z.M. Yaroslavska, Candidate of Biological Sciences (before this, H.K. Turenko served as curator for a long period). The subfamily Pitcairnioideae is represented in the collection by the genera *Hechtia* Klotzsch (one species), *Dyckia* Schult. & Schult.f. (five species), *Pitcairnia* L'Hér. (five species), and *Puya* Molina (two species). Plants of all these species bloom annually, and *Dyckia remotiflora* A.Dietr. as well as *Pitcairnia mirabilis* Mez produce viable seeds. The subfamily Tillandsioideae consists exclusively of epiphytic plants, represented by the genera *Guzmania* Ruiz & Pav. (three species), *Tillandsia* L. (14 species) and *Vriesea* Lindl. (five species). A special place in the collection is held by species such as *Guzmania minor* Mez, *Tillandsia usneoides* (L.) L., *T. cyanea* (A.Dietr.) É.Morren, *T. bulbosa* Hook, and *Vriesea splendens* (Brongn. ex Neumann) Lem., which were acquired from the tropical forests in the vicinity of Manaus, Brazil (Cherevchenko et al., 1989). In their natural habitats, these species form large epiphytic clusters, coexisting with orchids, ferns, and aroids. The subfamily Bromelioideae is the most comprehensively represented in the collection, comprising the genera *Acanthostachys* Link, Klotzsch & Otto (one species), *Ananas* Mill. (three species), *Billbergia* Thunb. (15 species), *Canistrum* É.Morren (one species), *Cryptanthus* Otto & A.Dietr. (11 species), *Bromelia* L. (one species), *Neoregelia* L.B.Sm. (11 species), *Nidularium* Lem. (eight species), and *Aechmea* Ruiz & Pav. (24 species).

The collection includes both epiphytic and terrestrial bromeliads originating from diverse environments ranging from humid tropical rainforests, deserts, and semi-deserts to hot tropical forest zones, arid steppes, and rocky terrain. This offers extensive possibilities for creating exhibits that showcase diverse plant communities. The collection of subtropical fruit plants (in 1974–1990 curated by T.S. Pravdziva, since 1990 curated by V.S. Vakhrushkin, a Junior Research Fellow, and currently curated by R.M. Hurieva, an Engineer) comprises ten species and approximately 15 varieties representing six genera across six families. The core of the collection consists of members of the genus *Citrus* L. (Rutaceae Juss.): lemon (*C.* × *limon* (L.) Osbeck), mandarin (*C. eticulata* Blanco), orange (*C.* × *sinensis* (L.) Osbeck), and grapefruit (*C.* × *paradisi* Macfad.). In addition to citrus fruits, the collection includes specimens of Oriental persimmon (*Diospyros* kaki Thunb., Ebenaceae Gürke), common fig (*Ficus carica* L., Moraceae), feijoa (*Acca sellowiana* (O.Berg) Burret, Myrtaceae Juss.), and pomegranate (*Punica granatum* L., Lythraceae J.St.-Hil.). The Myrtaceae family is represented by several species belonging to the genera *Eugenia* P.Micheli ex L., *Callistemon* R.Br., *Melaleuca* L., and *Psidium* L.

A special place is held by the collection of *Rhododendron indicum* cultivars, commonly referred to as Indian azaleas. S.M. Prykhodko, Candidate of Biological Sciences, played a pivotal role in establishing this collection and breeding these cultivars (Cherevchenko &

Maiko, 1986; Kvasha et al., 1993; Cherevchenko & Chuvikina, 2002). M.K. Paranenko dedicated her entire life to cultivating azaleas; it is thanks to her that we can still admire the lush blooms of plants now over 60 years old. R.P. Holovko, a chief specialist in the department, served as the curator of the collection for more than 30 years. Since August 2021, the collection has been curated by M.V. Opryshko, a leading engineer and young, talented specialist who effectively represents the third generation of curators for this collection.

The collection of *Rhododendron indicum* cultivars includes 25 historic German cultivars bred in the 1920s and 1930s (i.e., 'Professor Walters', 'Paul Schaeme', 'Adventsglocken', 'Concinna', 'Apollo', and 'Celestina') that essentially marked the beginning of the Tropical Plants Department's collection. Also present are 29 cultivars and hybrids developed within the department by S.M. Prykhodko during the 1960s and 1970s. During the winter season, specimens of various cultivars, ranging in age from 10 to 60 years, provide a continuous flowering display and are exhibited annually in the botanical garden's display greenhouses.

In 2001, five Indian azalea cultivars developed at the NBG (i.e., 'Kyivskyi Vals', 'Alenkyi Tsvetochek', 'Heroiam Voiny', 'Ohoniek', and 'Suzirya') were included in the State Register of Plant Varieties of Ukraine. These cultivars were developed by S.M. Prykhodko, R.P. Holovko, and M.K. Paranenko. In addition to Indian azalea cultivars, the collection also includes two natural species of the genus *Rhododendron* L.

The collection of *Codiaeum hybridum* hort. (Euphorbiaceae) comprised 55 cultivars and hybrids. Most recently, the collection was curated by N.V. Kharchenko, a Lead Engineer who had worked in the department since its inception (before that, the collection was curated by G.K. Turenko). The first *Codiaeum* Rumph. ex A.Juss. specimens arrived at the NBG in 1973 from the Main Botanical Garden of the Russian Academy of Sciences, Moscow, and the Tallinn Botanical Garden. Over the following 30 years, the collection was expanded through scientific expeditions and acquisitions from botanical gardens across the former USSR, including those in Moscow, Tallinn, Chisinau, Minsk, Sukhumi, and Batumi. The collection was also completed with specimens gained at commercial exhibitions. In addition to *Codiaeum* specimens, the collection includes eight species and forms of *Acalypha* L., as well as representatives of the Malvaceae, including *Abutilon* Mill., *Hibiscus* L., and *Malvaviscus arboreus* Dill. ex Cav, some of which were brought from Germany in 1946. Unfortunately, on the eve of the Russian aggression against Ukraine, the collection was left without a curator and is currently going through a difficult period.

The collection of *Camellia japonica* cultivars (Theaceae Mirb.) was established in the early 1970s, when three– to four–year-old plants were brought in from Georgia. In 1986, the collection was expanded with plant specimens of various cultivars obtained from the Sukhumi Arboretum and the "Yuzhnye Kultury" State Farm (Adler, Russia). Since 1998, it has been curated by I.I. Kharchenko, Candidate of Biological Sciences. Currently, the collection features 14 cultivars and hybrids representing all six groups defined by the International Camellia Society: single, anemone-form, peony-form, rose-form, semi-double, and double (Kharchenko, 2003).

The oldest greenhouse at the NBG is the domed greenhouse, which houses 151 taxa across 30 families. Among these, the families Araceae, Moraceae, Cycadaceae Pers., Asparagaceae, and Musaceae Juss. are the most comprehensively represented. In 2004, for the first time in its history, the domed greenhouse was opened to the public. The collection is used to create exhibits representing six of the Earth's ecological-geographical zones, as well as a section dedicated to economically useful plants. This collection includes three female specimens of *Cycas revoluta* Thunb. that have reached the reproductive stage. In addition to *C. revoluta*, the greenhouse houses two other species of the genus *Cycas* L.: *C. circinalis* L. and *C. micholitzii* Dyer. The family Zamiaceae Horan. is represented in the collection by *Ceratozamia mexicana* Brongn. and *Zamia latifolia* Lodd. ex A.DC.

Throughout the long history of the collection in the oldest greenhouse, a number of staff members have served as curators. Among them, V.I. Syrychev deserves special mention. Engineers K.M. Bardina, O.V. Afanasieva, and I.Y. Maltsov, as well as Candidate of Biological Sciences N.O. Denisyevska also served as a curator for shorter periods. Currently, the bulk of this collection has been relocated to

the Great Domed Greenhouse of the NBG. This facility is the largest of its kind in modern-day Ukraine and boasts the richest diversity of tropical flora.

Botanical gardens that house collections of tropical and subtropical plants bear a significant responsibility for the preservation and propagation of these plants. This is especially critical today, given the various restrictions (e.g., under CITES regulations) on collecting specimens from many taxonomic groups in the wild. Long-term maintenance and propagation of plants in greenhouse conditions, aimed at *ex situ* biodiversity conservation and potential repatriation, can only be achieved through a thorough study of plant developmental biology (both *in situ* and *ex situ*) and their ecological and coenotic characteristics, alongside the development of mass propagation methods and cultivation technologies.

The foundation for *ex situ* conservation of the gene pool of rare species lies in the development of effective methods for their propagation and cultivation in greenhouse environments. For orchids, which have tiny seeds and reduced embryos, *in vitro* culture is the only efficient method for mass propagation.

In 1975, a laboratory for seed and *in vitro* micropropagation was established within the Department of Tropical and Subtropical Plants, on the initiative of T.M. Cherevchenko. Here, for the first time in Ukraine, a method was developed for the seed and clonal micropropagation of tropical and subtropical plants from various taxonomic groups using *in vitro* culture. The method was based on a comprehensive study of the biology of individual development and the eco-physiological characteristics of plants. The diversity of applied greenhouse plants was very limited at the time in Ukraine, Russia, and the Baltic states. Hence, it was precisely through the work of this laboratory that the range of ornamental greenhouse plants was expanded by including orchids from the genera *Cymbidium* Sw., *Calanthe* R.Br., *Dendrobium* Sw., and *Phalaenopsis* Blume.

For the sowing of tropical orchid seeds, a nutrient medium was formulated based on Knudson's mineral salts. However, instead of using expensive and hard-to-obtain components (such as coconut endosperm or other exotic organic additives), the medium was supplemented with sodium humate (50 mg/L), peptone (2 g/L), and activated charcoal (500 mg/L). The use of this medium to germinate seeds of many species yielded positive results: it reduced germination time, increased germination rates, and accelerated seedling development. The research team was granted an author's certificate for this medium (Kushnir et al., 1981). In 1982, the V.Y. Yuriev Prize was awarded to T.M. Cherevchenko, H.P. Kushnir, and T.K. Maiko for their series of works titled "Study of the biological characteristics of tropical orchids and the development of methods for their propagation and cultivation" (Hrodzinskyi, 1982).

From 1975 to 1986, the laboratory was headed by H.P. Kushnir, a Candidate of Biological Sciences. From 1986, it was headed by A.M. Lavrentieva, a Candidate of Biological Sciences, and from 2010 by R.V. Ivannikov, a Doctor of Biological Sciences. Throughout the laboratory's existence, methods have been developed for the mass propagation of over 150 Orchidaceae species, as well as representatives of other tropical families. The laboratory team has developed and modified propagation techniques for tropical and subtropical plants belonging to families such as Orchidaceae, Proteaceae Juss., Bromeliaceae, Araceae, Cactaceae, Musaceae, Begoniaceae, Cycadaceae, Nepenthaceae Dumort., Gesneriaceae, Theaceae, etc. Orchids constitute the majority of the specimens maintained in *in vitro* culture. Methods for the mass propagation have been developed for seven species of the genus *Laelia* Adans. (including *L. lobata* (Lindl.) A.H.Kent listed in CITES Appendix I – Ivannikov, 2001), several *Cattleya* Lindl. species endemic to Brazil and Venezuela (i.e., *C. aclandiae* Lindl., *C. bowringiana* O'Brien, *C. percivaliana* (Rchb.f.) O'Brien), some species endemic to Vietnam (i.e., *Paphiopedilum delenatii* Guillaumin, *Coelogyne lawrenceana* Rolfe) and Madagascar (*Angraecum eburneum* Bory and *A. sesquipedale* Thouars).

Today, this unit has evolved into a robust biotechnology laboratory, maintaining a dynamic bank of sterile cultures comprising over 200–250 taxa. Efforts to introduce new species are ongoing; recently, sterile cultures have been established for various species and cultivars of *Sansevieria* Petagna, *Musa* L., *Cordyline* Comm. ex R.Br., *Veltheimia* Gled., and

Azalea indica L., as well as for the Cactaceae species (including the rare *Astrophytum asterias* (Zucc.) Lem.). The collection primarily consists of rare species, plants with potential for use in landscape design, and species whose *in vitro* morphogenesis offers insights into fundamental questions regarding the reproductive systems of flowering plants.

For half a century, this laboratory has served as a scientific and methodological center, contributing to the training of biotechnology specialists for numerous botanical gardens and arboreta across Ukraine.

A significant scientific achievement was the publication of the fundamental monograph "Biotechnology of tropical plants" by T.M. Cherevchenko, A.M. Lavrentieva, and R.V. Ivannikov in 2008. This monograph synthesized the results of long-term research into the biotechnology, physiology, and reproductive biology of tropical and subtropical plants. It represents a significant scholarly contribution, systematizing the theoretical foundations and practical approaches for employing biotechnological methods to conserve, propagate, study, and introduce plants with complex developmental biology, specifically species characterized by limited seed reproduction, low seed viability, or specific cultivation requirements.

A notable indicator of the unit's scientific potential is the series of dissertation research projects conducted there; of particular significance is the doctoral dissertation titled "Reproductive biology of orchids *in vitro*", defended in 2012 by R.V. Ivannikov. The research conducted within this framework has deepened fundamental understanding of the reproductive processes in tropical orchids, the specifics of their seed and vegetative reproduction, and the mechanisms that determine successful propagation and the maintenance of plant viability *ex situ*.

Furthermore, the Biotechnology Laboratory has long served as a base for a comprehensive research program aimed at developing and refining biotechnological approaches for the *in vitro* conservation of the gene pool of tropical flora. Of particular importance are studies focused on establishing and maintaining aseptic cultures, initiating and optimizing micropropagation processes, inducing regeneration, and rooting and adapting regenerated plants to *ex vitro* conditions. The application of tissue and organ culture has been viewed not merely as an effective tool for the mass propagation of valuable plants but primarily as a modern methodological approach to the long-term conservation of biological diversity and rare taxa, especially those for which traditional seed or vegetative propagation is largely ineffective.

Consequently, the unit's scientific activity has established a comprehensive research program that integrates fundamental studies of life-cycle patterns and reproduction in tropical plants with the development of applied biotechnological methods for their conservation. The results obtained hold not only theoretical significance for the advancement of botany, plant physiology, and plant biotechnology, but also direct practical value for establishing and maintaining collections of tropical and subtropical plants, preserving rare and vulnerable taxa, and ensuring the long-term *ex situ* conservation of the plant gene pool.

The introduction of tropical plants, as a method for the *ex situ* conservation of biodiversity, is inextricably linked to experimental research aimed at elucidating the physiological and biochemical characteristics that determine a plant's adaptive capacity and, ultimately, the success of the introduction process. The intensive integration of experimental research methods into introductory studies was fostered by N.V. Zaimenko, Doctor of Biological Sciences. In 1982, N.V. Zaimenko became the head of the Laboratory for the Diagnosis of Mineral Nutrition of Tropical and Subtropical Plants in Protected Cultivation, and served as the Head of the Department of Tropical and Subtropical Plants from 1992 to 1996. Moving beyond addressing specific tasks related to the development of mineral nutrition systems for tropical plants (Zaimenko, 1987), N.V. Zaimenko shifted her focus to elucidating the general patterns governing plant functioning under greenhouse cultivation conditions (Zaimenko, 1999, 2001).

One of the department's priority research areas is space biology, specifically the study of how microgravity conditions affect the anatomical, morphological, physiological, and biochemical characteristics of the family Orchidaceae (Cherevchenko & Zaimenko, 2003). In particular, T.M. Cherevchenko

proposed using epiphytic orchids as a model system to study the effects of microgravity. Experiments conducted between 1979 and 1981 demonstrated that epiphytic orchids are the most suitable group of plants for investigating the impact of dynamic weightlessness; they are undemanding regarding nutrient and water supply, and their roots exhibit a weakened geotropic response. To study the effects of prolonged space flight, 22 species of tropical terrestrial and epiphytic orchids were selected for inclusion in the Malachite micro-greenhouse (Hrodzinskyi, 1982).

For the first time in global scientific research, the growth and development patterns of higher plants under prolonged dynamic weightlessness in a sealed environment were characterized. The hypothesis regarding the weakened geotropic response of epiphytic orchids was experimentally confirmed, and the feasibility of utilizing these plants for the spacecraft interior phytodesign was prooved (Cherevchenko & Kosakovskaya, 1990).

Since 2000, T.M. Cherevchenko and N.V. Zaimenko have been members of the Committee on Space Research (COSPAR). Besides this, T.M. Cherevchenko was a member of the Council of the Central Space Agency of Ukraine.

The department's research history outline would be incomplete without mentioning T.K. Maiko, Candidate of Biological Sciences (who worked in the department from 1976 to 1995), and her contribution to the development of modern research areas concerning introduced tropical plants. The group she led included engineers I.K. Musat and N.A. Zadisenska. They investigated the physiological and anatomical characteristics of orchids, as well as the endogenous factors that determine them. Using *Cymbidium* Sw. hybrids and *Thunia marshalliana* Rchb.f. as model subjects, the team conducted the first study in Ukraine on the accumulation patterns of native growth regulators (auxins, gibberellins, and phenolic inhibitors) throughout the annual developmental cycle (Maiko et al., 1981). At the time, these findings were crucial for developing biotechnologies for promising commercial orchids. Today, these results contribute to the theoretical interpretation of biomorphological research, viewed through the lens of the reliability theory of plant systems (Cherevchenko et al., 1982). T.K. Maiko authored dozens of scientific papers focused on the hormonal regulation of growth and development in introduced ornamental tropical and subtropical plants, the species with potential for commercial floriculture.

For the past 40 years, one of the department's key research areas has been developing principles for interior landscaping across various types of spaces, as well as selecting plant species suitable for these purposes. This field of study was initiated as early as the beginning of the 1980s. In 1983, V.V. Snizhko defended the first Candidate of Sciences dissertation in the USSR titled "Decorative and bioecological features of plants in phytodesign" (Snizhko, 1983). Thanks to research conducted by department staff members V.V. Snizhko and V.B. Bohatyr (Bohatyr, 1986), the range of plants used for landscaping was significantly expanded through the introduction of new tropical species that had previously been rare even in botanical garden collections. The department's research findings were widely applied: highly ornamental species of orchids, crotons, and aroids, along with their cultivation technologies, were transferred to floricultural enterprises across the USSR.

Research in this area was continued by I.P. Kharytonova, Candidate of Biological Sciences (Kharytonova, 2004). In 1980, T.M. Cherevchenko, V.B. Bohatyr, and Y.P. Kobzar (a specialist in landscape construction who worked at the NBG for over 30 years) were awarded Certificates of Honor by the Presidium of the Supreme Soviet of the Ukrainian SSR for their contributions to the landscaping of facilities for the 1980 Olympic Games (specifically, the Central Stadium in Kyiv). The Malachite micro-greenhouse, exhibited at the Exhibition of Achievements of National Economy (VDNKh) of the USSR, was awarded a silver medal. In 1981, this micro-greenhouse was showcased at the Intercosmos exhibition in France (in the town of Bougival), as documented in archives deposited at the Museum of the History of the NBG.

In recent years, the department's research team, led by Doctors of Biological Sciences L.I. Buyun and R.V. Ivannikov, has conducted a comprehensive comparative analysis of the biological characteristics of over 150 tropical and subtropical plant species. Based on this, they formulated fundamental principles and developed practical recommendations for

utilizing these plants in the interior landscaping of spaces serving various functions.

For the first time in Ukraine, a system of 'phytoremediation module clusters' has been proposed to optimize human indoor environments. It includes facilities for security and defense personnel, healthcare institutions, and rehabilitation centers. These systems can remove a wide range of pollutants in enclosed indoor spaces, including volatile organic compounds (VOCs), inorganic compounds, and particulate matter (PM) with various aerodynamic diameters, while also inhibiting the growth of pathogenic microorganisms. The aesthetically pleasing configuration of these 'phytomodules' also provides a positive psychological benefit to people.

The proposed approaches are based on general principles of phytoremediation for human environments using plants, as well as an original concept of 'phytoremediation module clusters' developed with careful consideration of the specific needs of Ukrainian society during the ongoing war and the post-war period. One of the practical outcomes of this work was the publication of the fundamental monograph "Phytoremediation modules: fundamental principles of creation and innovative aspects of use" (2024).

The evolution of the scientific approaches and ideas underpinning the study of tropical plants cultivated in greenhouses at the NBG can be traced by analyzing the titles of research projects conducted by the department's staff over the last 30 years. "Development and biomorphological analysis of the collection of tropical and subtropical plants at the Central Republican Botanical Garden of the Academy of Sciences of the Ukrainian SSR" (1975–1977); "Improvement and biomorphological analysis of the collection of tropical and subtropical plants at the Central Republican Botanical Garden of the Academy of Sciences of the Ukrainian SSR" (1978–1982); "Biological foundations for the cultivation of tropical and subtropical plants in protected environments, with potential for introduction" (1983–1987); "Biological foundations for the reproduction of tropical and subtropical plants in protected environments and the development of cultivation technologies" (1988–1992); "Specifics of morphogenesis in tropical and subtropical plants under introduction conditions" (1993–1997); "*Ex situ* conservation of tropical and subtropical plant biodiversity and its application in phytodesign" (1998–2002); "Introduction of species from tropical floras for the purpose of *ex situ* biodiversity conservation and the enrichment of ukraine's plant resources" (2003–2007); "Theoretical and practical aspects of the comprehensive conservation of the phytogenetic pool of tropical and subtropical plants in Ukraine" (2008–2012); "Reproductive characteristics and structural-functional adaptations of tropical and subtropical plants under greenhouse and *in vitro* cultivation conditions" (2013–2017); "*Ex situ* conservation of tropical plant biodiversity under conditions of global climate change, and an assessment of the potential for their practical application" (2018–2022). Currently, the department's team is researching the topic: "Induction of phenotypic plasticity in tropical and subtropical plants: a search for predictive markers of resilience" (2023–present).

In line with this theme, the primary tasks carried out by the scientists and staff of the Department of Tropical and Subtropical Plants at the NBG. Using the department's collection, they focus on conserving and replenishing the plant gene pool (representing global flora) in artificial environments. These research directions are aligned with national and international programs. Research on plant species of tropical and subtropical floras is conducted in the following areas:

- study of developmental biology under greenhouse cultivation (alternation between phases of active growth and dormancy);
- study of structural morphology (the architecture of vegetative and reproductive shoots, and patterns of shoot formation);
- study of reproductive biology (timing and duration of flowering, pollination characteristics, and the duration of fruit maturation);
- study of the structural aspects of plant adaptation within greenhouse environments;
- study of the physiological and biochemical characteristics of plants belonging to various ecological groups;
- development of mass propagation methods and investigation of plant morphogenesis under greenhouse and *in vitro* culture conditions;

- analysis of consortial relationships within enclosed environments, and the exploration of ways to enhance the adaptive capacity of introduced tropical and subtropical plants;
- study of the impact of microgravity on the growth and development of plants from various ecological groups.

Current efforts are primarily focused on rare species from several families within Liliopsida, namely Araceae, Bromeliaceae, Liliaceae s.l., and Orchidaceae, which are on the verge of extinction within their natural ranges. In addition to these species, the research also encompasses woody plants, specifically *Camellia japonica* and various cultivars of *Rhododendron indicum*, which show promise for use in floriculture and interior plantscaping.

A key research focus within the Department of Tropical and Subtropical Plants is the study of plants as modular structures. This concept includes viewing a plant organism as a system of interconnected, repeating elements distributed across space and time. Practically, it aids in addressing specific tasks, such as developing methods for vegetative propagation. Theoretically, it provides a framework for interpreting the results of biomorphological studies from a broader biological perspective, specifically, through the lens of the reliability theory of biological systems (Cherevchenko et al., 2004).

It is undoubtedly worthwhile to continue studying the reproductive biology of orchids under greenhouse cultivation. The development of seed-based propagation methods for introduced species relies on the production of high-quality seeds. Even short periods of transport or storage negatively affect seed viability in many tropical plants. Moreover, the collection of seeds of certain species from natural populations in the tropics, followed by their introduction into botanical gardens in the temperate zone, constitutes the trade subject under CITES regulations.

The conservation of rare and endangered orchid species, and indeed, plants in general, within greenhouse cultivation requires studying their adaptive potential in response to external factors, as well as understanding the mechanisms of structural adaptations that enhance plant resilience. Using scanning electron microscopy (SEM) and light microscopy, the department investigates the structure of surface tissues, particularly those of the leaves (Sytnianska, 2003). It is precisely on the plant's surface that a range of processes occur, which determine the plant's ability to adapt to its surrounding environment.

This section examines the structural features of the seed coat in orchids, which can serve as an indirect indicator of a particular species' association with a specific ecotype. Comparing the anatomical structure of plants (both those recently collected from the wild and those cultivated in a greenhouse environment for many years) helps assess the effectiveness of the established cultivation techniques. For a long time, research into the structural adaptations of plants across various taxonomic groups of tropical flora was led by N.P. Sytnianska, a Candidate of Biological Sciences, has been with the Botanical Garden since 1992.

A distinct phase in the Department of Tropical and Subtropical Plants' educational outreach began in early 2005 with the opening of the first phase of a new greenhouse complex. This project had been under construction for nearly 40 years. The addition of 2,300 m^2 of greenhouse space significantly improved conditions for maintaining the core collections and enabled a more comprehensive display of global floral diversity for the general public.

The first plants to be moved into the new greenhouses belonged to the families Ericaceae, Theaceae, and Crassulaceae. Symbolically, the first greenhouse, covering an area of 424 m^2, was occupied by various cultivars of the Indian azalea; it was, in fact, with these very plants that the collection of tropical flora at the NBG first began in 1946. The commissioning of the new greenhouse complex will facilitate the development of the botanical garden as a scientific, conservation, and educational institution. Construction has been completed on a large-domed greenhouse covering an area of ca. 1,500 m^2 (Fig. 1) and an adjacent complex of exhibition greenhouses (Fig. 2). These facilities have made it possible to create displays and showcase plant groups that were previously absent from the collection, as it was previously impossible to simulate the specific ecological conditions they require.

Today, the Department of Tropical and Subtropical Plants serves as a significant



Figure 1. Large domed greenhouse of the exhibition complex belonging to the Department of Tropical and Subtropical Plants.

scientific hub; based on its collections, four doctoral dissertations have been completed, and 16 staff members have defended their Candidate of Sciences dissertations.

The scientific achievements of the Department's staff have been recognized with high state and academic awards. T.M. Cherevchenko was honored with the medals "For Valiant Labor" (1970) and "For Distinguished Labor" (1979), the Order of the "Badge of Honor" (1986), and the Order of Princess Olga, 3rd Class (1998). In 2001, T.M. Cherevchenko became a laureate of the V.I. Vernadsky Prize, the most prestigious award bestowed upon scientists in Ukraine. In 2003, Department researchers Z.M. Yaroslavska and R.V. Ivannikov (both Candidates of Biological Sciences) were awarded the Prize of the President of Ukraine for Young Scientists of the National Academy of Sciences of Ukraine for their series of works titled "*In situ* and *ex situ* conservation of the biodiversity of rare plant species". R.V. Ivannikov is also a recipient of the Cabinet of Ministers of Ukraine Prize for his contribution to state development. Furthermore, the Department's scientists have frequently received awards from the city and the National Academy of Sciences of Ukraine, as well as certificates of honor from the Ministry of Education and Science of Ukraine.

The research findings of the department's staff have been synthesized in 15 monographs, as well as numerous scientific articles and conference abstracts published in both domestic and international periodicals. These publications are well-known to a broad community of researchers in the fields of plant introduction and various branches of experimental biology. Reference books such as "Ornamental plants for open and protected ground", "Tropical and subtropical plants for protected ground", and "The amateur floriculturist's handbook" represent



Figure 2. Exhibition complex for tropical and subtropical plants.

a significant contribution to the development of ornamental horticulture and phytodesign in Ukraine. The monograph "Orchids in cultivation" authored by T.M. Cherevchenko and H.P. Kushnir and published in 1986 (Cherevchenko & Kushnir, 1986) was the first monograph in the USSR following the 1957 work "Orchids in cultivation" (Poddubnaya-Arnoldi & Selezneva, 1957) to present the results of a multifaceted study on tropical orchids grown in greenhouse conditions. The monograph "Tropical and subtropical orchids" constitutes a major contribution to the theory and practice of introducing tropical orchids; for this work, T.M. Cherevchenko was awarded the M.G. Kholodny Prize in 1994. In the monograph "Structural-Functional Foundations for the Design of Soil Substitutes" (1999), Doctor of Biological Sciences N.V. Zaimenko established the structural-functional principles for designing artificial biogeocoenoses, which became a significant contribution to the development of the theoretical foundations of plant introduction. Other published monographs, including "Orchids" (2001; authors: T.M. Cherevchenko, L.I. Buyun, L.A. Kovalska, and V.S. Vakhrushkin) and "Biotechnology of tropical and subtropical plants" (2008; authors: T.M. Cherevchenko, A.M. Lavrentieva, and R.V. Ivannikov) provide a fundamental synthesis of the experience gained at the NBG.

Today, there is every reason to assert that a school of orchidology has been established at the NBG, led by T.M. Cherevchenko, a Corresponding Member of the National Academy of Sciences of Ukraine and a professor. Within Ukraine, the NBG serves as a center for the comprehensive study of the introduction and conservation of orchids, covering areas such as the developmental biology of tropical orchids in greenhouse cultivation, reproductive biology, physiology and biochemistry, general morphology, ontogenesis and morphogenesis, as well as the development of methods for their mass

propagation and cultivation. The coordinating role of the NBG in the development of theoretical and practical aspects of orchid introduction in Ukraine is evidenced by the fact that it hosted two international conferences titled "Conservation and cultivation of orchids" (1983, 1999). It is worth pointing out that T.M. Cherevchenko is a member of both the European and American Orchid Societies. Since 2002, T.M. Cherevchenko has served as co-chair of the Ukrainian-Russian Commission for the Study, Conservation, and Cultivation of Orchids, operating under the Councils of Botanical Gardens of Ukraine.

Currently, the department employs two Doctors of Biological Sciences and nine Candidates of Biological Sciences; in recent years, talented young researchers have also joined the team. A dedicated group of engineers within the department ensures the continuous monitoring of the collection specimens and provides ongoing care for the plants, tailored to their specific biological requirements.

The unique collection of tropical and subtropical plants established at the NBG was recognized as National Heritage in 1999. It was the first such designation among similar collections in the country. The scientific and educational significance of this collection lies in their role as a foundation for interdisciplinary research. The ultimate goal of this work is the long-term *ex situ* conservation of tropical plant biodiversity, as well as the assessment of the potential of these living collections to serve as a source of material for applications in biotechnology, phytoremediation, phytopharmacology, and educational projects.

State support for the collection of tropical and subtropical plants recognized as an object of national heritage is justified by the following key arguments:

1. *Uniqueness of the collection.* There are no counterparts in Ukraine with respect to taxonomic composition. Collections of tropical orchids and aroids, cultivars of Indian azalea (*Rhododendron indicum*) and Japanese camellia (*Camellia japonica*), bulbous and rhizomatous geophytes, as well as tropical fruit-bearing plants, are not represented in any other botanical gardens in the country.
2. *Biodiversity conservation.* Amid global climate change, which threatens many tropical plant species, the artificial replication of climates in greenhouses is critical for the *ex situ* preservation of the gene pool.
3. A *comprehensive approach to the protection of tropical flora.* The facility employs various conservation strategies: maintaining living collections in greenhouses, establishing banks of sterile *in vitro* cultures, and storing seeds and pollinia, including through cryopreservation. This enables the preservation of rare and critically endangered species for which traditional propagation methods are unsuitable (e.g., Orchidaceae and Cycadales).
4. *Integration into international gene pool conservation programs.* The joint project between the Department of Tropical and Subtropical Plants at the NBG and the Institute of Tropical Biology of the Vietnam Academy of Science and Technology (VAST) titled "Translocation, studying appropriate conditions for *ex situ* conservation of 45 Vietnam orchid species from NBG, Ukraine and *in vitro* propagation of some rare orchid species" (2014–2015) serves as a prime example of the effective use of *ex situ* gene pool repositories for tropical and subtropical plants to prevent the degradation of unique biological resources within the global flora.

Given the high level of complexity and the costs of maintaining specialized infrastructure, state support for collections of tropical and subtropical plants is the only viable way to ensure the stable functioning of this facility, given its specific scientific nature and the need for continuous care.

Currently, the collection comprises specimens representing 3,795 plant species from 782 genera across 139 families. This facility, designated as a National Heritage asset, comprises botanical collections, the majority of which are maintained as living plants in greenhouses covering a total area of 3,000 m^2. Other specimens are planted in ground-based displays within the greenhouse complex, including: 'Tropical and Subtropical Fruit Crops', 'Plants of Arid Regions of the



Figure 3. Ground-planted exhibition of succulent plants.



Figure 4. A section of the 'Humid Tropics' exhibition.



Figure 5. 'Orchidarium' exhibition.



Figure 6. View from above of the exhibitions in the 'Large Domed Greenhouse'.



Figure 7. Panorama of the ‘Azaleas and Camellias’ exhibition.



Figure 8. A section of the ‘Aquatic and Semi-Aquatic Plants’ exhibition.



World' (total area 358 m²) (Fig. 3), 'Humid Tropics' (380 m²) (Fig. 4), 'Orchidarium' (123.5 m²) (Fig. 5), 'Large Domed Greenhouse' (1,500 m²) (Fig. 6), 'Azaleas and Camellias' (424 m²) (Fig. 7), and 'Aquatic and Riparian Plants' (125 m²) (Fig. 8).

An integral component of the NBG's collections of tropical and subtropical plants is a collection of sterile cultures maintained in the Biotechnology Laboratory of the Department of Tropical and Subtropical Plants. As of January 1, 2026, this collection comprises approximately 200 taxa of angiosperms and higher spore-bearing plants (Fig. 9).

Within the network of botanical gardens and arboreta in Ukraine, this department serves as a leading center for fundamental research in the following areas:

- study of the structure and barrier function of the leaf surface acting as the interface between the plant and its environment to identify markers for use in phytoremediation, biotechnology, and biomonitoring;
- investigation of reproductive biology and the patterns of plant morphogenesis, both *in vitro* and *in vivo*;
- development of biotechnological methods for the propagation of rare global plant species, and the maintenance of banks of vegetative and generative propagules *in vitro*;
- assessment of the adaptive potential of plants to ensure their long-term preservation in greenhouse cultivation and *in vitro* conditions;
- identification of biological markers (physiological, biochemical, anatomical, and stomatal) indicative of plant stress;
- screening of tropical plant extracts for biological activity to discover new sources of antimicrobial and antioxidant compounds;
- research into the biomorphology and anatomy of various groups within the order Asparagales to clarify phylogenetic relationships among genera and explore their practical applications.

The research findings of the department's staff are summarized in 16 monographs, methodological guidelines, numerous scientific articles, and conference abstracts, published in Ukrainian and international scholarly sources.



Figure 9. Inside the light room of the biotechnology laboratory.

Professional presentations abroad reflect the active engagement of the department's researchers in informing the international scientific community about the scientific, historical, and cultural significance of the NBG's unique collections. Both globally and nationally, botanical gardens are emphasized as open scientific institutions that share knowledge with the public. With over 80 years of experience in introducing tropical and subtropical plants, maintaining unique collections, and demonstrating significant intellectual capacity, the NBG stands as the country's leading institution for the *ex situ* conservation of tropical and subtropical plant biodiversity.

References

Bohatyr, V.B. (1986). *Biological characteristics of plants of the Araceae family promising for interior landscaping* [Abstract of Candidate of Biological Sciences dissertation]. Kyiv. [In Russian]

Borysenko, T.I. (1986). *Cacti: a reference book.* Naukova Dumka, Kyiv. [In Russian]

Buyun, L.I. (1986). *Developmental biology of Calanthe vestita Lindl. (Orchidaceae Juss.) under cultivation conditions* [Abstract of Candidate of Biological Sciences dissertation]. Kyiv. [In Russian]

Cherevchenko, T.M. (1984). *Tropical orchids: morphological study and introduction into greenhouse cultivation* [Abstract of Doctor of Biological Sciences dissertation]. Kyiv. [In Russian]

Cherevchenko, T.M., & Buyun, L.I. (2004). The role of temperate zone botanic gardens for *ex situ* biodiversity conservation of floras of tropics and subtropics. *Plant Introduction, 21,* 3–12. [In Ukrainian]. https://doi.org/10.5281/zenodo.3253031

Cherevchenko, T.M., & Chuvikina, N.V. (2002). Svitlana Mykolaevna Pryhod'ko – remarkable scientist, who lived in love with flowers (on the 80-th anniversary of birth). *Plant Introduction, 13,* 133–135. [In Ukrainian]. https://doi.org/10.5281/zenodo.3333819

Cherevchenko, T.M., & Kosakovskaya, I.V. (1990). Perspectives of tropical orchids in space research. In J. Arditti (Ed.), *Orchid biology: reviews and perspectives. Vol. 5* (pp. 251–263). Timber Press.

Cherevchenko, T.M., & Kushnir, H.P. (1986). *Orchids in cultivation.* Naukova Dumka, Kyiv. [In Russian]

Cherevchenko, T.M., & Maiko, T.K. (1986). Tropical and subtropical plants under greenhouse conditions at the Central Republican Botanical Garden: establishment of a gene pool, research results, and future prospects. *Introduction and Acclimatization of Plants, 6*, 66–68. [In Russian]

Cherevchenko, T.M., & Zaimenko, N.V. (2003). Effects of microgravity on physiological and biochemical transformations in orchids of different ecomorphotypes. *Biological Bulletin, 7*(1–2), 53–58. [In Russian]

Cherevchenko, T.M., Buyun, L.I., & Kovalska, L.A. (2004). Biomorphological characteristics of orchids (Orchidaceae Juss.) from the perspective of biological systems reliability theory. *Biological Bulletin, 8*(2), 32–36. [In Ukrainian]

Cherevchenko, T.M., Buyun, L.I., Kovalska, L.A., & Vakhrushkin, V.S. (2001). *Orchids.* Prosvita, Kyiv. [In Ukrainian]

Cherevchenko, T.M., Kushnir, H.P., Lavrentieva, A.N., & Kovalska, L.A. (1982). *Methodological recommendations for the mass propagation of orchids.* Ministry of Housing and Communal Services. [In Russian]

Cherevchenko, T.M., Porubinovskaya, H.V., Bogatyr, V.B., Denysievska, N.A., & Kovalska, L.A. (1989). Expedition to Brazil. *Introduction and Acclimatization of Plants, 11*, 16–21. [In Russian]

Denysievska, N.A. (1992). *Biological characteristics of species of the genus Anthurium Schott and their cultivation under greenhouse conditions* [Abstract of Candidate of Biological Sciences dissertation]. Kyiv. [In Russian]

Gryshko, M.M., & Sokolovskyi, O.I. (1951). *The botanical garden and its collections.* Publishing House of the Academy of Sciences of the Ukrainian SSR, Kyiv. [In Ukrainian]

Hrodzinskyi, A.M. (1982). Our award winners: T.M. Cherevchenko, H.P. Kushnir, and T.K. Maiko. *Bulletin of the Academy of Sciences of the Ukrainian SSR, 7*, 95–96. [In Ukrainian]

Ivannikov, R.V. (2001). *Developmental biology of species of the genus Laelia Lindl. (Orchidaceae Juss.) under greenhouse and in vitro culture conditions* [Abstract of Candidate of Biological Sciences dissertation]. Kyiv. [In Ukrainian]

Kharchenko, I.I. (2003). *Camellia japonica L. (Theaceae D.Don): morphology, developmental biology, and cultivation technology under greenhouse conditions* [Abstract of Candidate of Biological Sciences dissertation]. Kyiv. [In Ukrainian]

Kharytonova, I.P. (2004). Research of the phytodesign questions in M.M. Grishko National Botanical Gardens of NAS of Ukraine. *Plant Introduction, 21,* 52–56. [In Ukrainian]. https://doi.org/10.5281/zenodo.3253048

Kovalska, L.A. (1992). *Dendrobium phalaenopsis Fitzg. (Orchidaceae Juss.): biological characteristics and cultivation* [Abstract of Candidate of Biological Sciences dissertation]. Kyiv. [In Russian]

Kushnir, H.P., Budak, V.E., & Lavrentieva, A.N. (1981). *Nutrient medium for orchid seed germination (USSR Inventor's Certificate No. SU816438A1).* USSR State Committee for Inventions and Discoveries. [In Russian]

Kvasha, V.V., Kokhno, N.A., Sobko, V.H., & Maiko, T.K. (1993). *A garden above the Slavutych: a guidebook.* Svenas. [In Russian]

Lavrentieva, A.N. (1985). *Optimization of clonal micropropagation of Cymbidium hybridum in tissue culture* [Abstract of Candidate of Biological Sciences dissertation]. Kyiv. [In Russian]

Maiko, T.K., Kushnir, H.P., & Cherevchenko, T.M. (1981). On the relationship between the activity of endogenous growth regulators and the regenerative capacity of stem buds in Thunia marshalliana. *Introduction and Acclimatization of Plants in Ukraine, 18,* 96–98. [In Ukrainian]

Poddubnaya-Arnoldi, V.A., & Selezneva, V.A. (1957). *Orchids and their cultivation.* Publishing House of the USSR Academy of Sciences. [In Russian]

Snizhko, V.V. (1983). *Ornamental and bioecological characteristics of plants in phytodesign* [Abstract of Candidate of Biological Sciences dissertation]. Kyiv. [In Russian]

Sytnianska, N.P. (2003). Structural organization of the leaf surface in species of the genus *Cattleya* Lindl. (Orchidaceae Juss.). *Biological Bulletin, 7*(1–2), 36–38. [In Russian]

Yaroslavska, Z.M. (1999). *Biological characteristics of selected tropical orchid species with different morphological structures* [Abstract of Candidate of Biological Sciences dissertation]. Kyiv. [In Ukrainian]

Zaimenko, N.V. (1987). *Physiological basis for mineral fertilization of tropical orchid species* [Abstract of Candidate of Biological Sciences dissertation]. Kyiv. [In Russian]

Zaimenko, N.V. (1999). *Structural and functional principles of designing soil substitutes.* M.M. Gryshko National Botanical Garden of the NAS of Ukraine, Kyiv. [In Russian]

Zaimenko, N.V. (2001). *Scientific principles of structural and functional design of artificial biogeocenoses (in the soil–plant–soil system)* [Abstract of Doctor of Biological Sciences dissertation]. Dnipropetrovsk. [In Ukrainian]

Zhyla, A.I. (1993). *Biological characteristics of Asparagus densiflorus (Kunth) Jessop' Meyeri' and A. densiflorus f. sarmentosus under cultivation conditions* [Abstract of Candidate of Biological Sciences dissertation]. Kyiv. [In Ukrainian]

Колекції тропічних і субтропічних рослин – стратегічний ресурс України: від наукової та культурної спадщини до фундаментальної науки

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У публікації узагальнено інформацію про становлення та розвиток відділу топічних та субтропічних рослин, висвітлено основні результати наукових досліджень, визначено перспективи подальшої роботи. Наведено відомості про колекційних фонд відділу тропічних та субтропічних рослин з акцентом на основних систематичних групах рослин.

Ключові слова: відділ тропічних та субтропічних рослин, Національний ботанічний сад імені М.М. Гришка НАН України, історія розвитку, інтродукція рослин