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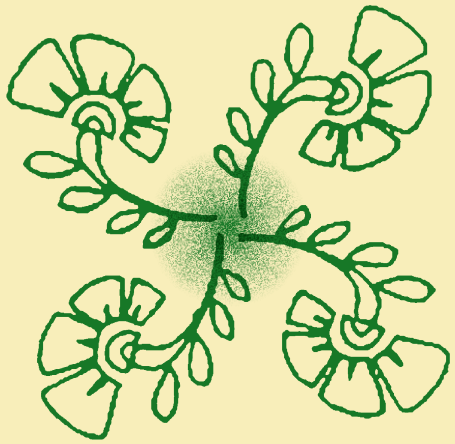
BALTIC BOTANIC GARDENS

IN 2009-2010

ESTONIA LATVIA LITHUANIA



Rīga, Latvia
2012

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The periodical issue of *Baltic Botanic Gardens* includes information about the main events in the botanical gardens of Estonia, Latvia and Lithuania in 2009-2010. It contains statistical information about the gardens and eight articles about the collections, research and public activities of the botanical gardens.

The authors themselves are responsible for the content of papers.

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IEGULDĪJUMS TAVĀ NĀKOTNĒ

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2, Kandavas Str.
LV 1083, Rīga
LATVIA

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CONTENTS

REPORT OF DEVELOPMENT

TALLINN BOTANIC GARDEN

Address	Kloostrimetsa Rd 52, Tallinn, Estonia 11913
Phone	+372 6062679
Fax	+372 6005529
e-mail	aed@botaanikaaed.ee
www	www.botaanikaaed.ee
Director	Karmen Kähr
Territory	42 ha

LIVING PLANT COLLECTIONS

Total No. of taxa: **8585**

Main taxa	No. of taxons
Indoor plants, including:	2027
succulent plants	825
orchids	348
subtropical plants	265
tropical plants	589
Trees and shrubs, including:	2335
roses	677
other trees and shrubs	1677
Trees and shrubs in Audaku Experimental Station	392
Herbaceous plants, including:	4223
alpine plants	664
tall perennials	388
peony	322
irises	269
astilbes	77
daylilies	135
phloxes	74
useful plants	270
medicinal herbs	70

decorative grasses	170
lilies	445
hyacinths	70
small bulbous plants	413
crocuses	127
tulips	310
daffodils	145
alliums	122
annuals	68
perennials of the Palm House lawn	75
ferns	9

HERBARIUM

Herbarium collection	Exemplars
Woody plants	8832
Herbaceous plants	8383
Wood collection	484
Carpological collection	725
Fungi (microfungi) Tree fungi	8500 67
Mosses	16 300
Lichens	40 500
Herbarium for Study	745
TOTAL	**84536**

THE MAIN ACTIVITIES

A project for schoolchildren – nature study combined with traditional school programmes, which have been carried through since 2006, was continued in 2009 and 2010, financed by the City of Tallinn.

In 2010 the reconstruction project of the greenhouses of the Tallinn Botanic Garden (started in 2008) was completed, including the reconstruction of the Southern and Northern wings of the greenhouse complex. The project was financed from the European Union Structural Funds through Enterprise Estonia, self-finance was provided by the City of Tallinn. In October 2010 tropical and succulent expositions were opened in addition to the subtropical exposition opened already a year earlier.

In 2010 the territory of the Botanic Garden was fenced off. This has enabled further development of outdoor collections.

There were 31000 visitors to the expositions of the Tallinn Botanic Garden in 2009, and 33200 visitors in 2010.

SCIENTIFIC ACTIVITIES

The basic directions of current research activities in the Tallinn Botanic Garden:

- The study of ecology, population and reproductive biology of endangered plant species with the aim of recovery/restoration of their natural populations by combined *ex situ* and *in situ* methods:
  Restoration ecology of three locally endangered fern species *(Asplenium septentrionale* (L.) Hoffm.*, Polystichum aculeatum* (L.) Roth*,* and *Woodsia ilvensis* (L.) R. Br.*)* in Estonia (Maris Rattur, M.Sc.).
- The ecological recovery of critically endangered fern lineage /Diellia/ Brack. (*Aspleniaceae*) in collaboration with the National Tropical Botanical Garden, Kauai, Hawaiian Islands (Ruth Aguraiuja, Ph.D.).
- The fern spore bank as a source for the recovery of the species and indicator for possible changes in the natural community (Ruth Aguraiuja, Ph.D.).
- The long-term projects of inventories and surveys (introduction projects, long-term observations and inventories of historical parks etc.).

Environmental monitoring:

- Spatial and temporal trends in heavy metal accumulation in mosses in Estonia. Participation in the United Nations Economic Commission for Europe International Cooperative Programme on Effects of Air Pollution on Natural Vegetation and Crops (UNECE ICP Vegetation) "Heavy Metals in European Mosses". It is one of seven ICPs and Task Forces that report to the Working Group on Effects of Long-Range Transboundary Air Pollution (LRTAP) Convention on the effects of atmospheric pollutants on different compounds of the environment and health (Siiri Liiv, Ph.D.).
- Monitoring of cliff forest plant communities (Olev Abner).
- Monitoring of threatened vascular plant species of Estonia (Maris Rattur, MSc, Ruth Aguraiuja, Ph.D.).

STRUCTURE AND STAFF

	2009	2010
Administration	3	10
Marketing and Sales Dept.	5	-
Dept. of Environmental Education	14	14
Dept. of Outdoor Collections	13	13
Dept. of Tropical and Subtropical Collections	11	7
Technical Dept.	5	6
TOTAL, including:	**51**	**50**
PhD	2	2
Msc	6	7

FINANCES (in *EUR*)

	2009	2010
Income		
Revenue	120280	123400
Targeted financing	8580	32240
TOTAL	**128860**	**155640**
Expenses		
Operational expenditure	283840	288590
Salaries	381080	398580
TOTAL	**664920**	**687170**

Educational nature programmes for students		
Targeted financing	12800	6400

BOTANICAL GARDEN OF THE UNIVERSITY OF TARTU

Address	38, Lai Str., 51005 Tartu, Estonia
Phone	+372 7376180
Fax	+372 7376218
e-mail	boated@ut.ee
www	www.ut.ee/botaed
Director	Mr. Heiki Tamm, PhD
Territory	4.0 ha

LIVING PLANT COLLECTIONS

Total No. of taxa: **7995**

Main taxa	No. of taxa
Indoor plants, including:	1850
Orchidaceae	190
Araceae	124
Arecaceae	70
Trees and shrubs, including:	955
Rosa	247
Juniperus	64
Rhododendron	62
Picea	25
Acer	22
Herbaceous plants, including:	5190
Native plants	200
Medicinal plants	150
Paeonia	320
Iris	180
Clematis	80
Primula	70

In greenhouses new expositions of epiphytic plants were arranged and the total number of species of *Orchidaceae* arouse to 190.

The Rose Garden, after 60 years of its existence, was reconstructed and more than 200 cultivars of roses were planted, including 20 cultivars bred in Estonia.

The collection of native plants was enriched by 37 species, most of them are considered as endangered in their natural habitats.

The new testing and reproduction garden started off well, there were nearly 800 taxa of young subtropical and tropical plants growing in the greenhouses and 150 taxa outdoors.

Library: 520 volumes.

THE MAIN ACTIVITIES

2009

The Botanical Garden continued research and conservation of ornamental and medicinal plants of the National Program of Collection and Conservation of Plant Genetic Resources for Food and Agriculture in Estonia. 57 new accessions were included in the data base, the collection beds were complemented with new cultivars: lilacs – 11, daylilies – 5, lilies – 4, and roses – 3 cultivars.

The Botanical Garden was active in organizing (in the scientific and organizing committees and moderating sessions) and participating in the EuroGard 5th Congress in Finland (2 reports) and organizing the post-congress tour of 3 days to Estonia. www.luomus.fi/eurogardV .

Tamm, H., Korotkova, O., Sild, J. 2009. Conservation of ornamental and medicinal plants in the Botanical Garden of the University of Tartu. EuroGard V. Botanic Gardens in the Age of Climate Change. Abstracts, Helsinki, 9-12.06. 2009. www.luomus.fi/eurogardV/book...

Uibo, E.-K. 2009. Geographic information system (GIS) in the Botanical Garden of the University of Tartu. EuroGardV, Botanic Gardens in the Age of Climate Change. Abstract, Helsinki, 9-12.06. 2009. www.luomus.fi/eurogardV/book...

Total number of visitors – 112 100, greenhouse visitors – 17 721, students – 646.

The statue of professor Gottfried Albrecht Germann, the first director of the Botanical Garden in 1803-1809, was erected.

2010

The Botanical Garden continued research and conservation of ornamental and medicinal plants of Estonia. 56 new accessions were added to the data base, and 17 new cultivars (bred in Estonia) were planted in the conservation beds.

The Botanical Garden organized the international workshop "Strategies and development of botanic gardens around the Baltic Sea" in co-operation with the Visby Group and the Tallinn Botanic Garden, Tartu-Tallinn, 31.09.-03.10.2010 (40 participants of 10 countries).

Together with the Museums of the University of Tartu, two panorama video clips with 16 specifying slides were made www.ut.ee/virtualtour .

Total number of visitors – 118 600, greenhouse visitors – 16 596, students – 802.

The most popular event was the Fifth Orchid Show of the Southern Estonia "Orchids – Natural Jewels at Your Window" in co-operation with the Jardin Garden Centre and other companies in March 2010.

SCIENTIFIC ACTIVITIES

Publications

Korotkova, O. D., Sild, J. 2009. Collections of ornamentals, medicinal and aromatic plants. Collection and Conservation of Plant Genetic Resources for Food and Agriculture in Estonia. Ministry of Agriculture, pp. 28-29

Tamm, H. 2009. The plant communities of old parks. Park as a Paradise in Art and Nature. University of Land Sciences of Estonia Press, Tartu, pp. 192-197 (in Estonian)

Tambets, K. (editor) *INDEX SEMINUM anno 2009 collectorum quae HORTUS BOTANICUS UNIVERSITATIS TARTUENSIS pro mutua commutation offert*. Tartu, 27 p. Seed list of 726 taxa

Hyvarinen, M., Tamm, H., Sild, J. 2010. *Ex-situ* plant conservation in botanic gardens around the Baltic Sea. Abstracts and Posters. 4th Global Botanic Gardens Congress, 13-18.06.2010, Dublin

Tambets, K. (editor) *INDEX SEMINUM anno 2010 collectorum quae HORTUS BOTANICUS UNIVERSITATIS TARTUENSIS pro mutua commutation offert*. Tartu, 26 p. Seed list of 769 taxa

STRUCTURE AND STAFF

	2009	2010
Administration	3.5	3.5
Botanist	1	1
Gardeners	8	7
Technical workers	2	2
TOTAL, including:	**14.5**	**13.5**
PhD	1	1
MSc	2	2

FINANCES (in *EEK, 1 EEK = 0.06 EUR*)

	2009	2010
Income		
University funding	5 070 100	4 727 200
Research projects	797 800	702 100
Other	371 700	373 900
TOTAL	**6 239 600**	**5 803 200**
Expenses		
Salaries	2 773 500	2 672 300
Exploitation of rooms	2 022 100	2 047 800
Other	1 497 800	940 600
TOTAL	**6 293 400**	**5 660 700**

Heiki Tamm
Director

BOTANICAL GARDEN OF THE UNIVERSITY OF LATVIA

Address	Kandavas Str. 2, Riga, LV-1083, Latvia (Botanical Garden)	"Rododendri", Spilve, Babite, LV-2101, Latvia (Rhododendron breeding and testing nursery "Babite")
Phone	+371 67450852	+371 67913107
Fax	+371 67450852	+371 67913127
e-mail	botaniskais.darzs@lu.lv	rodod@lanet.lv
www	www.botanika.lu.lv	www.rododendri.lu.lv
Director	Anta Sparinska	Head: Rihards Kondratovics
Territory	15 ha	11.8 ha

LIVING PLANT COLLECTIONS IN THE BOTANICAL GARDEN

Total No of taxa: **5354**

Main taxa	No. of taxons
Indoor plants, including:	1614
Succulent plants	727
Tropical plants	376
Subtropical plants	387
Azalea	124
Trees and shrubs, including:	798
Rhododendrons	110
Lilacs	72
Magnolias	14
Herbaceous ornamental plants, including:	2152
Dahlias	309
Lilies	80
Hostas	106
Systematic groups of plants	Reconstruction of exposition
Biological and morphological groups of plants, including:	770
Medical plants	286
Poisonous plants	64
Mire plants	20

LIVING PLANT COLLECTIONS IN THE RHODODENDRON BREEDING AND TESTING NURSERY "BABITE"

Total No of taxa: **273**

Main taxa	No. of taxons
Rhododendron species	73
Rhododendron cultivars	200

THE MAIN ACTIVITIES

2009

- The main exhibitions are "Azaleas", "Riga Flower Show", "Bible Plants".
- Activities to advance the garden reconstruction plans:
  - the inspection of the artistic and historical value of manor houses (four houses – federal monuments of wooden architecture) in the territory of the Botanical Garden;
  - the proposal and preliminary design for the restoration of the manor houses.
- Latvian Plant Breeder's Rights certificates: 3 (Rhododendron breeding and testing nursery "Babite").

2010

- In 2010 there were structural reforms in the University of Latvia as a result of which the Rhododendron breeding and testing nursery "Babite" was merged with the Botanical Garden.
- The main exhibitions are "Azaleas", "Plants in Your Cosmetics", "Riga Flower Show", "Seeds and Fruits", "Moss and Lichen", "Bible Plants".
- Accomplished reconstruction of the Rose Exposition.
- The opening of the Trail through Bryophytes and Lichens.
- Latvian Plant Breeder's Rights certificates: 12 (Rhododendron breeding and testing nursery "Babite").

SCIENTIFIC ACTIVITIES

Projects

Grant supported by the Science Council of Latvia "Plant biotic interactions: effect of microorganisms and control of responses of biotic factors" (headed by Dr. biol. S. Tomsone, in 2009, 2010).

Grant supported by the Science Council of Latvia Nr. 09.1576 "Biological diversity in the level of species, ecosystems and landscape" (headed by Dr. biol. G. Brūmelis, together with the Faculty of Biology, University of Latvia, in 2010).

Project "Restoration of Raised Bog Habitats in the Especially Protected Nature Areas of Latvia", supported by the European Commission LIFE+ programme, Raised Bogs – LIFE08 NAT/LV/000449 (headed by Dr. biol. M. Pakalne, in 2010).

Publications

2009

A. Sparinska, R. Zarina, N. Rostoks. Diversity in *Rosa rugosa* x *Rosa hybrida* interspecific cultivars. Proceedings of the 23rd International Eucarpia Symposium, Section ornamentals: "Colourful breeding and genetics". Ed. by J. M. van Tuyl, D. P. de Vries, August 31–September 4, 2009, Leiden, the Netherlands, ISHS Acta Horticulture 836: pp. 111-114

А. Ореховс, И. Набурга-Ермакова, М. Смона. Ассортимент многолетников пригодных для посадок в непосредственной близости к многоэтажным жилым зданиям. Formation of Urban Green Areas. Scientific Articles, Klaipeda, 2009, 1 (6), 117-120

2010

I. Nāburga-Jermakova, A. Orehovs. Existence dynamic of some Latvian plants in long-term artificial plant communities of perennials, Acta Biologica, Univ. Daugavp. Suppl. 2, 2010, 153-156

I. Apine, V. Nikolajeva, E. Vimba, M. Smona, S. Tomsone. *Melampsora allii-fragilis* f. sp. *galanthi-fragilis* reported for first time to cause rust on *Galanthus plicatus* in Latvia, Plant Pathology, Volume 59, Issue 6, December 2010

I. Apine, V. Nikolajeva, E. Vimba, M. Smona, S. Tomsone *Melampsora allii-fragilis* f. sp. *galanthi-fragilis* reported for first time to cause rust on *Galanthus plicatus* in Latvia, New Disease Reports 21, 6 http://www.ndrs.org.uk/article.php?id=021006

Index Seminum annis 2010-2011 collectorum quae, Hortus Botanicus Universitatis Latviensis, pro mutual commutatione offert, LXXVI, Rīga, 2010

Conferences

2009

I. Nāburga-Jermakova, A. Orehovs. The testing of introduced perennials for landscape gardening. Eurogard V, Botanic gardens in the age of climate change, Abstracts, Ed. by S. Lehvävirta, D. Aplin, L. Schulman, Helsinki, 2009, p. 126

L. Strazdina. The identification key for species of genus *Carex* L. as a tool for correct sedge material collecting for *ex-situ* conservation in the Botanical Garden of the University of Latvia. Eurogard V, Botanic gardens in the age of climate change, Abstracts, Ed. by S. Lehvävirta, D. Aplin, L. Schulman, Helsinki, 2009, p. 137

A. Galeniece. Biological Diversity of Magnolia in Latvia, Abstracts of the 2nd International Symposium on the Family Magnoliaceae (ISFM), Guangzhou, China, 5-8 May, 2009, p. 46

A. Sparinska, R. Veveris, R. Zarina, N. Rostoks, Dz. Rieksta. Diversity in *Rosa rugosa* x *Rosa hybrida* interspecific cultivars. XXIII International Eucarpia Symposium, Section ornamentals: "Colourful breeding and genetics". August 31-September 4, 2009, Leiden, the Netherlands, p. 39

2010

I. Apine, B. Bankina, V. Nikolajeva, I. Luca-Neusa, S. Tomsone. Powdery Mildew of Rhododendrons in Latvia. Book of Abstracts, Volume II, IHC, Lisboa, August 22-27, 2010, 419

L. Strazdiņa, M. Pakalne, I. Dauškane, A. Markots, A. Rečs. Ecological and hydrological research in the inter-dune mire complex in Slitere National Park, XXIII Conference-Expedition of the Baltic Botanists, 2010

I. Nāburga-Jermakova. The Influence of Green Plantings on Biodiversity of Environment Formation of Urban Green Areas, Scientific Articles, Klaipeda, 2010, 119-124

M. Smona. The analysis of the interaction between plantings and different types of urban public areas. Formation of Urban Green Areas, Scientific Articles, Klaipeda, 2010, 151-154

I. Nāburga-Jermakova. The Botanic Gardens introduction works influence on local flora, 23rd Expedition of the Baltic Botanists, 19-22 July, Haapsalu, Estonia, 2010, 126

THE RHODODENDRON BREEDING AND TESTING NURSERY "BABITE" IN BRIEF

In 1957 the selection of new rhododendron varieties was started under the guidance of Professor Rihards Kondratovics in the Botanical Garden with the aim to cultivate open-air, ornamental and winter-hardy rhododendrons adapted to the Latvian agro-climatic conditions. Since 1980 further work has been continued at the Nursery of Rhododendrons "Babite" of the University of Latvia. As a result, 634 crosses in different combinations have been made and the selection of several thousands of hybrids gave hundreds of the most valuable and perspective hybrids.

In the period of 1999-2010, upon successful examination of plant varieties, 69 varieties of open-air rhododendrons were approved and included in the Latvian State Register of Protected Plant Varieties (33 summer-green and 36 evergreen varieties of rhododendrons), 36 of them are also registered in the International Rhododendron Register, the Royal Horticultural Society.

VISITORS

Botanical Garden:

Year	2009	2010
Visitors	51704	50021

Rhododendron breeding and testing nursery "Babite":

Year	2009	2010
Visitors	10008	15074

STRUCTURE AND STAFF

Botanical Garden

	2009	2010
Administration	5	3
Scientific personnel	8	8
Field workers	19	19
Technical personnel	7	7
TOTAL, including:	**39**	**37**
PhD	3	3
Msc	5	3

Rhododendron breeding and testing nursery "Babite"

	2009	2010
Administration	3	3
TOTAL, including:	**16**	**16**
PhD	2	2
Msc	3	3

FINANCES (in LVL, *1 LVL = 1.43 EUR*)

Botanical Garden

	2009	**2010**
Income		
University of Latvia grant	121983	111417
Government grant	0	46839
Income	71520	63660
Research projects (except LIFE)	8820	20791
TOTAL	**202323**	**242707**
Expenses		
Salary, inclusive of tax	191055	191312
Maintenance of infrastructure	29767	50919
TOTAL	**220822**	**242231**

Rhododendron breeding and testing nursery "Babite"

	2009	**2010**
TOTAL Income	**127081**	**118870**
TOTAL Expenses	**127081**	**118870**

NATIONAL BOTANIC GARDEN OF LATVIA

Address	Miera Street 1, Salaspils, LV-2159, Latvia
Phone, fax	+371 67945460
e-mail	nbd@nbd.gov.lv
www	http://www.nbd.gov.lv
Director	Andrejs Svilāns
Territory	129 ha

LIVING PLANT COLLECTIONS

Total No. of taxa: **~13560**

Main taxa	No. of taxons
Indoor plants, including:	2196
Greenhouse flowers (gerberas, chrysanthemums, alstroemerias)	450
Orangery plants	1716
Cyclamen cvs.	30
Trees and shrubs, including:	4900
Conifers (incl. new forms)	900
Rhododendrons	250
Crataegus	230
Other woody plants	3520
Open area ornamentals, including:	5216
Bulbous plants species collection	2200
Rosa cvs.	505
Dahlia cvs.	265
Astilbe cvs.	130
Phlox paniculata cvs.	110
Hosta cvs.	55
Paeonia cvs.	130
Hemerocallis	~190
Iris sp. + cvs.	190
Tulips	480
Narcissi	120
Lillium sp. + cvs.	205
Rock garden plants	485
Asteraceae (perennial)	63

Asters (*Callistephus chinensis*) cvs.	88
Other annuals	100
Utility plants (berry, technical, medicinal, spice a.o.)	1113
Rare and endangered plants of Latvia	135

HERBARIUM

50 000 specimens

THE MAIN ACTIVITIES

Traditional NBG plant markets (7 markets each year – from April to October), with the participation of nurseries and individual plant growers from all Latvia, and also some growers from Lithuania and Estonia.

Excursions and exhibitions:

In 2009 – 35 guided excursions; 7 thematic excursions, "Rose Days" in the NBG, exhibitions "Coniferous Plants" and "Chrysanthemums" in the Natural History Museum of Latvia, 5 exhibitions in the NBG, "Asters" in Šiauliai Narcissi University Botanic Garden, participation in the exhibition "Garden and Flora" and "Balttour" (Rīga, Ķīpsala Exhibition Centre), "Plant Parade" (Jelgava), "Peonies" (Rundāle Palace), "Flower Ball" (the Botanic Garden of the University of Latvia).

Number of visitors in **2009** – 28487

In 2010 – 34 guided excursions, 8 thematic excursions; the Chrysanthemum exhibition in the Natural History Museum of Latvia, "Rose Days" in the NBG, "Astilbes" at Jēkabpils city fest, "Houseplants" in Šiauliai University Botanic Garden, "Plants and Global Climate Changes" in the Ministry of Environment; „Houseplants" in Šiauliai University Botanic Garden, participation in the "Flower Ball" (the Botanic Garden of the University of Latvia), "Rose Days" (Rundāle Palace), "Garden and Flora" (Kīpsala Exhibition Centre), "Plant Parade", "Peonies", "Roses", "Lilies", "Dahlias", and "Bath Traditions" in the Natural History Museum of Latvia.

Number of visitors in **2010** – 24877

SCIENTIFIC ACTIVITIES

Projects that were carried out in the years **2009** and **2010**:

"Development of endangered plant species bank *in vitro* and particular investigation of taxa problematic in cultivation". The project was supported

by the Foundation of Environment Protection of Latvia, project manager Dr.biol. Dace Kļaviņa.

"The ecological and biological investigation of wild orchid species as the basis for biodiversity conservation of Orchidaceae in Latvia". The project was supported by the Latvian Council of Science, project manager Dr.biol. Gunta Jakobsone.

Participation in scientific conferences

2009

67th Scientific Conference of the University of Latvia – report;

The Nordic Arboretum 18. Union Symposium, Finland/ Oulu University. Dendrologinen Aikauslehti. – report;

Third International Symposium on Acclimatization and Establishment of Micropropagated Plants, Faro, Portugal – 2 poster presentations;

International Scientific Conference "Vaccinium ssp. and less known small fruit: challenges and risks". Latvia University of Agriculture, Jelgava, October 6-9, 2009;

Fifth International Conference "Research and Conservation of Biological Diversity in the Baltic Region." Daugavpils, April 22-24, 2009 – poster presentation;

Fifth European Gardens Congress (EuroGard) "Botanic Gardens in the Age of Climate Change". Helsinki, 8.06.-12.06.09 – 2 poster presentations;

International conference "Balkans and Baltics in the United Europe: history of religion and culture" – report.

2010

68th Scientific Conference of the University of Latvia – 2 reports;

51st International Scientific Conference, Daugavpils – report;

XXIII Conference-Expedition of the Baltic Botanists (Haapsalu, Estonia, July 19-22, 2010 – 2 poster presentations;

XVIII Congress of the Federation of European Societies of Plant Biology. Valencia, Spain, 4.-9. 07. 2010 – poster presentation;

52nd International Scientific Conference of Daugavpils University, Daugavpils, 14-16. 04. 2010 – 3 reports.

Publications

2009

Amatniece V. (2009) Dahlia Cultivars of Latvian Breeding in National Botanic Garden of Latvia. / In: Baltic Botanic Gardens in 2007-2008, Rīga, 66-70

Bondare I. (2009) New Arboreta in Latvia (Rucava). In: The Nordic Arboretum 18. Union Symposium. Finland/ Oulu University. Dendrologinen Aikauslehti, 2009

Jakobsone G. (2009) Germination and development of some terrestrial orchids *in vitro*. *Acta Horticulturae* (Proceedings of the Third International Symposium on Acclimatization and Establishment of Micropropagated Plants), Portugal, 812: 533-537

Kļaviņa D., Druva-Lūsīte I., Gailīte A. (2009) Asymbiotic cultivation *in vitro* of the endangered orchid *Cypripedium calceolus* L. and some aspects of *in vitro* growth. *Acta Horticulturae* (Proceedings of the Third International Symposium on Acclimatization and Establishment of Micropropagated Plants), Portugal, 812: 539-544

Kļaviņa D., Šmite D. (2009) Threatened Plants of Latvia in National Botanic Garden. / In: Baltic Botanic Gardens In 2007-2008, Rīga, 61-65

Knape Dz., Šmite D., Višņevska L., Roze A. Index seminum 2009, 2010, 2011

Laiviņš M., Krampis I., Šmite D., Bice M., Knape Dz., Šulcs V. (2009) Atlas of Latvian Woody Plants. Rīga, Institute of Biology of the University of Latvia. 606

Ripa A., Audriņa B. (2009) Rabbiteye Blueberry, American Cranberry and Lingonberry Breeding in Latvia. Latvian Journal of Agronomy. 12, 93-98

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Strode L., Roze D. (2009) Conservation of Biological Diversity of Meadow Biotopes *ex situ* in National Botanic Garden. Fifth International Conference "Research and Conservation of Biological Diversity in Baltic Region." Daugavpils, April 22-24, 2009. Book of Abstracts, Daugavpils University Academic Press "Saule", 137

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STRUCTURE AND STAFF

	2009	**2010**
Administration	8	7
Dept. of Environmental Education and Information	9	9
Utility Division, (incl. Technical and Exposition Departments)	35	30
Department of Dendroflora	11	11
Department of Herbaceous Plants	9	9
Department of Food, Spice and Medicinal Plants	4	4
Department of Houseplants	15	12
Orangery	2	2
Department of Plant Biological Diversity Conservation *in vitro*	8	10
TOTAL, including:	**101**	**94**
PhD	10	11

FINANCES (in *LVL, 1 LVL = 1.43 EUR*)

	2009	**2010**
Income		
State financing (incl. scientific grants)	555 199	436 754
Own income (tickets, plant sale a. o.)	122 992	98 268
TOTAL	**628 191**	**535 022**
Expenses		
Salaries	367 742	294 261
Taxes	83 900	74 161
Communal utilities (heating, electricity, a. o.)	161 019	87 617
Other expenses	32 377	45 404
TOTAL	**648 038**	**501 443**

THE KALSNAVA ARBORETUM

Address	Slodas, Jaunkalsnava, Kalsnavas pagasts, Madonas novads, LV-4860
Phone	+371 28380280
Fax	+371 64826568
e-mail	j.zilins@lvm.lv
www	www.lvm.lv, www.mammadaba.lv
Manager	Jānis Zīliņš
Territory	143.96 ha

LIVING PLANT COLLECTIONS

Total No. of taxa: **2769**

Main taxa	No. of taxons
Trees and shrubs, including:	2591
Conifer trees	651
Deciduous trees and shrubs	1762
Paeonia	178

STRUCTURE AND STAFF

	2009	2010
Administration	3	3
Greenhouse specialist	1	1
Seasonal workforce	9	11
Tractor operator	1	1
TOTAL, including:	**14**	**16**
PhD	0	0
Msc	0	0

FINANCES (in *EUR*)

	2009	2010
Income	Not available	Not available
TOTAL	**Not available**	**Not available**
Expenses	236400	220200
TOTAL	**236400**	**220200**

VILNIUS UNIVERSITY BOTANICAL GARDEN

Address	Kairėnų 43, LT-10239 Vilnius, Lithuania
Phone	+370 52193133
Fax	+370 52317933
e-mail	hbu@gf.vu.lt
www	http://www.botanikos-sodas.vu.lt
Director	dr. Audrius Skridaila
Territory	198.85 ha

LIVING PLANT COLLECTIONS

Total No. of taxa: **10680**

Main taxa	No. of taxons
Indoor plants, including:	780
Crassulaceae DC.	120
Cactaceae Juss.	70
Liliaceae Juss.	30
Trees and shrubs, including:	4600
Ericaceae Juss.	500
Rosaceae Juss.	390
Oleaceae Hoff. et Link.	200
Ribes L.	386
Syringa L.	200
Conifers	450
Lianas	150
Alpine flora	140
Herbaceous plants, including:	4855
Dahlia Cav.	360
Hemerocallis L.	400
Gladiolus L.	120
Paeonia L.	300
Indigenous species growing in natural habitats	445

THE MAIN ACTIVITIES

2009

The building of garden infrastructure was continued: completed the first stage of new garden stable building (project financial supported by State investment program); work in progress on the installation of a café

room in the former mill (financed by a private investor); development of the infrastructure of a Japanese garden (financially supported by Vilnius city municipality) etc.

The garden staff has developed and delivered lectures of 6 courses at 3 universities and 1 high school, and 4 courses at the Vilnius Labour Market Training Center (non-formal education); participated in 4 committees (as members) of theses defence of a PhD degree; guided 14 graduation work trainings, 5 practices; wrote reviews of 37 student graduation works.

The garden organized a workshop to discuss the influence and problems of invasive species in Lithuania (23/05/2009) and two international events: the botanic gardens workshop of Lithuania, Latvia and Estonia (25/05/2009) and the Conference of the Baltic Sea Region Botanic Gardens (15-18/09/2009; financially supported by SIDA).

The number of garden visitors reached up to 40,000 per year. During this year the garden organized 11 major events for the general public, 11 popular lectures; over 1,500 visitors used the garden's specific additional services (for recreation, picnics, weddings, holidays, celebration of different organizations anniversaries, various events, etc.); 1200 visitors used the horses service etc. In 08/12/2009 the garden was the venue for the presentation of a new coin issued by the Lithuanian National Bank (in Lithuanian currency -50 Lt) with the image of the plant "*Silene Lithuania*".

2010

The building of the garden infrastructure was continued: completed work of the installation of the café room in the former mill (it opened for visitors in September); development of the net of trails in the old landscape garden (financially supported by Vilnius city municipality), completed work of creating of a plant maze, etc.

The garden staff has delivered lectures of 7 courses at 2 universities and 1 high school; participated in 2 committees (as members) of theses defence for a PhD degree; guided 5 graduation work trainings, 5 practices; wrote reviews of 10 student graduation works; organized a workshop for plant growers (22/05/2010).

The number of garden visitors reached up to 50,000 per year. During this year the garden organized 12 major events for the general public (including 2 plant fairs, the International Day of Biodiversity), 7 popular lectures, 6 art exhibitions, 171 guided excursions; over 500 visitors received the garden staff consultations, 1500 visitors used specific garden services (for recreation, picnics, weddings, holidays, celebration of different organizations anniversaries, various events, etc.); 2800 visitors used the garden horses service. The garden was the venue for some activities of the international project "Researcher Night", Lithuanian project "Spaceship Earth" etc.

SCIENTIFIC ACTIVITIES

Main research areas: plant genotaxonomy and biotechnology of cultivation and reproduction; introduction and investigation of ornamental and fruit plants; accumulation, investigation and preservation of plant genetic resources; investigation of immunogenetics, polymorphism, genetic instability of plants; micropropagation *in vitro.*

Projects

European Commission Community Programme on the Conservation, Characterization, Collection and Utilization of Genetic Resources in Agriculture: Core Collection of Northern European Gene Pool of *Ribes*. Dr. D. Ryli kis. 2009-2011.

Establishment of on-line data base (http://euroribes.ateisiu.lt/), establishment of the central collection of 59 *Ribes* L. cultivars.

Ribes/Rubus European Central Data Base. Dr. D. Ryli kis. The Database is managed by the IPGRI and ECP/GR request.

Website: www.ribes-rubus.gf.vu.lt

Triticeae Genomics for the Advancement of Essential European Crops TritiGen. FA 0604. Dr. L. Balčiūnienė. 2007-2011 (project of COST programme).

Publications

2009

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N. Jones, H. Ougham, H. Thomas, I. Pašakinskienė. Markers and mapping revisited: finding your gene // New phytologist. 2009, vol. 183, iss. 4, pp. 935-966

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M. Navalinskienė, M. Samuitienė, B. Grigaliūnaitė, R. Juodkaitė, G. Štukėnienė, S. Dapkūnienė. Fitopatologičeskij kontrol genofonda dekorativnych rastenij v Litve // Aktualnye problemy prikladnoj gienetiki, selekcii i biotechnologii rastenij = Actual problems of applijed gienetics, breeding and biotechnology of plants : sbornik naučnych trudov [gosudarstvennogo Nikitskogo botaničeskogo sada]. T. 131. Jalta, 2009, ń. 27-31

2010

G. Brazauskas, I. Pašakinskienė, T. Asp, T. Lubberstedt. Nucleotide diversity and linkage disequilibrum in five Lolium perenne genes with putative role in shoot morphology // Plant Science 179 (2010) 194-201

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A. Aučina, M. Rudavska, T. Leski, D. Ryliškis, M. Pietras, E. Riepšas. Ectomycorrhizal fungal communities on seedlings and conspecific trees of Pinus mugo grown on the coastal dunes of Curonian Spit in Lithuania // Mycorrhiza. Published online 12 October 2010. ISSN 1432-1890 (Online), ISSN 0940-6360 (Print)

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V. Lygis, B. Grigaliūnaitė, A. Matelis, V. Pribušauskaitė. *Exobasidium japonicum* – rododendrų pūslialigės sukėlėjas // Vytauto Didžiojo universiteto Botanikos sodo raštai. T. XIV, 2010, pp. 105-112. ISBN 1392-3714

L. Labokas, J. Patamsytė, L. Balčiūnienė. Evaluation of field collection of wild *Rubus idaeus* // Vytauto Didžiojo universiteto Botanikos sodo raštai. T. XIV, 2010, pp. 91-97. ISBN 1392-3714

L. Balčiūnienė, V. Vaitkūnienė, A. Leistrumaitė. Miežių genetiniai ištekliai: hibridų kolekcijos ūkinių savybių tyrimas // Vytauto Didžiojo universiteto Botanikos sodo raštai. T. XIV, 2010, pp. 23-28. ISBN 1392-3714

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S. Dapkūnienė, G. Štukėnienė, R. Juodkaitė, O. Motiejūnaitė. Lietuvos dendrologinės vertybės – augalų nacionaliniai genetiniai ištekliai // Klaipėdos valstybinė kolegija. Miestų želdynų formavimas. Mokslo darbai. 2010, pp. 54-59. ISSN 1822-9778

B. Grigaliūnaitė, E. Meidus, D. Radaitienė. Šermukšnio (*Sorbus* L.) fitosanitarinė būklė Vilniaus universiteto Botanikos sode // Dekoratyviųjų ir sodo augalų sortimento, technologijų ir aplinkos optimizavimas. Mokslo darbai, 2010, 1 (6). pp. 49-54. Kauno kolegija, Mastaičiai. ISSN 2029-1906

STRUCTURE AND STAFF

	2009	**2010**
Administration	10	10
Scientists	12	12
Curators of plant collections	12	12
Field workers, technicians etc.	49	50
TOTAL, including:	**83**	**84**
D.Sc.	1	1
PhD	8	8
Msc	3	3

FINANCES (in *LT, 1 LT = 0.29 EUR*)

	2009	**2010**
Income		
State budget subsidy	1977 000	1867 000
Other state budget assignations	2284 00	294 00
Vilnius City Municipality	120 000	40 000
Support of other institutions, persons, etc.	82 000	226500
Grants	32 000	188 000
Other income (sale of plants, tickets etc.)	194 000	252 000
TOTAL	**2633400**	**26029 00**
Expenses		
Salaries (incl. taxes)	1778 000	1787 000
Infrastructure maintenance	388400	5159 00
Infrastructure development	467 000	300 000
TOTAL	**2633400**	**26029 00**

BOTANICAL GARDEN OF KLAIPEDA UNIVERSITY

Address	Kretingos Str. 92, Klaipeda, Lithuania
Phone	+370 46398832, +370 46398833
Fax	+370 46398837
e-mail	bs@ku.lt
www	ku.lt/botanikos-sodas/index.php
Director	Ona Ruta Zadeikiene
Territory	9.3 ha

LIVING PLANT COLLECTIONS

Total No. of taxa: **3044**

Main taxa	No. of taxons
Outdoor plants, including:	3044
Trees and shrubs	1425
Herbaceous ornamental plants	995
Medicinal and spice plants	359
Indigenous plants on the territory	265

SCIENTIFIC ACTIVITIES

Projects

National project. Modeling of stress adaptation for over-ground part and roots of *Poaceae* plants in the aspect of growth, 2009

International project. 7FP (Seventh Framework Programme) project "Researcher Night in Lithuania 2009", 2009

Publications

2009

Skuodienė R., Nekrošienė R. 2009. Effect of perennial grasses ploughed in as green manure on the occurrence of net bloch in spring barley. *Agronomy Research. Volume 7. Special issue 1. Fostering healthy food systems through organic agriculture – Focus on Nordic-Baltic Region.* Tartu, pp. 492-497 http://www.isinet.com/cgi-bin/jrnlst/jlresults.cgi.

Nekrošienė R. 2009. Cultivation possibilities for Thyme, an important medicinal plant, in Western Lithuania. *Agronomy Research. Volume 7. Special issue 1. Fostering healthy food systems through organic agriculture – Focus on Nordic-Baltic Region.* Tartu, pp. 430-435. http://www.isinet.com/cgi-bin/jrnlst/jlresults.cgi

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Nekrošienė R. 2009. Landscape gardening of surroundings of block of flats in Southern Sweden. *Formation of Urban Green Areas. Scientific Articles,* Nr. 1(6), Klaipėda, pp. 93-96

Nekrošienė R. 2009. Peculiarities of green places formation in model homesteads in Melnrage. *Formation of Urban Green Areas. Scientific Articles*, Nr. 1(6), Klaipėda, pp. 89-92

Nekrošienė R., Repšienė R. 2009. Dendrofloros rūšių įvairovė ir būklė centrinės-šiaurinės Klaipėdos miesto dalies parkuose. *Respublikinės mokslinės konferencijos „Dekoratyvinių ir sodo augalų sortimento, technologijų ir aplinkos optimizavimas" mokslinių straipsnių rinkinys*, Mastaičiai, pp. 59-63

Nekrošienė R. 2009. Stuomeniniai augalai. *Mokomosios praktikos metodiniai nurodymai*, Klaipėda, ISBN 978-9955-18-393-8

Skridaila A., Žilinskaitė S., Jokšienė T., Mildažienė V., Ragažinskienė O., Česonienė L., Varkulevičienė J., Snieškienė V., Žeimavičius K., Šimatonytė A., Baronienė V., Motiekaitytė V., Klimienė A., Vainorienė R., Grigaitė A., Malciūtė A., Kavanauskaitė A., Lopetienė E., Nekrošienė R. 2009. Botanic Gardens of Lithuania. Vilnius, 179 p. (in Lithuanian and English). ISBN 978-9955-33-510-8

Šimkūnas A., Valašinaitė S., Mažeika V. 2009. Peculiarities of development and overwintering of various *Festulolium braunii* cultivars. Vagos, 85 (38)

Šimkūnas A., Valašinaitė S., Ščavinskas M. 2009. About the nonlinear aspects in the biological and social-historical systems. *Tiltai*, 4, pp. 237-242

Šimkūnas A., Valašinaitė S., Mikalauskas M. 2009. About the states of plant systems from the byophysical viewpoint. Tarptautinė virtuali mokslinė konferencija "Современные направления теоретических и прикладных исследований '2009", Ukraina, pp. 20-22 www.sworld.com.ua

Šimkūnas A., Valašinaitė S., Ščavinskas M., Weston D. J. 2009. About Nonlinear System Aspects in Biology and History. *Tarptautinė mokslinė konferencija „Crisis: catalyst for creativity and innovation"*. LCC tarptautinis universitetas, Klaipėda, Lietuva

2010

Nekrošienė R. 2010. Performance of urbanised ecosystems. *Formation of Urban Green Areas. Scientific Articles.* Nr. 1(7). Klaipėda, pp. 125-131. http://journals.indexcopernicus.com/karta.php?id=1406

Nekrošienė R. 2010. Changes of composition of lawn grass species and varieties in mixtures. *Optimization of Ornamental and garden Plant Assortment, Technologies and Environment. Scientific Articles* 1(6), Mastaičiai, pp. 116-120 (in Lithuanian).

Nekrošienė R. 2010. Medicinal plant resources in natural habitats in Lithuania, collections of these plants in scientific institutions. Žolininkystės, daržininkystės ir sodininkystės iššūkiai. Tarptautinės konferencijos medžiaga. Skuodas, pp. 15-23 (in Lithuanian).

STRUCTURE AND STAFF

	2009	**2010**
Administration	2	2
Curators of plant collections	5.5	5.5
Researchers	3	3
Technicians	9.5	11.5
TOTAL, including:	20	22
PhD	2	2
Msc	2	2

FINANCES (in *LT, 1 LT = 0.29 EUR*)

	2009	**2010**
Income		
State budget subsidy	381 700	39 1700
Other income (trade of plants, tickets, etc.)	24 000	54 000
TOTAL	**405 700**	**445 700**
Expenses		
Salaries (incl. taxes)	381 700	421 700
Infrastructure maintenance and development	24 000	24 000
TOTAL	**405 700**	**445 700**

ŠIAULIAI UNIVERSITY BOTANIC GARDEN

Address	Paitaičių Str. 4, Šiauliai
Phone	+370 41553934
Fax	+370 41557039
e-mail	dir@bs.su.lt
www	www.sodas.su.lt
Director	Asta Klimienė
Territory	2.5 ha

LIVING PLANT COLLECTIONS

Total No. of taxa: **4134**

Main taxa	No. of taxons
Trees and shrubs, including:	873
Coniferous	232
Deciduous	308
Ericacea fam.	317
Fenological	16
Herbaceous plants, including:	3261
Medical and aromatic plants	52
Department of plant systematics	830
Department of mountain plants	1282
Department of floriculture	1097

THE MAIN ACTIVITIES

Two main annual and traditional festivals – "Delights of Spring" and "Assumption in Šiauliai".

Participation in the European project "Research Nights",

Local activities jointly with a number of education institutions, communities, non-goverment institutions – more than 130 excursions per year.

SCIENTIFIC ACTIVITIES

The project "The cognition and preservation of the distinctive identity through the environment of Ziemgala region" within the Latvian-Lithuanian cross border cooperation programme (EU).

Publications

Klimienė A**.** 2009. Original Activities at the Botanical Garden of Šiauliai University. Cooperation between Botanical Gardens in the Baltic Sea Region: The second international conference, September, September 15-18, 2009, Vilnius, Lithuania. Programme, Abstracts and Participants. Vilnius, p. 13

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STRUCTURE AND STAFF

	2009	**2010**
Administration		
Researchers	4	4
Specialists	2	2
Other	14	14
TOTAL, including:	**20**	**20**
PhD	1	
Msc	2	2

FINANCES (in *LT, 1 LT = 0.29 EUR*)

	2009	**2010**
Income	340 800	354649
Expenses, including:	318 118	319 257
Wage	231 461	231 461
Tax	3625	36253625
Other	30 014	35 212
TOTAL	**348 132**	**354 469**

KAUNAS BOTANICAL GARDEN OF VYTAUTAS MAGNUS UNIVERSITY

Address	Z. E. Zilbero str. 6, Kaunas, 46324 Lithuania
Phone	+370 37390033
Fax	+370 37390133
e-mail	bs@bs.vdu.lt
www	http://botanika.vdu.lt
Director	Vida Mildaziene
Territory	62.5 ha

LIVING PLANT COLLECTIONS

Total No. of taxa: **6977**

Main taxa	No. of taxons
Sector of floriculture	5079
Sector of dendrology:	858
Pinophyta	251
Magnoliophyta	607
Sector of pomology:	415
Actinidia collection	55
Corylus avellana collection	9
Lonicera edulis collection	14
Rubus collection	15
Vaccinium macrocarpon collection	53
Vaccinium oxycoccus collection	120
Vacinium vitis-idaea collection	23
Vaccinium covilleanum collection	69
Vaccinium sp. collection	39
Viburnum collection	18
Sector of medicinal plants:	625
Medicinal plants	419
Spices-melliferous plants	157
Hops	49

STRUCTURE AND STAFF

	2009	2010
Administration	2	2
Department of Plants Pathology	4	3
Department of Dendrology	4	5
Department of Floriculture	20	20
Department of Medicinal Plants	6	6
Department of Pomology	6	6
Technical and transport service	26	27
TOTAL, including:	**68**	**69**
PhD	8	8
Msc	1	1

FINANCES (in *LT, 1 LT = 0.29 EUR*)

	2009	2010
Income		
State budget subsidy	1494600	1494600
Other state budget assignations	256500	1040800
Other income (tickets, plant sales, ect.)	237800	223300
TOTAL:	**1988900**	**2758700**
Expenses		
Salaries (incl. taxes)	1516500	1562500
Other	472400	1196200
TOTAL:	**1988900**	**2758700**

THE MAIN ACTIVITIES

Kaunas Botanical Garden of Vytautas Magnus University consists of five sectors – Medicinal Plants, Plant Pathology, Dendrology, Pomology, Floriculture, and service subdivision. It occupies an area of 62.5 hectares. Approximately 7000 different plants comprise the collections and expositions that are open for public attendance and cover an area of about 30 ha. The botanical expositions and collections, the Greenhouse, a big park and an interesting pond system have a big potential not only for plant conservation and research but also for all modern forms of interactive education, cultural tourism and community use. Kaunas Botanical Garden receives 50 thousand visitors per year. In 2009-2010 green classes were

set up, and the number of events and projects for visitors substantially increased. Several projects for the development of international tourism were implemented. The relationships with the local Aleksotas community became much tighter, and Kaunas Botanical Garden club of friends was re-activated. The environmental education project „Žaliasis Aleksotas" (see http://www.zaliasisaleksotas.lt/) was started in 2010. The children science laboratory "NSO laboratory" was opened in 2010 by prof. Birute Galdikas. In this laboratory a new interactive programme for informal education, science communication and eco-education is created and implemented.

Sector of Medicinal Plants

Medicinal plant collecting and research on medicinal plants at Kaunas Botanical Garden of Vytautas Magnus University was started in 1924. The research problems and topics underwent considerable changes in the long period of 84 years; however, the main initial goals are still of high interest to this day. The main goal of medicinal plant investigation is to enrich the local flora with new species and varieties that can be valuable for pharmaceutical and food industries. The introduction and acclimatization of new medicinal and aromatic plants from various geographical regions and selecting the most perspective species and varieties are aimed at protecting genetic resources and biodiversity. Knowledge about specific properties of medicinal plants is essential while developing recommendations for producers of medicinal plant stock as well as for the formulation of new concepts for planting, growing and analysis of medicinal plants.

These collections have been changed over the years: the location, size, number of species and varieties, classification and growing schemes varied in different periods.

At present the collections-expositions of medicinal plants contain 419 species, which belong to 281 genera and 88 families. Their classification is based on bioactive compounds synthesized by plants. 20 species belong to the category of protected and rare plants. The collections-expositions of spice and melliferous plants contain 134 species that belong to 99 genera and 34 families. In the exposition for the blind and visually-impaired people 50 species and 16 families are represented. The collection of hops contains 30 varieties, one hybrid and 19 wild individuals.

Research topic: Introduction and acclimatization of species and varieties of medicinal and aromatic plants, investigation of their diversity, protection and development of their genetic resources in Central Lithuania.

The collections-expositions are part of Lithuanian national gene fund and play an important role in the education of students, PhD students and herbal professionals.

Sector of Dendrology

The dendrology collection was started in 1923 by prof. K. Regel. The direction of research in the dendrology sector is introduction, acclimatization and genetic resources of woody plants. The collections consists of two parts: one is arboretum introduction and another is in an old landscape park, which was announced as protected by the state in 1958, and recognized as a monument of national importance in 1986. In the central part of the arboretum extant plants, such as ginkgo (*Ginkgo biloba*), katsura tree (*Cercidiphyllum japonicum*), silver maple (*Acer saccharinum*), grey poplar (*Populus x canescens*), dawn redwood (*Metasequoia glyptostroboides*) and black pine (*Pinus nigra*), are planted. There were 450 species and forms of exotic woody plants in the seventh decade in the botanical garden; under the supervision of M. Lukaitiene. V. Ivanauskas, dr. M. Navasaitis, dr. L. Januskevicius, dr. V. Baroniene, D. Liagiene the collections grew to the present size. In 2000, the dendrological collection gained the protection status.

The collection of woody plants in 2010 was composed of more than 800 species, subspecies, varieties, forms, cultivars of woody introduced plants, including 250 gymnospermous and almost 600 angiospermous species. 6 species and 12 cultivars of plants were obtained in 2006-2010. The richest collections are of *Cupressaceae, Pinacea, Oleaceae, Ericaceae, Rosaceae, Hydrangeaceae* and *Aceraceae* families. Colourful Lawson cypress (*Chamaecyparis lawsoniana*), different cultivars of American arbor-vitae (Thuja), flowery rhododendrons (*Rhododendron*), heaths (Calluna), and the richest collection in the Baltic countries and Scandinavia of shrubby cinquefoil (*Potentilla fruticosa*) can be visited in the arboretum. Visitors are interested in rare and decorative plants, such as Korean fir (*Abies coreana*), junipers (Juniperus) with blue-green foliage, Indian abelia (*Abelia trifoliata*), star magnolia 'Susan' and 'Nigra' (*Magnolia*) and box-elder maple (*Acer negundo*) 'Flamingo'.

The most perspective plants for introduction – the cultivar of American arbor-vitae (*Thuja occidentalis*), 2 species and 4 cultivars of spindle tree (Euonymus), 13 cultivars of cinquefoil shrubby (*Potentilla fruticosa*) and 3 species and 5 cultivars of spiraea (*Spireae*) are selected for studies and conservation. This work is performed under the programme "Accumulation, preservation and investigation of the gene pool of decorative plants in Lithuania" within the project "Accumulation, preservation and investigation of the gene pool of decorative plants".

Six species (one of gymnospermous and 5 of angiospermous) out of the 12 species of woody plants of the Red Book of Lithuania are cultured in the dendrology collection of Kaunas Botanical Garden.

Sector of Pomology

Development of the horticultural plant collection and their research was started in Kaunas Botanical Garden of Vytautas Magnus University in 1923, immediately after its foundation. Walnuts, grapes and apricots have been investigated in the department of Pomology since 1951. Continuing long-lasting traditions, since 1993 the introduction and acclimatization of new perspective berry plants have been performed in Kaunas Botanical Garden. Considerable collections of blueberry *Vaccinium x covilleanum Butkus et Plizka*, American cranberry *Oxycoccus macrocarpus (Aiton) Pursh*, actinidia *Actinidia Lindl.*, European cranberry bush *Viburnum opulus L.* were established. The unique collection of European cranberry *Oxycoccus palustris Pers.* with over 110 clones was collected during the expeditions to strictly protected areas as well as Ignalina, Utena and Jurbarkas region bogs in 1995-2000.

62 species and clones of high-bush blueberry, obtained from various institutions in the USA, Germany, Poland, Latvia and Sweden, are investigated in Kaunas Botanical Garden of VMU. The research is performed for evaluating biochemical composition of berries, reproduction peculiarities and estimation of adaptation potential of high-bush blueberry species to the climate conditions in Lithuania.

53 species and clones of American cranberry are investigated. Its genetic diversity, biological and economical productivity are assessed, perspective cultivars are selected for their cultivation in industrial plantations in Lithuania.

The collection of actinidia genus is comprised of 87 species, cultivars and clones. The performed research includes the evaluation of genetic and phenotypic diversity, research of biologically active substances in kolomikta kiwi (*Actinidia kolomikta* (Maxim.) Maxim.) berries.

Valuable clones of cowberry *Vaccinium vitis-idaea L.*, European cranberry bush *Viburnum opulus L.*, hazelnut *Corylus avellana L.,* Arctic bramble *Rubus arcticus L.* are selected and investigated in the collection of berry plants. To this aim, classical morphological diversity and productivity assessment methods are used and modern genetic, molecular biology and biochemistry research methods are also applied.

The results of research on berry plant introduction are the following: optimal conditions of reproduction and cultivation of these plants are determined, the most perspective cultivars of high-bush blueberry, American cranberry and kolomikta kiwi are selected for cultivation in Lithuania, and recommendations are prepared for farmers interested in alternative farming possibilities with regard to cultivating these plants and using their berries. Seminars and scientific conferences are regularly organized. Kaunas

Botanical Garden of VMU cooperates with various Lithuanian research institutions, Botanical Gardens of Estonia, Byelorussia, Poland as well as Horticulture and Floriculture Institute in Skierniewice (Poland), proficients of berry plant cultivation and owners of plantations in Poland, Germany, Sweden and Canada.

Sector of Plant Pathology

The main task of the Pathology group is to investigate the variety of pathogenic organisms, their migration ways and interaction with the introduced plants. The research in the field of phytopathology in Kaunas Botanical Garden has been iniciated in the fourth decade of 20th century by professor A. Minkevicius who investigated garden plant diseases. Later on the phytopathology research was concentrated on the diseases of roses and trees and was continued by assoc. prof. L. Zuklys and assoc. prof. R. Zukliene. In the studies by Dr E. Petrauskaite more attention has been paid to the pathology of flowers; Dr E. Baltrusaitiene was an expert on plant bacterial infections. Two prominent enthomologists were working in Kaunas Botanical Garden – scale insects were studied by assoc. prof. A. Vengeliauskaite, and blights attacking medicinal and decorative plants were rsearched by assoc. prof. V. Juronis. Presently, Dr V. Snieskiene and Dr A. Stankeviciene investigate diseases of medicinal and decorative plants as well as fungal role in plant rhizosphere. Considerable attention is also given to the development of practical recommendations for protection of introduced plants against pathogenic organisms. The Plant pathology group of Kaunas Botanical Garden is involved in monitoring the condition of green areas in cities of Lithuania.

Sector of Floriculture

Since the foundation of the Botanical Garden special attention has been paid to the expositions and collections of ornamental plants. Flowerbeds were being planted and collections of ornamental plants were being collected extensively for many years. During World War II almost all this treasure was ruined. The collections were re-established by O. Skeiviene, A. Boguseviciute, A. Baliuniene, E. Radauskiene, E. Zliobiene, D. Dainauskaite, A. Linkeviciene and J. Vaidelys. Since 2000, the sector is headed by Dr J. Varkuleviciene.

Today floriculture expositions and collections are in the central part of the Botanical Garden and cover a total area of 2.5 ha. The main research is performed on acclimatization of introduced ornamental plants, accumulation, evaluation and preservation of Lithuanian cultivars and hybrids' genetic fund in Kaunas Botanical Garden.

In the sector of floriculture there are 5200 taxons of ornamental perennial plants grown in expositions and collections of lignified and herbaceous ornamental plants. A unique flora taxonomy collection curated by K. Stankeviciene provides an insight in plant taxonomy and enables to view very rare species. This collection consists of 85 families and more than 800 taxons of local flora and introduced plants that are displayed in taxonomical order. A big collection of bulbous and other monocolydenous plant species and sorts is grown on the pond island. Collections of various flowers, cultivars and hybrids are gathered in the department of expositions and collections: dahlias – 276 taxons, peonies – 178; iris – 196; astilbe – 54; lilies – 112; day lilies – 114; tulips – 487; roses – 350; other perennial flowers – over 814 taxons.

The activity of the Botanical Garden in seed exchange aims to maintain close contacts with botanical gardens all over the world in order to carry out extensive seed and plant exchange. The exchange of seeds and plants is the first stage of plant introduction that is an effective tool for enrichment of the collections. The catalogue of seed exchange "Index seminum" has been published since the foundation of the garden. Currently the Botanical Garden carries out seed exchange with 410 addressees (responsible person – K. Stankeviciene). In recent years we have received nearly 1000 new plant species as seeds or live plants from other botanical gardens. In turn, we have sent seeds of more than 800 plants to other botanical gardens.

Plants belonging to the regional and national herbal collection are gathered and investigated in the Botanical Garden. Nearly 10,000 herbarized plant samples are preserved in the Herbarium of Kaunas Botanical Garden.

The construction of the greenhouse of VDU Kaunas Botanical Garden was started in 1923 and finished in 1938. Plants are grown in 6 sections of the greenhouse according to the geographical-climatic principle: section I – tropical forests; II – rainforests; III – dry tropics; IV – tropics; V – cool subtropics; VI – warm subtropics. The greenhouse plants are situated according to their requirements for temperature and humidity level. There are two main climatic mode types: tropical (temperature in winter is 18-25 °C) and subtropical (temperature in winter is 6-15 °C). In both parts the plants are grouped according to their geographical origin.

The greenhouse plant exposition covers an area of 800 m^2. There are tropical and subtropical plants of 1500 species, cultivars and forms, including plants that originate from South America and Malaysia rainforests, Southeast Asia monsoon forests, dry African savannah and well-known Mexican deserts. Many of them are edible or potherb plants (banana, pineapple, vanilla, cardamom, ginger), others are valued as industrial material (agaves, gravillea, etc.) or are widely used for medicinal purposes (aloe, ephedra, pelargonium, passiflora).

5 cultivars ('Jadvyga', 'Linkėjimai Latvijai', 'Lietuvaitė', 'Jaunystė' and 'Pasaka') of Primula malacoides Franch. were created and legalized in VDU Kaunas Botanical Garden in 1967-1976. Originator – Ona Skeiviene. These original cultivars grow easily and flower abundantly, are ornamental and have delicate scent. Works of seedage and selection are carried out annually.

Nursery Arboretum

There are more than 250 species and forms of ornamental trees and shrubs grown in the nursery arboretum of Kaunas Botanical Garden. These plants are provided to institutions or individual customers and are also used for the public landscaping of Kaunas city. Plants offered for sale by our nursery are multiplied and reared in our garden, thus they are well adapted to the local climate. Major assortment comprises rhododendrons, shrubby cinquefoil, arbor-vitae, false cypress and juniper cultivars. Some rare seedlings, as ginkgo, katsura trees, can be obtained here. Some seedlings are sold in containers and therefore can be purchased all the year round.

ARTICLES

REMARKABLE TREES OF PIRITA CITY DISTRICT

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Keywords

Greenery, Pirita city district, ancient trees, summer estate, farm greenery, introduced species.

Abstract

The oldest native and introduced trees of Pirita city district originate from the greenery of former farms and summer estates. Kose and Windeck summer estate parks are extensive parks remarkable for their rare trees. The first important period of planting of introduced tree species was between the years 1880 and 1940, and the second – between 1955 and 1980. Remarkable trees of the second period of planting grow mainly in private gardens.

Introduction

Tallinn Botanical Garden is located in Pirita city district, an area with the widest variety of species and cultivars. However, there are multiple ancient trees and trees rare for an urban environment growing outside the Botanical Garden – in parks, forests, green areas, at old summer estates, street sides, in gardens and summer cottage areas as well. Some of them are of natural origin, but the majority of them have been planted by people.

Since the mid-1970s researches of urban flora have been done in Tallinn Botanical Garden. Subordination to the Academy of Sciences required the issue to be reviewed under various subjects during a long period. Scientists relating to ecology and landscape science (Jüri Rauk, Heldur Sander, Andres Tarand, Heiki Tamm), above all, participated in such researches. The most thorough researches on various groups of plants took place in Kadriorg Park

(team under the leadership of H. Tamm). At the request of Tallinn city in the 1980s the woody flora of Kalamaja, Kadriorg, Mustamäe, IV neighbourhood of Lasnamäe and Old Town was researched. At the same time the biomass of Tallinn in various land categories (Jüri Rauk) and distribution thereof depending on the use of land (Heldur Sander) were estimated. Jüri Elliku participated in the majority of researches as a dendrologist. Marina Šestakov performed the researches of green areas of the central city district and former summer estates.

In the year 2008 a decision was taken to check the existence and condition of ancient trees and trees of rare species or cultivars in Pirita city district.

Methods

Field works for the inspection of existence and condition of remarkable trees were in progress in the years 2008 and 2009. The perimeter at breast height (at the height of 1.3 m above the ground surface) of the trees, marked with the letter P, and the height of the trees, marked with the letter H, were measured. Height was measured by Haglöf Electronic Height Meter (Clinometer). Later the diameter at breast height marked with the letter D was calculated. The main basis for the choice of trees was the work "Remarkable Trees of Tallinn and Protection Thereof" and some data from the field works covering particular areas at earlier periods.

Ancient trees in Pirita city district

The definition of an ancient tree has not been precisely specified. An old tree which has a significant biological, aesthetic or cultural value is considered to be an ancient tree. An ancient tree often has signs of ageing (dry branches in the crown, large cavities and hollows in the trunk) and is big in comparison to other individuals of the same species or cultivar. 'Ancient tree' refers to the age of a tree. Unfortunately, it is difficult to estimate the age of trees as there are few trees regarding whereof some written data, drawings or images have remained. Estimation of the age of trees by increment boring does not provide reliable results in case of older trees as tree trunks are hollow.

Thus, in our research ancient trees were defined by their large size, and we treated trees with diameter at breast height over 1 m.

In Pirita city district ancient trees can be found, above all, amongst English oaks (*Quercus robur*), small-leaved limes (*Tilia cordata*) and white willows (*Salix alba*, *Salix* × *rubens*). English oak can be considered to be a natural species in fore-klint areas, especially Cambrian sandstone terrace. It is known that in the years 1875-1877 a beautiful oak grove was planned

and separated in Maarjamägi, where in the year 1882 Saare Street and in the year 1900 Tamme, Lepa and Kase streets were laid out (Nerman, 2008). Small-leaved lime is a natural species spread over the area of Merivälja on the soils formed on moraines, as well as on the upper edge of Maarjamägi klint section. Willows have been planted in Pirita.

The biggest known tree in Pirita city district is a black willow growing in front of 3 Kase St (*Salix* × *rubens*), P=702 cm (D=224 cm), H=19 m; its trunk is divided into two branches at the height ca 2 m; some years ago the crown was cut back for safety. The estimated age of the tree is 70 years.

The biggest small-leaved lime in Tallinn grows in front of the main building of the former Carlshof, i.e. Kose summer estate at the address Kose tee 57. Carlshof summer estate was established presumably in the year 1784, when this place was purchased by an alderman's widow, Margaretha Elisabeth Clayhills. The summer estate was separated from the Varsaallika peasant Christian's land. It is believed that the buildings located next to the main gate originate from the foundation date as the main building was constructed later. After M. E. Clayhills's death in the year 1816 the plot of land was transferred to the Koch family and was owned by them until 1922 (Nerman, 2008). The trunk of the biggest lime P=675 cm (D=215 cm) is divided into three branches at the height ca 1.6 m, and at the height ca 2 m the branches are P=323 & 298 & 283 cm (D=103 & 95 & 90 cm), H=23 m, the diameter of the crown is 18 m. The tree is believed to have been planted in the foundation period of the summer estate, and it is ca 230 years old now. This lime has been under national protection. At the edge of the plot of land there is another ancient lime, P=355 cm (D=113 cm), H=23 m, the diameter of the crown is 24 m.

The biggest oak in Pirita city district grows in the area of the former Kose summer estate (German: *Alt-Kosch*) at the address 9 Kose Rd. The perimeter of the tree at breast height (P) is 477 cm (D=152 cm), height (H) 20.5 m and the diameter of the crown is 20 m. The tree may date back to the first years of the summer estate as of the foundation thereof, or even to the period before it. The Kose summer estate was founded by Joachim Christian Koch in the year 1790 in the area taken from Tallinn city for metayage. Around the estate a park was formed. The Russian literary man Aleksandr Miljukov (1817-1897) in the year 1849 wrote in his travel diary: "It is difficult to imagine the whole beauty of this mini-Eden. The river flows between the steep banks, and it is so fascinating; you enjoy it at every step – looking at either wild or enchanting landscape. In a low velvety meadow and hill terraces surrounding it there is a small but gorgeous garden. This is neither a French classical garden where nature is decorated and smartened up by art, nor an English romantic park where nature imitates art, but this is a fruit of some kind of passionate fusion of nature and art where

the strength and beauty of both have joined in harmony of the parts and charming beauty of the whole. When walking here, you forget the both the medieval and modern times." (Nerman, 2008). In front of the summer estate gate there is an ancient oak, P=340 cm (D=108 cm), H=18 m, the diameter of the crown is 23 m, and at the edge of the estate enclosure wall there is a big small-leaved lime, P=322 cm (D=103 cm), H=24 m. In the last quarter of the 19th century several trees of introduced species were planted in the garden.

In the middle of the 17th century in the area of Väo estate Varsaallika, Lillepi and Mähe individual farms were established At the beginning of the 19th and 20th century the land of the Lillepi farm was used as meadows for rent. As soon as cattle raising in the city gradually decreased after the Second World War, a green area appeared there, which in the year 1965 was transformed into a park by building of road network and playgrounds, and planting of trees and bushes. Nowadays there are multiple ancient trees in Lillepi Park, diameter of trunks whereof shall soon exceed 1 m. In the southern part of Lillepi Park there are groups of oaks ca 150 years old. Taking into account the branchy form of the trees, in their early age they grew in the open. The perimeter of the biggest oak at breast height is P=298 cm (D=95 cm). At the southern edge of Lillepi Park there are multiple European white elms (*Ulmus laevis*), Pmax=122 & 141 & 226 cm (D=39 & 45 & 72 cm). In the western part of the park there are multiple black alders (*Alnus glutinosa*), Pmax=311 cm (Dmax=99 cm) and common ashes (*Fraxinus excelsior*), Pmax=342 cm (Dmax=109 cm), and two hybrids *Alnus* × *pubescens*, P=347 cm (D=111 cm), H=20 m, P=257 & 277 cm (D=82 & 88 cm), H=22 cm.

The most common tree species in Pirita city district is Scots pine (*Pinus sylvestris*), which grows on a vast area of both banks of the Pirita River that flows through the city district in sandy and peaty soil, on the two former dunes and wet areas between the dunes. Some pines are of natural origin, and some of them have been planted. It is known that important planting works were commenced in the middle of the 19th century. In the 1860s, on the initiative of Viimsi estate, the planting of forest on the seashore of Pirita was started, which nowadays stretches for ca 2,3 km from Merivälja Road and the sea. The planting was performed in three parts; the latest and closest to the Pirita River was planted at the beginning of the 20th century (Tallinna haljastuse arengukava, 2005).

The oldest Scots pines of Tallinn grow in Kose forest where some trees are ca 200 years old, and their trunks are P>314 cm (D>100 cm). Some pines of advanced age, ca 140 years old, can be detected in Lillepi Park. Their trunks exceed P>270 cm (D>87 cm).

Trees of rare species or cultivars in Pirita city district

At the end of the 19th century and at the beginning of the 20th century vacation areas appeared at the periphery of Tallinn or even outside the city. After the year 1883 new summer estates and villas sprang up in Pirita city district, in the area of Kose summer estate and Maarjamägi. New farms appeared in the area of Lepiku and Mähe (Nerman, 2008).

Nowadays some individuals of introduced species have remained in the former vacation areas as well. The aforementioned Kose summer estate is remarkable for a lot of ancient, over 100-year-old conifers of introduced species. Among them there are some balsam firs (*Abies balsamea*) Pmax=141 cm, H=16.5 m, Canadian fir (*Abies* × *phanerolepis*), P=106 cm, H=12.5 m, eastern white pine (*Pinus strobus*) P=153 cm (D=49 cm), H=18 m, Douglas fir (*Pseudotsuga menziesii*), Pmax=299 cm, H=23.5 m, European yew (*Taxus baccata*) behind the main building of Kose summer estate, P=32 & 22 & 21 & 31 & 33 & 61 cm (D=11 & 7 & 7 & 10 & 11 & 20 cm), H=6.2 m; P=49 & 52 & 33 cm (D=16 & 17 & 11 cm), H=5.8 m, Norway spruce (*Picea abies*) 'Tuberculata' at Kose summer estate, P=243 cm (D=77 cm), H=13.5 m, Serbian spruce (*Picea omorika*), P=121 cm (D=39 cm), H=21 m, blue spruce (*Picea pungens*) 'Glauca', P=174 cm (D=55 cm), H=22 m; P=175 cm (D=56 cm), H=22 m, Northern white cedar (*Thuja occidentalis*) 'Filicoides' at the Kose summer estate gate, P=140 cm (D=45 cm), H=11 m; P=145 cm (D=46 cm), H=11.5 m; behind the main building P=111 cm (D=35 cm), H=12 m. The deciduous trees that deserve special mention are the Canadian poplars (*Populus* × *canadensis*) 'Marilandica', Pmax=376 cm (D=120 cm), H=24.5 m, growing on the river bank.

Another park where some individuals of introduced tree species have remained is the former Windeck Villa Park at the addresses 2 Kose Rd 2, 2a Kose Rd, 2 up to 16 Tuulenurga St, and partially 102 Pirita Rd and 1 Tuulenurga St. The wooden villa was built in the 1870s by Tallinn burgomaster Robert Weisse (1817-1886), and in the year 1995 the villa was destroyed by fire. R. Weisse ordered to create a park around the villa and the adjoining buildings (Elliku, Sander, 1996). Growing in Windeck Park is the biggest northern red oak (*Quercus rubra*) in Tallinn, P=204 cm (D=65 cm), H=24 m, a lot (over 50) of European larches (*Larix decidua*), Pmax=315 cm (Dmax=100 cm), H=24 m, some Douglas firs (*Pseudotsuga menziesii*), Pmax=231 cm, H=22 m, two common beeches (*Fagus sylvatica*) P=172 cm (D=55 cm), H=25 m and P=147 cm (D=47 cm), H=22 m, an eastern white pine (*Pinus strobus*), P=143 cm (D=46 cm), H=18 m, silver poplar (*Populus alba*), Pmax=289 cm (D=92 cm) and a large-leaved lime (*Tilia platyphyllos*), P=328 cm (D=104 cm), H=24 m. In Windeck Park and in the area adjoining it at the edge of Saare Road there is a significant

number of the biggest common hornbeams (*Carpinus betulus*) known in Tallinn, a total of 29 trees, over 5 m high, P=132 cm (Dmax=42 cm).

Amongst the greenery of the farms founded in the second half of the 19th century some ancient English oaks (*Quercus robur*) have remained in Mähe, in the territory of a former farm owned by the Tallinn mayor of the time,Voldemar Lender, its present address being No.1 Põõsa Rd. Two bigger oaks, P=393 cm (D=125 cm), H=19.5 m, diameter of the crown 20 m and P=273 cm (D=87 cm), H=18 m, diameter of the crown 17 m, have been taken under local protection. A big European larch (*Larix decidua*), P=324 cm (D=103 cm), H=27 m, still growing in the farm area, at 17 Mähe Rd, is also remarkable.

In the year 1908 some individual summer cottages were built near the Pirita River. In the year 1912 ten hectares were separated from Väo estate where new summer cottages were built, and the area was named Kose-Kallaste, i.e. Uue-Kose (Nerman, 2008). Pirita became the vacation area for townspeople. An ancient European white elm (*Ulmus laevis*), P=239 cm (D=76 cm), H=18 m, growing in the southeastern edge of Merivälja Road, belongs to the greenery of the Pirita Restaurant established in the year 1910 in an old tavern building. All plots of land in Uue-Kose failed to be developed before the First World War, and planning and development of the area was continued in the period of the Republic of Estonia. In the period between1923 and 1928 planning of the area between Lillepi and Varsaallika, and Vabrikusauna (surroundings of present Vabaõhukooli Road and two Pirita oxbows; the western part is now named Lükati, and north-eastern part is named Padaorg) was recommenced. The surroundings of Lillepi-Varsaallika and Lükati were intended to be garden suburbs (Bruns, 1998). The biggest crack willow (*Salix fragilis* 'Bullata') in Tallinn, P=220 cm (D=70 cm), H=12 m, which grows in the area of the former Lillepi Farm, on the bank of the Varsaallika brook, at the southern side of today's Pirita Selver department store (the present address 4b Rummu Rd), dates from this period. Around the summer cottages and villas there were sizeable plots of land, and around some buildings pleasure gardens were created. A significant part of the plots of land was developed and gardened only after the Second World War. Amongst the older pleasure gardens we can highlight the garden at 4 E. Särgava Ave, where two common beeches (*Fagus sylvatica*) 'Atropunicea' (f. *purpurea*), P=157 & 149 cm (D=50 & 47 cm), H=20 m; P=133 & 205 cm (D=42 & 65 cm), H=20.5 m grow, and the area at 5 E. Särgava Ave where three common beeches (*Fagus sylvatica*) 'Atropunicea' (f. *purpurea*), P=245 cm (D=78 cm), H=23 m, P=151 & 103 & 94 cm (D=48 & 33 & 30 cm), H=22 m; P=228 cm (D=73 cm), H=20 m grow in a row at the southern edge. In the courtyard of 6a E. Särgava Ave there

are two big large-leaved limes (*Tilia platyphyllos*), P=282 cm (D=90 cm), H=18 m, and P=271 cm (D=86 cm), H=18 m.

In 1924 the Merivälja garden suburb development plan was completed, and in 1928 the Pirita garden suburb plan was developed. The first two houses in Merivälja were complete in 1925. By the year 1932 there were 252 building sites allocated, and construction works were commenced at 80 thereof (Bruns, 1998).

In the 1930s a country-wide home decor campaign was held in Estonia, particularly large-scale in resort areas. During this period new trees were planted at the old churchyard at Pirita Convent church. Two trees growing at the churchyard (9, Kloostri Rd) have been taken under national protection: a silver birch (*Betula pendula*) 'Youngii', P=82 cm (D=26 cm), H=11 m, and European larch (*Larix decidua*) , P=158 cm (D=50 cm), H=19 m. The latter, with its branches downward, looks somewhat like a *pendula.*

After the Second World War, mainly since 1950, the development of the areas planned before was commenced in Pirita city district. Maarjamägi, Kose, Varsaallika, Pirita and Merivälja became residential areas of detached houses. In the gardens of the houses some impressive individuals of trees rare for an urban environment can be discovered. In the garden at 11 Kalmuse Rd there is a Manchurian walnut (*Juglans mandshurica*), P=141 cm (D=45 cm), H=15 m, in the garden at 16 Kloostrimetsa Rd – a Mahaleb cherry (*Cerasus mahaleb*, syn. *Prunus mahaleb*), P=48 & 43 cm (D=15 & 13 cm), H=4.5 m, in the garden at 5 Jaanika Rd – a silver poplar (*Populus alba*) 'Sovjetica Pyramidalis', P=255 cm (D=81 cm), H=25 m; P=231 cm (D=74 cm), H=25 m; P=144 cm (D=46 cm), H=22 m (brought from Ivantjevka tree school near Moscow, planted by Roland Säreal in 1961), in the front garden at 22A Kase St – a hall nulg (*Abies concolor*), P=183 cm (D=58 cm), H=20 m, in the garden at 9 Tamme St – a Manchurian walnut (*Juglans mandshurica*), H=10 m, in the front garden at 7 Paju St – a Manchurian fir (*Abies holophylla*), P=118 cm (D=37 cm), H=14 m, at 3 Viimsi tee – a silver birch (*Betula pendula*) 'Youngii', P=77 cm (D=25 cm), H=5 m, in the garden at 14 Viimsi Rd – an English hawthorn (*Crataegus laevigata*) 'Rubra Plena', $P_{1.1}$=161 cm ($D_{1.1}$=52 cm), H=9 m, in the garden at 3 Lääne Rd – an English hawthorn (*Crataegus laevigata*) 'Rubra Plena', P=70 & 65 & 97 cm (D=22 & 21 & 31 cm), H=9.5 m, in the garden at 3A Ranniku tee – a Serbian spruce (*Picea omorika*), P=105 cm (D=34 cm), H=15 m, in front of the garden at 17 Vaate Rd – a Japanese walnut (*Juglans ailantifolia* var. *cordiformis*), P=119 cm (D=38 cm), H=7 m, in the garden at 57 Hõbekuuse Rd – a Japanese walnut (*Juglans ailantifolia* var. *cordiformis*), P=108 cm (D=35 cm), H=7 m, at 8 Tuule Rd – a common beech (*Fagus sylvatica*), P=108 cm, (D=35 cm), H=16 m, common ash (*Fraxinus excelsior*) 'Pendula', P=120 cm (D=38 cm), H=6 m

and a Manchurian walnut (*Juglans mandshurica*), P=165 cm (D=53 cm), H=15 m, in front of 8 Viimsi Lane – English oaks (*Quercus robur*) 'Fastigiata', P=196 cm (D=62 cm), H=17 m, in the garden at 19 Ida Rd – a field maple (*Acer campestre*), P=46 & 56 & 44 & 46 & 57 & 46 cm (D=14 & 18 & 14 & 14 & 18 & 14 cm), H=7.5 m, in the garden at 27 Väina Rd – Scottish laburnum (*Laburnum alpinum*), H=6 m, in the garden at 4 Väina Rd – a Japanese yew (*Taxus cuspidata*), P=39 & 51 & 49 cm (D=13 & 16 & 15 cm), H=5 m, at the same site another tree with multiple thin branches, H=6 m, in the garden at 28 Lodjapuu Rd – a black locust (*Robinia pseudoacacia*), P=76 cm (D=24 cm), H=7 m.

Rare species of trees can be found near public and social welfare objects. Groups of white spruces (*Picea glauca*), Pmax=49 cm (Dmax=16 cm), a Serbian spruce (*Picea omorika*), Pmax=49 & 43 cm (D=16 & 14 cm), H=9 m and some Yezo spruces (*Picea jezoensis*), Pmax=40 & 41 cm (Dmax=13 & 13 cm) grow at the former Merivälja Social Welfare Home, or the present Boarding House Park, at Ranniku Rd 48. In the garden at E. Särgava Ave 1, which during the Soviet period had been used as a kindergarten, a silver birch (*Betula pendula*) 'Youngii' grows, P=56 cm (D=18 cm), H=8 m.

Analysis and conclusion

Pursuant to the data from earlier published literature as well as the data collected in the course of field works of the last 15 years, it has been established that the majority of ancient trees in Pirita city district grow in the area of former summer estates and farms. Upon regular check the majority of the earlier identified ancient trees continued to exist and were in at least satisfactory condition.

Older individuals of introduced species rare in urban greenery grow in parks of former summer estates and gardens of villas. In the last 15 years mainly firs (*Abies* sp. sp.) and spruces (*Picea* sp. sp.) have perished in these areas.

The majority of rare trees growing in the gardens of private houses in the years 1950-1980 have remained. Some trees which grew too close to buildings or were significantly damaged by diseases had been removed.

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GENETIC DIVERSITY AND VOLATILE COMPOUNDS IN RUGOSA HYBRIDS OF *ROSA*

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Rose, microsatellite genotyping, interspecific hybridization, volatile compounds, scent

Abstract

The species *Rosa rugosa* Thunb. and its hybrids show high disease resistance and tolerance to environmental stress conditions. Interspecific crosses between *Rosa* x *hybrida* and *Rosa rugosa* are difficult to obtain, but they could potentially yield resistant varieties with valuable ornamental properties. In native regions these plants are used as wide-ranging medicinal plants and resource of rose oil. In this research we tried to understand whether Rugosa hybrid pedigrees were from Floribunda and Climbing Floribunda hybrid roses, how this inheritance was reflected in diversity of volatiles, and whether volatile compounds in flowers were suitable for the production of rose oil.

Eight Latvian varieties that resulted from crosses with *R. rugosa* type roses and six parents were analyzed with 21 microsatellite markers to confirm the results of interspecific crosses and to identify the presence of modern rose genetic material. Two crosses, 'Abelzieds' (*R. rugosa* 'Alba' x 'Poulsen's Pink') and 'Zaiga' (*R. rugosa* 'Plena' x 'Flammentanz'), exhibited the presence of Floribunda and Climbing rose characteristics. Phenotypically, only one interspecific cultivar, 'Zaiga', showed modern garden rose type flower colour and leaf shape.

Altogether 32 different compounds were identified in the rose samples which were analyzed in the study. Of those, only three were found in all seven samples: phenylethylalcohol, B citronellol, benzylalcohol. *Rosa rugosa* and 'Plena' had the most significant amount of odour.

The highest level of volatile aroma compounds in comparison to all other rose varieties used in the study was found in the headspace above *Rosa rugosa* 'Plena'. Genetic diversity in the rose varieties was also reflected in the wide range of volatile compounds present at variable concentrations.

INTRODUCTION

The diploid species *Rosa rugosa* Thunb. and its hybrids have a wide range of uses. When *R. rugosa* species became known, it was heralded as the forbear of a new race of garden roses (Nicolas, 1926). In native regions these plants are used as wide-ranging medicinal plants and resource of rose oil. In China the petals in full flowering are used as health-care food. Furthermore, the petals have been used in medicine for treating liver-depressed hypochondrium pain, anxiety, bad memory, bloated gastric cavity and tuberculosis etc. (Briskin, 2000). In Sweden the fruits are used in tartars, soups and jams. At the same time, on coastlines of Europe and North America *Rosa rugosa* is considered as an invasive species which rapidly spreads and destroys native plant communities.

During the past 60 years the rose breeding programme at the National Botanic Garden of Latvia has been carried out to obtain ever-blooming and winter-hardy varieties (Rieksta, 1988). Until now, 20 varieties have been registered and distributed to gardens. Hybridization was carried out between the rose species *R. rugosa* forms and garden roses – Floribunda roses and Climbing roses. Hybrids were successfully obtained from crosses between *R. rugosa* forms, but only a few hybrids were obtained from crosses involving *R. rugosa* cultivars pollinated by Floribunda and Climbing roses. In this research we tried to understand whether *Rugosa* hybrid pedigrees are from Floribunda and Climbing roses, how this inheritance is reflected in the diversity of volatiles, and whether the flowers' volatile compounds are suitable for the production of rose oil.

Different types of molecular markers are used extensively in plant taxonomy (Ballard, 1996), as well as in the assessment of the extent of genetic diversity available to plant breeders and in mapping and cloning genes for specific traits. RAPD (Millan et al., 1996) and minisatellite (Ben-Meir and Vainstain, 1994) markers have been applied to investigate phylogenetic relationships in genus *Rosa* and the genetic variation between rose cultivars, respectively.

For centuries, roses have been the most important crop in the horticulture industry; its economic importance also lies in the use of its petals as a source of natural fragrances (Borochov, 1982).

Rose flower fragrance is of a composite character that is determined by a complex mixture of low-molecular-mass volatile molecules. Research into flower fragrance focused on its chemical elucidation and, as a result, hundreds of compounds were identified (Hoshidoko, 1996). More than 400 different volatile compounds have been identified in various rose scents, and these compounds have been classified into several chemical groups, including hydrocarbons, alcohols, esters, aromatic ethers, and "others" (aldehydes, such as geranial and nonanal, rose oxide, and norisoprenes (Bechec, 2006)).

There are no studies of the content of volatile compounds in Latvian-grown *Rugosa* hybrids. Thus, it could be interesting to find out how breeding pathways impact changes in volatiles.

MATERIALS AND METHODS

Plant material

The rose cultivars used in the present studies are a part of the breeding programme of the National Botanic Garden of Latvia. In the first part of the research we compared 14 varieties and their pedigries. They were 'Abelzieds' (*R. rugosa* 'Plena' x 'Poulsen's Pink'), **'**Liga' (*R. rugosa* 'Plena' x 'Abelzieds'), **'**Ritausma' (*R. rugosa* 'Plena' x 'Abelzieds'), **'**Guna' (*R. rugosa* 'Plena' x 'Parkdirrektor Rigers' and 'Abelzieds' pollen mix), **'**Zilga' ('Schneezwerg' seedling), **'**Zaiga' (*R. rugosa* 'Plena' x 'Flammentanz' and 'Abelzieds' pollen mix), **'**Violeta' ('Frau Dagmar Hastrup' x 'Zilga'), **'**Parsla' ('Plena' x 'Abelzieds'). (Table 1).

For the research of the content and amount of volatile oils we used seven cultivars: 'Liga', 'Ritausma', 'Zaiga', 'Sniedze', 'Frau Dagmar Hastrup', *R. rugosa* var. plena and species *Rosa rugosa*.

DNA extraction and PCR fragment analysis

Genomic DNA was isolated from fresh leaves or from frozen leaves of a single plant stored at -80 °C using the procedure described by Xu et al. (2004). DNA concentration was checked spectrophotometrically, and the integrity of samples was checked using electrophoresis in 1% w v^{-1} 1 x TBE agarose gels. DNA concentration of different samples was adjusted to 25 ng μl^{-1}, and approximately 50 ng were used in PCR reaction.

A set of 21 microsatellites (Yan et al., 2005) was used to analyze the 14 rose cultivars. PCR reactions contained in a 20 µl volume ca. 50 ng genomic DNA, 0.2 mM dNTPs, 0.5 µM each primer, 1 unit of Maxima Hot Start *Taq* DNA Polymerase (*Fermentas*, Vilnius, Lithuania), and 1 x reaction buffer containing 2 mM $MgCl_2$. Thermocycling was carried out as described by Esselink et al. (2003), with primer annealing temperature of 50 °C (Yan et al., 2005). PCR products were resolved in a 10% w v^{-1} 1 x TAE native polyacrylamide gels (acrylamide: bis-acrylamide ratio 37.5 : 1). The size of PCR products was estimated from molecular weight standard curves constructed using FastRuler DNA Ladder (*Fermentas*, Vilnius, Lithuania).

Microsatellite fragments were scored as presence or absence of a band in polyacrylamide gel. Dice dissimilarity data matrix was calculated with DARwin 5.0 software (http://darwin.cirad.fr/darwin/Home.php) and was further used to carry out principal coordinate (PCo) analysis and to construct Neighbour-Joining dendrogram.

Table 1. Phenotypic characteristics of the rose cultivars

Cultivar	Plant			Foliage		Flower type			
	Growth type	Growth habit	Prickles	Size	Intensity of green	Type	Colour group	Diameter	Fragrance
	Shrub	moderately spreading	medium	medium	dark	single	pink blend	medium	strong
'Liga'	Shrub	moderately spreading	very many	medium	medium	double	pink	large	medium
'Ritausma'	Shrub	intermediate	many	medium	dark	double	pink	large	medium
var. Plena	Shrub	upright	many	medium	medium	double	red purple	medium	strong
'Zaiga'	Shrub	moderately spreading	very many	large	light	double	pink	large	weak
'Frau Dagmar Hastrup'	Shrub	intermediate	many	medium	medium	single	Pink blend	large	strong
'Abelzieds'	Shrub	moderately spreading	medium	large	medium	semi-double	pink blend	medium	weak
'Guna'	Shrub	spreading	very many	medium	dark	semi-double	red purple	large	weak
'Parsla'	Shrub	upright	many	large	medium	semi-double	white	large	strong
'Violeta'	Shrub	upright	many	medium	dark	double	red purple	large	medium
'Zilga'	Shrub	moderately spreading	many	small	light	semi-double	red purple	medium	medium

Detection and identification of volatile aroma compounds

Volatiles from roses were extracted using solid phase microextraction (SPME). 0.5 g of samples were weighed in a 20 ml headspace vial and capped with a septum. For SPME extraction a divinylbenzene/Carboxen/polydimethylsiloxane (DVB/Car/PDMS) fiber (Supelco Inc., Bellefonte, PA, USA) was used. SPME parameters were the following: incubation time 10 min, extraction temperature 35±1 °C, extraction duration 30 min, desorption 15 min, 250 °C. For the analysis of the SPME extracts, a Perkin Elmer Clarus 500 GC/MS and an Elite-Wax ETR column (60 m x 0.25 mm i.d.; DF 0.25 μm) was used. Working conditions: injector 250 °C; transfer line to MSD 260 °C; oven temperature from 40 °C, hold 10 min, programmed from 40 to 60 °C at 2 °C min^{-1}, and from 60 to 250 °C at 20 °C min^{-1}, hold 5 min; carrier gas (He) 1 ml min^{-1}; split ratio 2:1; ionization EI+ mode; acquisition parameters in full scan mode: scanned m/z 40-400.

Compounds were identified by comparing their mass spectra with mass spectral libraries (Nist98), and by calculating linear retention indexes and comparing them with literature data. All analyses were performed in triplicate. Compounds in the tables are shown in the order of the retention time. As a quantitative measure, the share in the total GC peak area for each compound is given.

RESULTS AND DISCUSSION

Genetic diversity of Latvian rose cultivars

We used a set of microsatellite primers developed for *Rosa hybrida* (Yan et al., 2005) to study the genetic diversity of Latvian cultivars with *R. rugosa* cultivars in their pedigrees, and to study the contribution of parental genotypes to phenotypic diversity. In total 51 polymorphic bands were scored as present/absent.

SSR genotype data were used to construct a weighted Neighbour-Joining dendrogram (Fig. 1). With the exception of the cultivar 'Liga', two groups of cultivars were observed clustering according to their pedigrees, e.g., cultivar 'Violeta' clustered together with its parents 'Frau Dagmar Hastrup' and 'Zilga'. Thus, SSR genotype data appeared to have an excellent compatibility with the known pedigrees and a good power for cultivar identification. However, the discrimination power of SSR markers was reduced in the case of siblings of the cross involving the same parents, e.g. 'Ritausma' and 'Parsla', which both resulted from a cross between 'Plena' and 'Abelzieds'. Furthermore, no differences in genotypes were observed between 'Schneezwerg' and its free pollination seedling 'Zilga', even though 'Schneezwerg' and 'Zilga' were clearly differentiated by their flower colour of pure white and red purple, respectively.

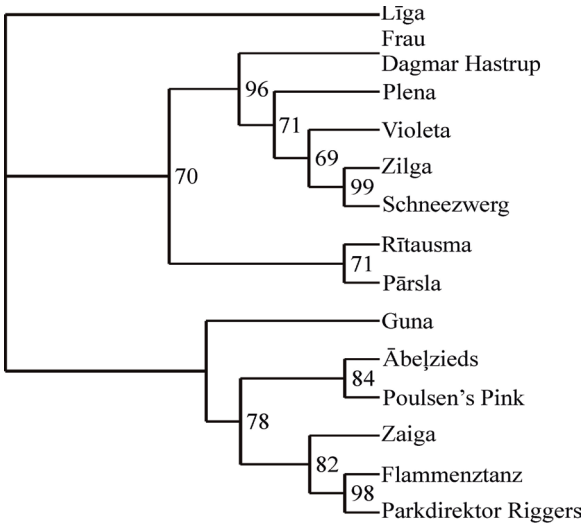

Figure 1. Neighbour-Joining dendrogram of the rose varieties based on SSR genotype data was constructed using *DARwin* 5.0 software. Numbers indicate bootstrap support over 50%.

According to preliminary data, the majority of varieties that resulted from interspecific crosses showed strong presence of *R. rugosa* gene pool both in terms of genotype and phenotype. However, two crosses, 'Abelzieds' (*R. rugosa* 'Alba' x 'Poulsen's Pink') and 'Zaiga' (*R. rugosa* 'Plena' x 'Flammentanz'), exhibited presence of Floribunda and Climbing rose characteristics.

Comparison of volatile oils from *Rugosa* hybrids

Altogether 32 different compounds were identified in the rose samples which were analyzed in the study. Of those, only three compounds were found in all seven samples: phenylethylalcohol, B citronellol, benzylalcohol. *Rosa rugosa* and 'Plena' had the most significant amount of odour.

The highest level of volatile aroma compounds in comparison to all other rose varieties used in the study was found in the headspace above *Rosa rugosa* 'Plena'. The lowest level of volatile compounds was found in 'Zaiga' headspace. However, the highest variability of volatile compounds was found in the samples of *R.rugosa*, 'Plena' and 'Frau Dagmar Hastrup'. Thus, genetic diversity in the rose varieties was also paralleled by the wide range of volatile compounds present at variable concentrations.

Table 2. The GC peak area of main detected volatile coumpond in petals of hybrid rugosas.

Volatiles compounds	Cultivar (peak area)							
	Rugosa	Plena	Plena1	Zaiga	Līga	FrauDagmara	Sniedze	Ritausma
undecane, 5,7dimethyl	1133960	1255765	0	0	0	0	1754987	0
alpha phellandrene	0	0	0	0	3495070	0	0	0
dodecane, 2,6,11 trimethyl	1862496	0	0	0	0	0	0	0
decane, 2,3,5,8-tetramethyl		222338	0	0	0	0	0	0
heptadecane, 2,6,10,15tetramethyl	0	0	0	0	0	1329020	2226847	0
acetic acid hexylester	0	1386556	2209274	0	0	1302570	0	0
2-heptanol	0	0	0	0	1730829	0	0	0
3-hexen-1-ol, acetate	7177771	3682755	3690573	0	0	15578187	2619526	0
pentafluoropropionic acid, hexyl ester	0	0	0	1319235	0	0	0	0
1-hexanol	2679749	3418984	5038485	0	6015888	1324070	5174004	4473861
rose oxide 16409-43-1	2679749	2145467	0	0	0	0	0	0
3-hexen-1-ol	2857049	1157937	0	0	1961662	4272543	0	1272872
2-hexen-1-ol	0	0	1326534	1322657	1438404	1659399	0	0
furan, 3-(4-methyl-3-penthyl)	1102559	0	0	0	0	0	0	0
acetic acid	0	0	0	0	0	1899226	0	0
cas4630-06-2	3332818	0	0	0	0	0	0	0
copaene	0	1595192	0	0	0	0	0	0
150-84-5	3845682	0	0	0	989859	0	2205824	0
2-octen-3-ol 3,7 dimethyl acetāts	3238145	18609810	8723456	0	1517607	5682136	3050645	0
alpha cubenene	0	0	0	0	0	0	2090054	0
2-octen-3-ol 3,7 dimethyl	0	0	0	0	0	1692383	0	0
alfa-farnesene	9270653	13789474	0	0	971606	4824677	0	6582642
Bcitronellol	124888224	221573200	195884704	10053717	103678888	96661760	174595968	15735500
nerol (106-25-2), geraniol (106-24-1)	35373576	8418697	14115603	4856884	2383310	26620152	3305640	0
2-tridecanone	0	2041939	1565049	0	0	0	0	0
phenylethylacetate 103-45-7	5278684	4044111	4086697	0	0	2999021	1230875	0
nerol (106-25-2)	34269804	9339524	17433672	37961284	0	41918700	10566134	0
benzylalcohol	6347367	4527556	5998075	1177979	4693621	9258682	9928112	3499675
9-nonadecene	0	0	0	1000323	0	0	0	0
phenylethylalcohol	172835584	192296448	95947216	38207320	51129492	107235744	165753776	125711144
methyleugenol (93-15-2)	16808888	39183360	9598414	1552394	1254253	38320132	7488153	0
eugenol	6387346	1126147	0	0	0	12438249	1520285	0

The composition of headspace of rose varieties differed, therefore it is important to compare the percentage of the contents of volatile compounds in the headspace. The volatiles found in the largest amount were phenylethylalcohol (28,6%-79,9% depending on the variety), B citronellol (10%-57,2% depending on the variety), but the amount of benzylalcohol was only 0,9-2,6% (Table 2).

Other significant compounds were nerol (up to 39%, but absent in 'Ritausma' and 'Liga'), geraniol (up to 8%, not found in 'Ritausma') and methyleugenol (up to 10%, not found in 'Ritausma'). Only *R.rugosa* and 'Plena' had a small amount of rose oxide, one of the usual compounds of rose oil . Most of the volatiles in flowers of *Rosa* were in common with the damask rose, but *Rosa* was also characterized by a spicy note from eugenol in its deep sweetness.

CONCLUSIONS

A set of *Rosa hybrida* microsatellite markers showed a good discrimination power for Latvian rose varieties with *Rosa rugosa* cultivars in their pedigrees.

However, some closely related cultivars, such as 'Ritausma' and 'Liga', while exhibiting similar phenotypes, showed remarkable genotypic diversity; thus, the used set of microsatellite markers had limited ability to differentiate among closely related cultivars.

Forty-two volatile aroma compounds were identified in *Rugosa* hybrid flowers. Phenylethylalcohol, betacitronelol and nerol were predominant, but the overall composition of compounds differed very significantly among the varieties.

Most useful for the production of volatile oils were species *Rosa rugosa* and the variety 'Plena'.

The amount of volatile compounds in the rose varieties decreased as the distance to the *R. rugosa* and 'Plena' increased in the dendrogram based on SSR genotype data.

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EARLY GROWTH AND ECTOMYCORRHIZAL COLONIZATION OF BARE-ROOT SCOTS PINE SEEDLINGS GROWING IN SUBSTRATA WITH FOREST LITTER ADDITION

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Keywords

Substrata, growth, mycorrhiza, Scots pine seedlings, bare-root nursery.

Abstract

In this paper, we examined effects of different substrata with forest litter addition on early growth and ectomycorrhizal colonization of Scots pine seedlings in bare-root nursery of the Vilnius University Botanical Garden. The results of juvenile stage study of Scots pine seedlings have shown pronounced differences in growth, root-collar diameter and species richness of ectomycorrhizal fungi between applied substrata. Observed ECM communities were characterized by combination techniques of traditional morphotyping and molecular methods (PCR and sequencing). Substrata with forest litter amendment were attributed to higher species richness of ectomycorrhizal fungi compared with control. The ectomycorrhizal colonization of seedlings growing in nursery soil with leaf litter amendment would be in need for afforestation of post-agricultural lands.

INTRODUCTION

Scots pine is the conifer species most commonly used for reforestation and afforestation programs in Central and Northern Europe. For example, Lithuania produces close to 80 million tree seedlings per year and approximately 20% of these are Scots pine (Lithuanian State Forest Management Institute, 2007). Successful establishment and performance of forest tree seedlings on reforestation and afforestation sites mostly depend on the quality of the planting material, especially on the quality of seedlings' root systems, which should be highly branched with many absorbant short roots (Duryea and Landis, 1984; Marx and Hatchell, 1986).

Stimulation of root growth in mineral and organic soil by a slow-release fertilizer could be substituted by adding natural forest soil (Sayer, 2006; Aučina et al., 2007). The reviewing of the results of 152 years of litter manipulation provides the first detailed insights into its importance in forest ecosystems and there are more than twice as many studies on effects of litter removal than of litter addition (Sayer, 2006). It is proven that transfer of forest soil to the planting hole is an economical and effective method of introducing or improving the availability of rhizosphere microbiota (Amaranthus and Perry, 1987; Colinas et al., 1994a, 1994b). Aučina et al. (2007) findings provide evidence that the supply of organic matter through litter manipulation may influence the chemistry of soil, thus improving the growth and survival of Scots pine seedlings and their mycorrhizal communities. Seedlings with mycorrhiza are better prepared to reduce planting shock during the first growing season after outplanting on changed growth conditions and have a better chance to initiate soil exploration in water and nutrients availability than nonmycorrhizal seedlings (Kropp and Langlois, 1990).

The objective of this work was to evaluate the effectiveness of applied growth media with forest litter amendment on the growth of bare-rooted Scots pine seedlings. Specifically, we provide comparative information on the identity of mycorrhizal colonization of Scots pine seedlings grown in substrata with natural forest soil addition in bare-root nursery.

MATERIALS AND METHODS

Description of the study site and experimental design: litter collection, substrate preparation, and seedling measurements

Forest litter was collected in healthy, natural oak, spruce and pine stands of similar ages but supported by a good rate of natural regeneration. The 90-year-old *Quercus robur* dominated stand was classified as an *aegopodiosa* type with soil characterized as *Eutric Planosols* (FAO 1998). Litter (2 cm deep) on the top layer of the soil was mixed with a 12 cm deep humus horizon and an 8 cm deep alluvial horizon. The 80-year-old Scots pine dominated stand was classified as nemoral type with *Vaccinium myrtillus* in the undergrowth layer and soil characterized as *Albic Arenosols* (FAO 1998). A humus-podzol horizon, 9 cm deep, was mixed with a 9-cm-deep alluvial horizon. The 70-year-old Norway spruce dominated stand was classified as an *oxalidosa* type with soil characterized as *Haplic Arenosols* (FAO 1998). Litter (3 cm deep) on the top layer of the soil was mixed with a 10-cm-deep humus horizon and an 8-cm-deep alluvial horizon. The mineral nursery soil (pH_{KCl}=5.41) was used as the control.

In April 2010, the collected leaf litter was transferred to the experiment site at the Vilnius University Botanical Garden (54°43′N, 25°24′E) and spread in a 20 cm layer on a prepared bed. For the preparation of each growth medium, 40 kg/m^2 of forest litter was used. As a soil amendment for plant growing a mixture of vermiculite and perlite, 15% and 10%, respectively, was used. The experimental design was divided into five complete blocks with four plots, per control and oak litter and spruce litter and pine litter treatment, randomly allocated in each block.

The pine seeds originated from the local provenance of Labanoras (55°16′N, 25°50′E). Seeds of Scots pine required no stratification, and seeds were sown using a 5 by 5 cm sowing stencil. One-year-old seedlings were manually maintained and were not fertilized. After one year of growth under nursery conditions, 20 seedlings per growth medium were randomly selected, and their stem height and root collar diameter were measured.

Mycorrhizal evaluation

The root systems of seedlings were extracted from the soil using a sieve under tap water and cut into fragments of 3 cm. For each seedling, three subsamples were counted up to approximately 250 root tips. Observations of the ectomycorrhizas were conducted under a dissecting microscope at magnification ×10 to ×60. The ECM morphotypes were described based on macroscopic observations (ramification system; colour, shape, texture, and thickness of the mantle; presence and organization of the emanating hyphae; rhizomorphs, and other elements) and were compared to a database (Aučina et al. 2007; Leski et al. 2010). The relative abundance of each morphotype (number of root tips of each morphotype/total number of mycorrhizas) was calculated for each subsample. The frequency of occurrence of each morphotype (number of samples of each morphotype/total number of samples) was calculated for each growth medium.

The selected samples of morphotypes were stored in 2% cetyltrimethylammonium bromide buffer for further analysis. Fungal symbionts were identified using polymerase chain reaction (PCR) amplification of the internal transcribed spacer (ITS) with the ITS-1F and ITS-4 primers (White et al. 1990) and sequencing. Two to three single ectomycorrhizal root tips from each morphotype from each treatment variant were sequenced. In total, 240 sequences were obtained. Sequencing of the PCR product was performed with a CEQ 20000XL automatic sequencer using the same set of primers. Consensus sequences were constructed, with manual editing of ambiguous readings, and were compared to published sequences in the GenBank and UNITE databases (Kõljalg et al. 2005) using the BLAST tool. Species-level identification of mycorrhizae was defined as sharing ≥98% of the ITS region sequence identity with the reference sequence.

Statistical analysis

The growth parameters of seedlings and the mean fungal species richness were analyzed using analysis of variance (the normality assumption for the data and the homogeneity of the variance were tested through the Shapiro–Wilk test and the Leven test, respectively). Post hoc comparisons of means between sites were made using Tukey's test at a significance level of $P<0.05$. For relative abundances, no homogeneity of variance was found, and differences in the relative abundance of morphotypes between growth media were therefore tested using the Kruskal–Wallis and Mann–Whitney U tests. Computations were performed using the statistical software package Statistica 5.5. Estimates of the true species richness (bootstrap, Chao 1 and Chao 2) were calculated with the EstimateS program version 8.2.0 (Colwell 2006). Shannon's diversity indices for the ECM assemblages of Scots pine seedlings were carried out with PAST 1.89 software (Hammer *et al.*, 2001) and were based on square root-transformed data. Individual correlation using Pearson correlation, as well as multiple regression were applied to assess relationships between growth parameters and species richness of ectomycorrhizal fungi, and relative abundance of one mycorrhizal morphotypes present on seedlings from all substrata. Stepwise multiple regressions with backward elimination were used after screening potential independent variables (relative abundance and species richness of ECM fungi) for significant autocorrelation. Dependent variables (growth parameters) were log-transformed to improve linearity. Relative abundance of mycorrhizal morphotypes was log (n+1) transformed.

RESULTS AND DISCUSSION

Seedling growth

Results of ANOVA revealed that applied treatment variants had significant effects on height and root-collar diameter of Scots pine seedlings, without significant influence of block (two-way ANOVA, $P=0.876$). The height and root-collar diameter of the seedlings were significantly greater for pine litter than control soil (Fig. 1-2).

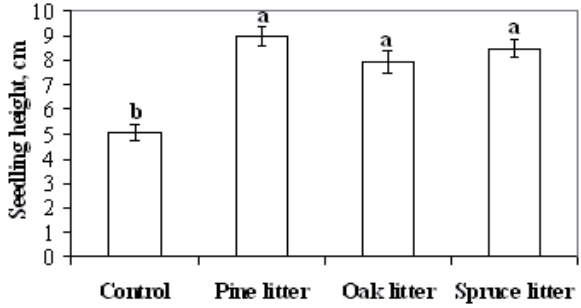

Fig. 1. The variation of height of *Pinus sylvestris* seedlings after one year of growth in bare-root nursery with untreated substrate and substrata with forest litter addition. Each bar shows the mean for 20 replicates ± standard error. Different letters indicate significant differences within growth media (a) at a P value of <0.05 (Tukey's test).

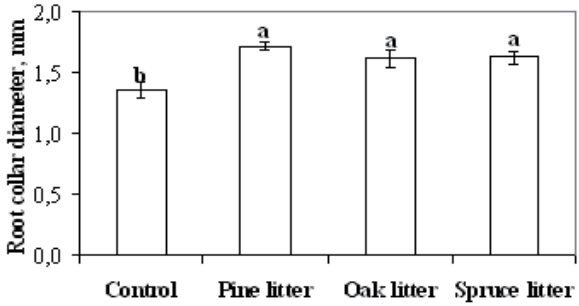

Fig. 2. The variation of root collar diameter of *Pinus sylvestris* seedlings in bare-root nursery with untreated substrate and substrata with forest litter addition. Each bar shows the mean for 20 replicates ± standard error. Different letters indicate significant differences within growth media (a) at a P value of <0.05 (Tukey's test).

Table 1. Molecular identification; relative abundance; observed total and mean species richness (± SE) and estimated species richness of ectomycorrhizal fungi on the roots of *Pinus sylvestris* seedlings after one year of growth in bare-root nursery with untreated substrate and substrata with forest litter addition (values are mean ± standard error, n=20).

Identification	Closest match	Identity (%)	Relative abundance (%)			
			Substrata			
			None (control)	Pine litter	Oak litter	Spruce litter
Ascomycota						
Wilcoxina mikolae	*Wilcoxina mikolae* (DQ069000)	99	96,3±3,67**a**	84,8±3,60**a**	84,3±3,92**a**	89,1±2,90**a**
Meliniomyces bicolor	*Meliniomyces bicolor* (HM190124)	98	—	8,5±2,43 **a**	8,4±2,39 **a**	5,9±2,53 **a**
Cenococcum geophillum	*Cenococcum geophilum* (DQ068980)	99	—	1,9±0,59 **a**	0,9±0,65 **a**	2,2±0,76 **a**
Leptodontidium sp.	*Leptodontidium* sp. aurim643 (DQ069033)	82	—	—	3,2±1,65 **a**	0,1±0,08 **a**
Ascomycota	uncultured *Ascomycota* (JN172989)	85	—	1,7±1,22 **a**	0,5±0,49 **a**	1,2±0,96 **a**
Basidiomycota						
Corticiaceae sp.	*Corticiaceae* sp. BB 2010 (HM189734)	91	3,7±3,67**a**	0,5±0,54 **a**	2,3±1,79 **a**	—
Suilloid	*Suillus luteus* / Great Britain (UDB001652)	97	—	2,4±1,65 **a**	0,3±0,18 **a**	0,2±0,16 **a**
Laccaria sp.	*Laccaria proxima* (DQ068958)	96	—	0,1±0,09 **a**	0,1±0,07 **a**	1,5±0,76 **a**
Observed species richness			2	7	8	7
Mean no species per seedling			1,1±0,10 **b**	2,9±0,43 **a**	3,0±0,45 **a**	3,1±0,38 **a**
Chao 1			2	7	8	7,5
Chao 2			2	8	8,7	9,0
Bootstrap			2,4	7,9	9,1	7,8
Shannon diversity index (H')			0,07±0,07 **b**	0,47±0,10 **a**	0,48±0,11 **a**	0,37±0,08 **ab**

Within a column, values with different letters are significantly different (P<0.05; Mann-Whitney U test for relative abundance and Tukey's test for mean species richness per seedling and Shannon diversity index).

Mycorrhizal development

In all treatment variants the rate of mycorrhizal colonization of Scots pine seedlings was high and neared 100%. Under all variant growth conditions in our experiment, the following ectomycorrhizal species by morphotyping and molecular methods were distinguished: *Cenococcum geophilum*, *Corticiaceae* sp., *Laccaria* sp., *Leptodontidium* sp., *Meliniomyces bicolor*, *Suillus* sp., uncultured *Ascomycota* and *Wilcoxina mikolae* (Table 1). Bare-rooted seedlings from separate substrata differed in the numbers of associated symbionts: eight morphotypes were found in oak litter, seven in pine and spruce litters, and two in control. Mean fungal species richness per seedling ranged from 1.1 to 3.1, with significant differences among treatment variants (two-way ANOVA, P=0.001). The block effect was not significant (two-way ANOVA, P=0.513). The estimated species richness values were 2, 7, 8, and 7.5 by Chao 1; 2, 8, 8.7, and 9.0 by Chao 2; and 2.4, 7.9, 9.1, and 7.8 by bootstrap estimator for seedlings in control, pine, oak, and spruce litters, respectively.

The only species *W. mikolae* (99% similarity to DQ069000) was common and also the most frequent (Fig.3). This ectomycorrhizal species dominated ECM communities on pine seedlings from all used treatment variants. The mycorrhizas formed by *M. bicolor* (98% similarity to HM190124), *C. geophilum* (99% similarity to DQ068980), uncultured *Ascomycota* (85% similarity to JN172989), *Suillus* sp. (97% similarity to UDB001652), *Laccaria* sp. (96% similarity to DQ068958) were present in all forest litter variants. Mycorrhizas formed by *Corticiaceae* sp. (91% similarity to HM189734) were detected on seedlings from control and pine and oak litter. *Leptodontidium* sp. mycorrhizas (82% similarity to DQ069033) were found on seedlings from spruce and oak litters. No significant differences in the abundance of all ectomycorrhizal species between the applied treatment variants were found.

The results of stepwise multiple regression analysis showed that only seedling height was significantly correlated with the species richness of ECM fungi (β=0.72, p=0.0006). As to seedlings height, no significant component of beta was found for abundance of *W. mikolae* mycorrhizas (β=0.27, p=0.160).

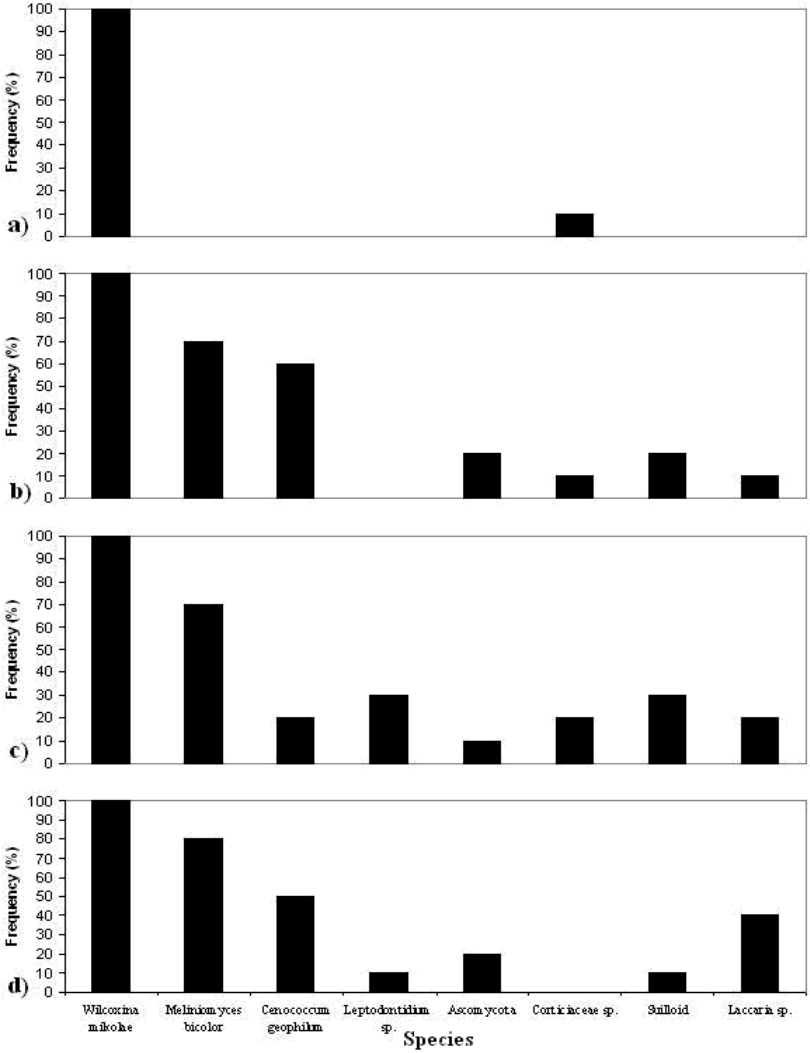

Fig. 3. Frequency of occurrence of mycorrhizal species in *Pinus sylvestris* seedlings after one year of growth in bare-root nursery with untreated substrate (a) and substrata with pine litter (b), oak litter (c) and spruce litter (d) addition.

CONCLUSIONS

The research of juvenile stage study showed that the use of substrata with forest litter addition had a significant effect on the early growth and ectomycorrhizal colonization of Scots pine seedlings in bare-root nursery. Substrata with forest litter amendment were attributed to higher species richness of ectomycorrhizal fungi compared with control. Ectomycorrhizal species of *Wilcoxina mikolae* was common, frequent and prevailed in all the observed treatment variants. No differences in abundance of separate ECM fungi between the applied substrata were found; however, species richness of ectomycorrhizal fungi was positively correlated with seedling height (β=0.72, p=0.0006). The effect of fungal diversity on growth was influenced by soil fertility for seedlings, suggesting that fertility influenced the balance between resource use complementarity and competition among the fungal species. A stimulatory effect of fungal diversity is more likely in natural forest soils because different fungi are better adapted to heterogeneous environments.

It is worth continuing studies in the future and examining the role of forest soils heterotrophic on ecosystem productivity under natural conditions. The ectomycorrhizal colonization of seedlings growing in nursery soil with leaf litter amendment would be in demand for the afforestation of post-agricultural lands.

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PROTECTED PLANTS IN THE COLLECTION OF THE BOTANIC GARDEN OF ŠIAULIAI UNIVERSITY

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Keywords

Conservation *ex situ*, rare plants, Botanic Garden, species.

Abstract

Botanic gardens and other *ex-situ* facilities, such as seed banks, are among the most extensive yet underused plant conservation resources in the world. Botanic gardens are now undertaking activities that bridge the gap between *in situ* and *ex situ* conservation, with the living collections being used as source material for reintroduction programmes**.** One of the most important goals of the Botanic Garden of Šiauliai University is to conserve rare species in *ex-situ* collections. The largest number of protected species is assembled in the collection of mountain plants, and in the geography and systematic collections. In the mountain plants collection there are 17 species of plants registered on the list of endangered European plant species. Altogether 75 rare and endemic species, mostly from the Alps, the Pyrenees, and the Tatry, grow in this section. The plants are vanishing because of the biological features of the species, climate change, human activities, etc. However, these species are very decorative and popular in gardening. Most plants growing in the geography and systematic collections are rare in Lithuania. Of the 357 plants inscribed in Lithuania's Red Book (2007) 94 species grow there. The species of Lithuania's Red Book are divided into 5 categories, which correspond to the established categories of the International Union for the Protection of Nature. There are 4% of the extinct plants of 0 (Ex) category, 19% of 1 (E), 31% of 2 (V), 28% of 3 (R), 11% of 4 (I) and 6% of 5 (Rs) category. Priority is given to the species which are in danger of extinction and which can be saved only by using special measures. Out of the 12 plant species of European Red List, 4 species are grown in the collection of mountain plants of the Botanic Garden and their adaptation level is good. The *ex situ* collection contains 16 species of the plants of I (E) category of Lithuania's Red Book. The adaptation levels of 7 species of these plants were estimated to be good and very good.

INTRODUCTION

Botanic gardens and other *ex-situ* facilities, such as seed banks, are among the most extensive yet underused plant conservation resources in the world. Botanic gardens are now undertaking activities that bridge the gap between *in situ* and *ex situ* conservation, with the living collections being used as source material for reintroduction programmes (Walter, Gillett 1997). In recent years *ex situ* conservation has become a much more precise science with a wonderful array of tools. Many botanic gardens today have areas of natural vegetation within their boundaries or in adjunct campuses (Guerrant et al.). The European flora is of global significance but many species are facing an ever-increasing range of threats, including the growing challenge of climate change (Sharrock, Jones 2011). While various estimates have been made for the number of threatened plant species in Europe, an up-to-date European Red List for plants does not exist. The Global Strategy for Plant Conservation (GSPC) calls for "*60% of threatened plant species to be conserved in ex situ collections*". To address this gap, BGCI has published a consolidated list of European threatened species as a step towards a formal Red List. Compiled on a database, this list consists of national Red List data from 30 European countries and includes over 16,000 country records covering around 9,600 species. (Sharrock, Jones 2009). In Lithuania discussion about protecting rare objects has been going on from 1959 when the Law on Nature Protection was adopted. Since 1981 the Red Book has been published as a separate colour edition. The Department of Environment publishes Lithuania's Red Book at least every 10 years. This Book brings information of the species of the protected plants in the Republic of Lithuania, their status, distribution, ecology and biology, profusion of these plants' population, imminent danger to them, the condition of the protection of these plants (Department of Environment 2011). Since 1993, the Department of Environment of Lithuania publishes the informative edition "Red Pages". The information in this edition is used to revise the list of species of protected plants included in the Red Book (Department of Environment 2011). One of the most important goals of the Botanic Garden of Šiauliai University is to conserve rare species in *ex situ* collections. The largest number of protected species is assembled in the collection of mountain plants, and in the geography and systematic collections. In the mountain plants collection there are 17 species of plants registered on the list of endangered European plant species. Altogether 75 rare and endemic species, mostly from the Alps, grow in this section (Vainorienė 2010). In the Botanic Garden there are also groups of plants at different stages of maturity from natural biotopes grown and investigated *in situ* and *ex situ*. In 2006-2010, the observations of *Primula farinosa, Cruciata glabra* were pursued in *in situ* collections. Most plants growing in

the geography and systematic collections are rare in Lithuania. 94 species out of the 357 plants inscribed in Lithuania's Red Book (2007) grow there. The species of Lithuania's Red Book are divided into 5 categories, which correspond to the established categories of the International Union for the Protection of Nature. There are 4% of the extinct plants of 0 (Ex) category, 19% of 1 (E), 31% of 2 (V), 28% of 3 (R), 11% of 4 (I) and 6% of 5 (Rs) category. Priority is given to the species which are in danger of extinction and which can be saved only by using special measures.

MATERIAL AND METHODS

These alpine endemic and rare species, growing in our Botanic Garden, are identified according to Sharrock, Jones (2009). The investigated plants are grown up from the seeds received from botanic gardens of European countries. The natural original locations are known for 5 species (*Aetionema thomasianum*, *Iris marsica, Primula glaucescens, Saponaria lutea, Thaspi zaffranii).* The vanishing species of the plants have been grown in the collection of mountain plants since 2003-2008. Five species (*Cytisus emeriflorus, Allium insubricum, Campanula incurva, Degenia velebitica, Thaspi zaffranii*) have been included in the collection quite recently and their adaptation features have been just started to be investigated.

The plants from Lithuania's Red Book have been grown in the Botanic Garden since 1997. In the section of rare and vanishing plants there are 18 species of the 1st category; in the year 2010, 16 species of the plants were observed.

The plants of the rare Lithuanian and European species are observed in spring when they recover and during the season of vegetation when some important facts are registered, for example, the beginning of the vegetation season. As for research, the condition of the collected plants was observed and identified, viable species sampling was performed by using morphological and biological features valuation methodology on decorative perennial plants. Also various visual evaluations were carried out: plant tolerance to cold, diseases and pest vulnerability, flowering intensity, productive processes, self-sow (3 points), and the decorative value of the species (5 points) (Vaidelienė, Vaidelis 2003)

RESULTS AND DISCUSSION

It was the first time in the history of the Botanic Garden that the plants were grouped according to the list of European threatened plants and according to the Red Book of Lithuania (Rašomavičius 2007). 17 species of the plants from the list of threatened European plant species grow in the collection of mountain plants (Table 1).

Table 1. List of rare species of plants in the Botanic Garden of Šiauliai University, collection of mountain plants

Species	Plant families	Year of receiving seeds	Distribution in the wild	The status of disappearance
Aethionema thomasianum Gay	*Brassicaceae* Burnett.	2005	France, Italy	V
Adonis pyrenaica DC.	*Ranunculaceae* Juss.	2003-2004	France, Spain	–
Allium insubricum Boiss. & Reuter	*Alliaceae* J. Agardh	2009	Italy	R
Androsace cylindrica ssp. *hirtella* DC.	*Primulaceae* Vent.	2008	France, Spain	–
Campanula incurva Aucher	*Campanulaceae* Juss.	2009	Greece	R
Cytisus emeriflorus Rchb.	*Fabaceae* Lindl.	2005	Italy, Switzerland	R
Degenia velebitica (Degen) Hayek	*Brassicaceae* Burnett.	2009	Croatia	V
Draba haynaldii Stur	*Brassicaceae* Burnett.	2004	Romania	V
Eryngium spinalba Vill.	*Apiaceae* Lindl.	2008	Italy	–
Iris marsica Ricci & Colasante	*Iridaceae* Juss.	2005	Italy	R
Moltkia suffruticosa (L.)Brand	*Boraginaceae* Juss.	2005	Italy	R
Physoplexis comosa (L.)Schur	*Campanulaceae* Juss.	2007	Austria, Italy	R
Primula glaucescens Moretti s.l.	*Primulaceae* Vent.	2008	Italy	R
Saponaria lutea L.	*Caryophyllaceae* Juss.	2004	France, Italy, Switzerland	R
Sempervivum pittonii Schott,Nyman & Kotschy	*Crassulaceae* DC.	2003	Austria	R
Thaspi zaffranii (F.K.Meyer) Greuter & Burdet	*Brassicaceae* Burnett.	2009	Greece, Crete	V
Wulfenia baldaccii Degen.	*Scrophulariaceae* Juss.	2006	Albania	Ex/E

Explanations:
E –Endangered species; V –Vulnerable species whose population figures and abundance are rapidly decreasing; R- Rare species with a small number of population due to their biological characteristics.

These are rare, limited populated endemic species of the Alps, the Pyrenees and the Tatry which are vanishing because of the biological features of the species, climate change, human activities, etc. Besides these species are very decorative and popular in gardening.

Despite the evolutionary advantages of sexual reproduction, vegetative reproduction often predominates in arctic-alpine plants. This is because vegetative reproduction is less energy costly, and more likely to be successful in harsh arctic and alpine environments (Good, Millwar 2007).

The data of adaptation and growing the species of the European list and Lithuania's Red Book in *ex situ* conditions are presented in Table 2.

Rare and threatened Europe's species *Primula glaucescens ir Androsace cylindrica* subsp. *hirtella, Physoplexis comosa* plants develop and germinate viable seeds best when growing under the cover. Four threatened European plant species adapted well, namely, *Aetionema thomasinianum, Iris marsica, Saponaria lutea, Sempervivum pittonii. Aetionema thomasinianum* blooms profusely and stands out by its intense self seeding. Five species of the plants *(Androsace cylindrica* subsp. *hirtella, Draba haynaldii, Iris marsica, Primula glaucescens, Sempervivum pittonii)* reproduce in vegetative way.

Table 2. Rare and protected plants adaptation data in the Botanic Garden of Šiauliai University

Plant name	Procreation by seeds				Vegetative reproduction			Tolerance to low temperature			Flowering intensity			Affected by diseases and pests			General evaluation				
Rare and threatened European species																					
Points	1	2	3	4	1	2	3	1	2	3	1	2	3	1	2	3	1	2	3	4	5
Aetionema thomasinianum				+	+					+			+			+				+	
Adonis pyrenaica		+			+					+		+				+			+		
Androsace cylindrica subsp. *hirtella*			+			+			+			+				+			+		
Draba haynaldii			+			+			+			+				+			+		
Eryngium spinalba		+			+				+			+				+		+			
Iris marsica			+			+				+		+				+				+	
Moltkia suffruticosa		+			+				+			+				+		+			
Physoplexis comosa		+			+			+				+				+		+			
Primula glaucescens			+			+		+					+			+			+		
Saponaria lutea			+		+					+			+			+				+	
Sempervivum pittonii		+				+				+		+				+				+	
Wulfenia baldaccii		+			+				+			+				+		+			

Plant name	Procreation by seeds				Vegetative reproduction			Tolerance to low temperature			Flowering intensity			Affected by diseases and pests			General evaluation				
Rare category I (E) Lithuania's Red Book species																					
Aster tripolium L.				+	+					+			+			+				+	
Cephalanthera longifolia (L.) Fritsch	+				+				+			+				+			+		
Cephalanthera rubra (L.) Rich.	+				+				+			+				+			+		
Dianthus armeria L.			+		+					+			+			+			+		
Dianthus superbus L.			+		+					+			+			+			+		
Dracocephalum ruyschiana L.				+		+				+			+			+				+	
Galium triflorum Michx.				+		+				+			+			+			+		
Glaux maritima L.	+						+			+			+			+				+	
Gnaphalium luteoalbum L.			+		+					+			+			+			+		
Hydrocotyle vulgaris L.			+				+			+			+			+					+
Isopyrum thalictroides L.		+				+			+			+				+			+		
Melittis melissophyllum L.				+	+					+			+			+					+
Ophrys insectifera L.	+				+				+			+				+			+		
Teucrium scordium L.		+					+		+				+			+				+	
Tofieldia calyculata (L.) Wachlenb.			+		+					+			+			+			+		
Viola persicifolia Schreb.				+	+					+			+			+					+

Explanations:

1. Procreation by seeds (points): 1 – no ripening seeds, 2 – not yearly ripening seeds, 3 – yearly ripening seeds, no self-sow , 4 –yearly ripening seeds, with self-sow.
2. Vegetative reproduction (points): 1 – no vegetative reproduction, 2 – (1-2 suckers, 3 – (3 and more suckers).
3. Tolerance to low temperature (points): 1 – plants were destroyed by frost, 2 – strong cold affects partly, 3 – frost and cold do not affect.
4. Flowering intensity (points): 1 – do not flower, 2 – flower in single blossoms, 3 – abundant flowering.
5. Affected by diseases and pests (points): 1 – affected in mass, yearly , 2 – affected rarely, not in mass, 3 – not affected.
6. General evaluation (points): 1 – condition is very bad, 2 – bad, 3 – satisfactory, 4 – good, 5 – very good condition.

There are numerous rare, endemic species growing in mountains (Forenbacher 2001, Vetaas *et al* 2002). Their cultivation is important for the purpose of the preservation of the species. The genus *Degenia* is a monotypic genus (one of the rarest on Mt Velebit), endemic, endangered and famous. *Degenia velebitica* is one of the 45 most endangered species in Europe, and one of the 250 most endangered in the world. (Naumovski 2005). *Physoplexis comosa* is one of the rarities of European alpine flora, it is a decorative plant with unusual inflorescence, growing on the limestone rocks (Jarmyn 2005).

Lithuanian rare plants are grown in the geography and systematic collection. There are 18 species of plants of category 1 (E). Priority is given to the species that are in danger of extinction and which can be saved only by using special measures. Some of the plants that are included in Lithuania's Red Book and grown in the SU Botanic Garden, for example, *Aphanes arvensis* L., have adapted well, self-seeding annually and multiplying profusely. *Aphanes arvensis* L. of the *Rosaceae* family is subsumed under category 0 (Ex). In 2010, 29 plant seeds were collected among category I (E), such as *Gnaphalium luteoalbum* L. and *Tofieldia calyculata* (L.) Wachlenb. Under this category subsumed is also the extinct in nature *Hydrocotyle vulgaris* L. among the *Apiaceae* family. It grows in the swamps, damp forests. This species has adapted well in the Botanic Garden since 2001, it grows in non-swampland area and widely expands near to ground by prostrate stems rooted beside joints. The plant multiplies not only in the vegetative way but also by seeds. In the Botanic Garden there are also groups of differently maturated plants from natural biotopes grown and investigated *in situ* and *ex situ*. *Ophrys insectifera* L. natural growth place is calcareous soil, mostly carbonaceous middling wet low swamps and valleys of the rivers. In Lithuania it has been found in Radviliskis and Akmene districts. Since the year 1997, *Aster tripolium* L grows in the SU Botanic Garden whose natural growing place is the seaside. The plant has adapted well, blooms annualy and matures seeds.

Five (31%) plants of category I (E) have a high adaptation potential and yearly ripen seeds to the self-sow. Five (31%) plants yearly ripen seeds, but do not self-seed and 4 (25%) plants yearly ripen seeds and reproduce vegetatively. In the SU Botanical Garden there are some plants which do not ripen seeds and do not reproduce. These are 3 (19%) species of the *Orchidaceae* family plants. 12 (75%) plants flower abudantly, 4 (25%) flower in single blossoms. In winter all the plants of the Lithuanian Red Book in the SU Botanical Garden are covered. 11 (69 %) plants tolerate low temperature, strong cold partly affects 5 (31%) plants, but during vegetation period they still regenerate. General evaluation of 9 (56%) plants is satisfactory, 4 (25%) is good, 3 plants (19%) are in a very good condition. No plants were affected by diseases or pests.

CONCLUSIONS

In the Botanic Garden of Šiauliai University 94 species of plants out of the 357 plants inscribed in Lithuania's Red Book (2003) grow e*x situ.*

The *ex situ* collection comprises 16 species of the plants of category I (E) of Lithuania's Red Book. High and good adaptation levels were estimated in the case of 7 species of these plants. In the mountain collection of the Botanic Garden of Šiauliai University there are 17 species of plants published in the list of threatened European plant species. Out of the 12 plant species of European Red List 4 species are grown in the Botanic Garden and their investigated adaptation level is good.

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SOME POPULAR SCIENCE AND OTHER PUBLIC ATTRACTION ACTIVITIES IN THE BOTANICAL GARDEN OF THE UNIVERSITY OF LATVIA

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Activities forwarding the public awareness about plants, biodiversity and related topics are among the main tasks of botanic gardens. During the recent years the Botanical Garden of the University of Latvia has turned to this issue more than ever. Besides popular science and educational activities, there are other events bearing the spirit of culture or recreation. This article will provide some examples of events taking place in our Garden aimed mainly at schoolchildren or general public.

Plant Conservation Day takes place on May 18th and is dedicated to preserving, protecting, and conserving plants for biological diversity, providing balance of the planet's vitality. Plants are the backbone of all life on Earth: they regulate our climate, purify our water, help create rich soils and protect these soils from erosion. Plants, in their amazing diversity, are also an essential resource for human survival and well-being: they provide food, medicine, shelter, and clothing, and are a source of unending beauty. On May 18th the popular science activities for pupils take place: offhand laboratories of botany, cell biology, plant physiology, evolution, plant propagation, bogs, mosses, insects etc. were put in an open-air territory. The Garden staff were working together with the teaching staff and students from the Faculty of Biology and Faculty of Geography and Earth Sciences, as well the Nature Conservation Agency and the Centre for Science and Mathematics Education. Schoolchildren can freely choose the most interesting topic or try all "laboratories", through microscope they can see raphide bundles – crystals of calcium oxalate – in a pineapple's cells thus understanding why the tongue has a special feeling while eating pineapples, or to see stomata cells, to understand why a pine-tree trunk in a bog reaches only 10 cm in diameter in 50 years and how peat forms, to get to know protected plants of Latvia, to see what insects live in grass and how different mosses are, to try to propagate plants by cuttings etc. Groups can undertake a guided excursion around the Garden. The visitors are 7 to 19 years old and, as experience

shows, adults love to participate in all activities as enthusiastically as pupils do. On this day from 9 a.m. till 3 p.m. around 600 visitors visit the garden.

Different activities are offered on the Researchers' Night. According to the general topic, for instance, in 2010 it was "Man, Nature, Climate", the Botanical Garden organized excursions at the greenhouses to show plants, growing in different climates and in various conditions – in water, on trees, in desert etc. A special exhibition displayed mosses and lichens of Latvia, while bryologists told about their differences, reproduction, peculiarities. To pay attention to water pollution and coral reefs the project "From Coral Reefs to the Baltic Sea" exhibited the crochet corals made by artists, pupils, teachers and other creative people in Latvia. Those who wished to participate in a workshop could make a "fossil" by pressing leaves or other plant material in a piece of clay. The visitors were welcomed from 5 to 22 p.m. Their number was not counted, but the epicentre was constantly full of people.

Several exhibitions were organized each year. Some of them were educational, some were for the soul or pleasure. The exhibition "Seeds and Fruits of the World" in 2010 presented all types of fruits and seeds, as well the adaptations for different ways of their spreading – by wind, water, animals etc. It was a good example of how to illustrate the text and pictures published in school textbooks. The exhibition for the soul was "The Bible Plants" during Christmas time in 2009 and 2010. Approximately 60 plants, fruits, seeds, herbs mentioned in the Bible were shown together with the quotations of the Bible and their botanical, historical or mythical descriptions. In both years the exhibitions were well attended and, despite the long texts, people were reading them and making photo-copies. Radio, TV and the press showed more interest in the events compared to other exhibitions. In the summer of 2010 this exhibition was displayed in the Saldus church on its 110th anniversary. Completely different was the exhibition "Plants in Your Cosmetics" in 2010, where different exotic or native plants, their parts, herbs were exhibited together with oils, shampoos, soaps, creams and descriptions of the active components, use of the plants, and recipes for making healthy cosmetics at home. Cosmetic samples were exposed in neutral vessels, labelled "cream with lavender" or "soap with olive oil" to show the diversity, not to advertise any producers. All samples were free to test.

The biggest event in the middle of summer in July is the four-day Garden Festival. It is a wide-ranged cultural, flower and ornamental plant exhibition which is widely visited in Latvia. Plants and flowers, bred and grown by the best Latvian gardeners and flower growers, are displayed. The aim of the expositions is to demonstrate the unique nature of each plant, to introduce the visitors with the best and newest plant varieties, to enhance

the joy of the beauty created by nature and man together. The high quality of the Garden Festival is consistently provided by its artistic layout, made by Latvian landscape architects and designers. The spirit of the Festival is to create a dream garden in which everyone can relax, get inspired, perfect their rituals and learn about the biodiversity of plants and its practical use.

Different events raise the number of people visiting the Botanical Garden, which means that more people, even if they come just to relax, get to know how different plants are. Experience shows that many come to the Garden again to other events or to see plants. In this way the Botanical Garden educates the population of Latvia step by step, starting from preschool children to seniors.

ENVIRONMENTAL EDUCATION AND INFORMATION IN THE NATIONAL BOTANIC GARDEN OF LATVIA

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What does an ordinary man, a potential visitor, imagine when hearing the words "Botanic Garden" for the first time?

First of all, perhaps, a garden. A place where something is grown, a beautiful place to relax and enjoy the time. Very well, but we – the Department of environmental education and information – must draw people's attention to the first part of the phrase, the word "Botanic". Our responsibility is to encourage visitors to notice not only the beauty of plants but also their diversity, to make them think deeper about the value of plants, conservation etc. So this article is about how to carry out one of the Botanic Garden's missions today: to educate visitors about the environment and biodiversity conservation issues, in other words, to invite visitors "to relax while gaining knowledge and gain knowledge while relaxing".

To fulfill this task, first of all we need to ensure that an ordinary person generally notices the phrase "Botanic Garden". The visitor must find the Garden – or the Garden must find the visitor. Where can people be found nowadays? In the virtual world. Certainly, the importance of virtual visibility and communication is increasing year by year, and if you are not in the Internet, you do not exist. Therefore, the NBG news is placed on the widely used websites, such as *delfi.lv*, *kasnotiek.lv*; in the year 2009 also on the website *redziruna.lv*, established by the Tourism Development State Agency. Considerable effort is being invested in the development of our homepage *www.nbd.gov.lv*. In 2009 two website sections were updated: the houseplants collection and utility plants collection were described more comprehensively. In 2010, information about the cognitive trails "Big Circle" and "Small Circle" were updated and richly illustrated. Since 2010, homepage visitors have been counted, and the overview shows 43941 visits during the year. It is noteworthy that the site was most frequently visited in April and May – the months when people are looking for some planting material. At this time the number of visitors exceeded six hundred per day.

In July 2009, during the Rose Days, a visitor survey was conducted. Within the survey people were offered to receive NBG news personally by e-mail. Approximately a quarter of the respondents chose this option and they regularly received news until 2010, when this form of communication was discontinued as inefficient: it was evident that one person rarely visited the Botanic Garden more often than a few times a year.

One of the most effective forms of free publicity is a press release informing about the NBG current events. Releases are, of course, being sent also to the online media, and thence often republished in social networks.

To increase the NBG news readership, in 2010 a significant innovation was introduced in the NBG homepage – buttons "Suggest to Friends", "Recommend on Facebook", "Recommend on Twitter", as well as the exploitation of these social networks was initiated by creating profiles of the institution. Quite importantly, it was a way to economize the decreased state funding on printed advertising.

In fact, the Botanic Garden, just like any other self-respecting tourist attraction and recreation object, should have an employee able to manage the latest available communication technologies to communicate with the potential visitors. It would be a chance to address the young people in a modern way. However, for the present the approach to the youth must be sought by other routes. One of the ways is to speak with teachers and university lecturers and offer to use the NBG collections in the teaching-learning process. Hence comes the issue of collaboration with schools.

In autumn and spring the NBG is quite a popular object for school excursions, especially for primary and elementary schools. During these open-air tours the children are encouraged to use all the senses – not only vision but also touch, smell, and taste: a good way to get children interested and excited, and to provoke a wish to visit the Garden again. Meanwhile, their teachers are introduced to the Botanic Garden's resources that can be used for teaching. Unfortunately, these tours generally are accompanied by class masters, not biology teachers. Our future strategy is to improve direct communication with biology teachers by offering field trips, thematic sessions and practical work in accordance with the school programme. Regular communication has already been established with several vocational schools: every year the NBG's Department of Dendroflora and the Utility Department provide thematic tours and practical training for Ogre Forestry School and Bulduri Gardening School students.

As has been already noted, the "regular" visitors typically visit the Botanic Garden to relax: to saunter in fresh air and the beautiful, clean environment, to have a picnic, to take photos against a colourful background. To combine the pleasant with the useful and to integrate educational process as part of recreation, the NBD has created an informative system of signs: labels and

information panels. They contain valuable information, but how to make the visitor notice it? When designing the panels we are trying to keep two types of visitors in mind: "spectators" and "readers". For the first we print colourful pictures, for the second – educational easy-to-read text, preferably with some "catch" to attract attention and create interest. Information panels are located on two routes, or cognitive trails, "Big Circle" and "Small Circle". In the year 2009 the preparation of informative materials and layout of the third cognitive trail, "Western Circle", was started with the financial support of Latvian Environmental Protection Fund Administration. In 2010 the development of the informational sign system was continued. In general, there are 30 large (90x90 cm) panels, about 100 A4 panels and thousands of plant labels in the Botanic Garden. Each year labels are being added, setting a goal – a label to each plant! Indeed, teaching the plant names is the best chance to show to the "spectators" that it is not an ordinary garden, but a botanic garden. As Carl Linnaeus has said: "Nomina si nescis, perit et cognito rerum": "If you do not know the names, your knowledge gets lost".

A very significant part of the NBG visitors are gardeners – people who love, admire and, most importantly, grow flowers and trees. For this target audience the NBG organizes Plant Markets. They are attended by nursery growers and collectors from all over Latvia, as well as from Lithuania and Estonia. An important task of Plant Markets is to serve as a meeting place of nursery growers and collectors, a chance to see and purchase specific plants which due to specific growing conditions cannot be found in commercial nurseries. This task is highlighted in the Plant Market's motto: "You will have it in your garden that your neighbour doesn't have!" Of course, the NBG also participates in Plant Markets by offering remains of seedlings grown for the plant collections. It is a great opportunity for the customer: to walk through the Botanic Garden, choose plants, read their names on the labels, and eventually buy them. Traceable origin and authenticity of plants are guaranteed. The Botanic Garden's Spring and Autumn Plant Markets have been organized for years and have become a traditional service; in the year 2009, due to the increasing popularity among growers as well as purchasers, it was decided to organize seven Plant Markets – every month from April to October. These seven markets in 2009 were attended by 989 traders, the number of visitors exceeded 10 000. In 2010 the number of traders was 835, but the number of visitors reached 14,600 – nearly 60% of the total number of visitors during the year! One's desire for their own flower on the sill, their own tree near the house and their own tomato in the greenhouse should never be underestimated!

Monthly, during the season, the same audience is also offered thematic tours, led by NBG experts. It is a possibility to get to know more about

plants in the NBG collections from the primary source, to get practical tips, to taste berries. In 2009 the following themes were offered:

- in June – honeysuckles, fodder plants and nectar plants;
- in July – species and cultivars of roses;
- in early August – medicinal plants, high blueberries and golden currants;
- in late August – sea-buckthorns, lingonberries, Guelder-roses and Actinidias;
- in early September – ornamental conifers;
- in late September – cranberries, elderberries and rowans.

To make those tours more accessible, in 2010 they were offered on Plant Market days, allowing visitors to "kill two birds with one stone": to get the plant that they had wanted and to obtain expert advice. The practice proved to be efficient: thematic tours were well attended. In the year 2010 other themes were offered, too:

- in April – tree planting demonstrations;
- in May – spring flowering trees and shrubs;
- in September – autumn flowering shrubs.

The NBG also offers some activities for special interest groups: seminars for biology teachers, customs officers, organic farmers etc. The NBG has an experience of such events, but this area still has a great potential for growth.

The NBG plant collections are rich and multiform, but unfortunately it is not possible to display all of them. Some collections are inconveniently placed for visitors or out of reach. Although research work is carried out in these collections, it is difficult to justify their existence if they are not used for education and for the promotion of significant social values. The challenge for the Department of Environmental Education and Information is to find ways to introduce visitors to the collections that are not displayed in outdoor expositions. One solution is to organize thematic exhibitions. In 2009 five exhibitions were organized in the NBG Tourist Information Centre:

- exhibition of pelargoniums and argiranthemums;
- exhibition of gerberas and alstroemerias;
- exhibition of medicinal plants;
- summer flowers show;
- exhibition of callistephus.

In 2010 the Tourist Information Centre rooms were rented out for financial reasons and partially occupied, and only one exhibition was organized there: the exhibition of medicinal and spice plants. In future

alternative ways must be found to provide publicity for the collections that are inaccessible for visitors.

Probably one of such ways is "guest tours" – exhibitions outside the NBG. Currently the NBG financial resources are insufficient to organize large exhibitions and to present the collections for a large number of visitors, so potential collaboration partners are being searched. Good cooperation has been established with the Natural History Museum of Latvia in Riga: every November an exhibition of the national chrysanthemum collection is organized there. Visitors can view over 150 chrysanthemum varieties and get NBG specialists' advice on their cultivation. For the present chrysanthemums are the only collection that is being sent on an "individual guest tour"; however, also other NBG flower collections are being represented at various events each year. In 2009, 45 cultivars of peonies and 73 cultivars of roses from the NBG collections were exhibited outside the NBG, while 34 cultivars of peonies, 68 cultivars of roses, 60 cultivars of dahlias, 81 cultivars of lilies, as well as astilbes and spice plants were on show in 2010. The exhibition "Conifers in the World" deserves special attention, being organized by the NBG Dendroflora Department in collaboration with the Natural History Museum of Latvia.

To enhance its public image and to attract potential visitors, the NBG also participates in various public events for plant lovers: the annual exhibition "Garden and Flora" at the international exhibition centre "Ķīpsala"; the "Plants Parade", organized by the Association of Plant Nurseries; the "Flower Ball", organized by the Botanical Garden of the University of Latvia, the Rundāle Palace Garden Festival, as well as the exhibition "Balttour". By invitation of Šiauliai University Botanic Garden the NBG team visited the Žoline Festival in August of 2009 and 2010, presenting collections of houseplants and callistephus.

In the year 2010, after the invitation of Latvian Academy of Sciences, the NBG joined the international event "Researchers' Night". It takes place every September throughout Europe. The theme of 2010, "Human. Nature. Climate", provided an opportunity to attract wide audience, focusing the attention directly on the scientific work that is being done in the NBG. The positive point is that this event is financed by the European Union and the entrance is free.

However, the "Researchers' Night" is not only possibility to visit the NBD for free. Such an opportunity is offered to everyone during the Salaspils town festival every May: the NBG offers free tours for Salaspils' inhabitants and guests under the guidance of the Director or NBG guides. Moreover, once a week Salaspils schoolchildren and senior citizens can visit the NBG for free. Of course, the Garden has special relationship with the town that has given the NBG its home.

The NBG has also gathered interesting experience of arranging corporate meetings and celebrations for various clubs, associations and companies, using the advantages and potential of the beautiful, clean environment. Such events are always combined with tours through the NBG.

Overall, in the two years the NBG has been attended by over 53 000 people. Taking into account the size of the NBD and its significance in Latvia, one would, perhaps, expect a larger number of visitors. But the potential of the existing infrastructure must be also taken into account. The research of the target audience and their needs, as well as active efforts to attract visitors are among the jobs to be done. However, in order to fulfil these tasks, priorities of the Botanic Garden should be first set and financial resources to invest in its infrastructure should be found.

PUBLIC EDUCATION AND ACTIVITIES IN KALSNAVA'S ARBORETUM JSC "LATVIAN STATE FORESTS" LSF SEEDS AND PLANTS

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From 1975 till 2005 the main function of Kalsnava's arboretum was creating a collection and complementing it, as well as working on plants introduction and multiplication.

In 2005 Kalsnava's arboretum started to work more actively in the spheres of tourism and environmental education. Every year the number of visitors has been gradually increasing. Already in 2007 Kalsnava's arboretum actively involved students in the educational programme 'Explore the Forest'; this programme draws students' attention to the plant varieties in Kalsnava's arboretum collection, educates students and in this way increases the popularity of Kalsnava's arboretum.

To make Kalsnava's arboretum collection more available for visitors, a refurbishment and renovation project has been designed that includes a number of infrastructure constructions and landscape architecture elements as well as new plant collections.

The existing collection database is complemented with new collections, one of which is the Peony collection, comprising more than 130 different varieties of peonies at one place. The Peony collection is one of the biggest in Latvia and in the Baltic States. To make Kalsnava's arboretum's collections more attractive and exclusive, a conifer maze of the Western thuja *(Thuja occidentalis)* plants has been formed, its labyrinth pattern tracing the Latvian Sun ornament.

During the period between 1 May 2009 and 31 October 2010 the arboretum was visited by 10 864 people, including 3860 schoolchildren, which is a third of the total number of visitors. Groups of people displaying particular interests, individuals and families visiting Kalsnava's arboretum can also make prior arrangements for a tour. They can choose between getting to know the arboretum's collections on their own or with the help of a tour guide who will take visitors on educational tours of the plants collections of individual interest. The most recent offer is entertainment of wedding parties by individual arrangements.

In cooperation with the staff of the local and regional schools the arboretum educates students about nature as well as draws pupils' attention to the collection with plants which are not found in Latvia now. In addition to that, all students receive information on protected and poisonous plants in our nature, thus acquiring basic knowledge of plants and their importance in our life. Already in May 2010 the first Forest Olympiad semi-final was held in the territory of Kalsnava's arboretum, which produced a group of finalists. The Olympiad is an event in which pupils from Form 1 to Form 9 take part, and it occurs in several stages. Students in cooperation with their teachers must do their homework in the context of Latvian nature and forests which they must send or hand in, or present to the JSC "Latvian State Forests" office for evaluation. Thus, engaging students in an interactive cooperation with our company, it is possible to educate more "green-minded" children and young people who in the future may become biology or forestry specialists.

SCIENCE AND EDUCATION IN THE BOTANIC GARDEN OF ŠIAULIAI UNIVERSITY

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Education, research, plants, mountain, floriculture, *Ericaceae* fam.

Abstract

According to the *BGCI,* botanic gardens are institutions holding documented collections of living plants for the purposes of scientific research, conservation, display and education (Tamutytė, 2006). Researchers at the Botanic Garden of Šiauliai University carry out investigations in the following main research areas: biodiversity *in situ* and *ex situ;* introduction and acclimatization of ornamental plants; on distribution, naturalization and control of neophytes; phenological observations. The Botanic Garden develops a seed fund and the seed interchange is maintained with 250 world botanic gardens. At the moment there are 5 departments which are responsible for tenable-sized collections. The purposeful establishment of departments had begun in 2001. Since 2011 the area has been 6.5 ha. The new place will provide a possibility to develop the existing collections and establish new ones. The vision of the Botanic Garden is to identify an original feature of the Garden and explore possibilities to take part in the activities of Botanic Gardens of Lithuania, the Baltic States and Europe, to investigate the possibilities of adjusting and growing introduced plants in the northern area of Lithuania, to preserve, grow and research the flora of Lithuania, especially the plant collection of Lithuanian vanishing species – for this purpose the Department of Lithuanian Flora has been established.

INTRODUCTION

According to the *Botanic Gardens Conservation International*, botanic gardens are institutions holding documented collections of living plants for the purposes of scientific research, conservation, display and education (Tamutytė, 2006).

Currently there are four Academic botanic gardens in Lithuania. The oldest are the Botanical Gardens of Vilnius University and Kaunas Vytautas Magnus University, but Klaipėda and Šiauliai Botanic Gardens are quite new institutions still trying to define their developmental goals. Since 2003 Šiauliai University Natural Science Faculty Botanic Garden is a member of the BGCI (Botanic Gardens Conservation International), Planta Europa and LUBSA (Lithuanian Universities Botanic Gardens Association). Since 2005 the Botanic Garden of Šiauliai University has been involved in the network of the International Phenology Gardens in Europe (IPG) (Grišaitė, 2007).

Establishment and location

In 1961, a biological station was founded in Šiauliai Pedagogical Institute which in 1962 was transformed into an agrobiological station. Its first head was the naturalist S. Gliaudys, he began growing woody and gardening plants. Only in 1997 a botanical garden was established on the basis of the agrobiological station. The founder was ass. prof. Dr. K. K. Vilkonis, a specialist in agriculture and botany. In 1997, the Botanic Garden occupied 4.48 ha. Currently the Botanic Garden occupies 2.5 ha in the city territory and 13 ha of park territories in the Bridai village (Tamutytė, 2006). The city of Šiauliai is situated in the northern part of the country. The landscape is relatively flat, at the elevation of 107 m. Winter and summer temperatures are close to the national average, but average precipitation is the lowest in the country and amounts to 350 mm per year.

Research and collections

The staff of the Botanic Garden of the Faculty of Natural Sciences, iauliai University, consists of three junior research assistants, they carry out scientific research in the following main research areas: biodiversity in situ and ex situ, introduction and acclimatization of ornamental plants, distribution, naturalization and control of neophytes, and phenological observations. The Botanic Garden develops a seed fund and the seed interchange is maintained with 250 world botanic gardens.

At the moment there are 5 departments in the Botanic Garden, which are divided in tenable-sized collections. The purposeful establishment of departments was begun in 2001. The focus of the **mountain plants** department is an 8-metre-high mound, which was formed while deepening the Violė stream. The area of the rock-garden occupies 0.08 ha. Seeds of introduced plants are received from world botanic gardens, but breeds most often are purchased in nurseries in Lithuania, Latvia or Poland. Most of the collected plants geographically are from the alpine areas of Europe, Siberia, Asia, and North America. In 2004 there were 568 taxa in the collection, but in 2007 there were more than 800 taxa, the majority of

them are from the alpine area. The collection is formed considering certain criterions, such as decorativeness, geographical aspects and infrequency of species. The majority of the collection constitutes perennial herby plants, while subshrubs form a smaller part, and 2 % are annual plants. The most numerous genera are Sedum, Gentiana, Saxifrage etc. species. There are special micro-niches for alpine plants, so that it could be possible to observe them, record data, make phenological observations, evaluate decorative and reproductive potentials. The most resistant species are selected. In the collection there are some genera of species (Alyssum, Arabis, Arenaria, Dianthus, etc.) which have been growing in Lithuania for a long time and do not require special care, but there are some rare or not very well known genera, such as Vitaliana, Townsendia, Bukiniczia, Sibbaldia, etc. Most of these plants acclimatized well, some of them stand out by self-sowing or intensive vegetative reproduction (Vainorienė, 2007, 2007).

For the purpose of expanding the range of introduced woody plants, the introduction of Ericaceae species plants was undertaken. The focus of attention was the Rhododendron genus plants. They are collected and investigated in the **Ericaceae department.** The popularity of this species is determined by its variability and decorativeness owing to its large leaves and quite massive, vivid colour and fragrant blossoms, which form multiflorus umbelliferous or peltate inflorescences. This section carries out microvegetative and generative reproduction research, and performs the overall evaluation of the collection. The majority of plants in the collection are in good condition. The area today is 0.04 ha. In the years of 2002-2003 36 taxa (19 species and 17 cultivars) of Rhododendron L. were imported from the Babite experimental station (University of Latvia). Now about 300 taxa of the Ericaceae are growing in the Botanic Garden, of which there are 74 rhododendron species, 8 subspecies, 9 varieties and 94 cultivars (Malciūtė, 2005).

The **Dendrology** collection is formed of the plants purchased from arboretums and received from other botanic gardens. The focus of this department is decorativeness, adjustment and varietal diversity of woody plants. The outcome of introduction is observed as well. At the moment in this collection there are about 220 taxa coniferous and 170 taxa deciduous trees, shrubs and subshrubs.

The Floriculture department occupies 0.16 ha of the garden territory. It was established while systematizing decorative perennial plants. At the moment in this collection there are about 900 taxa and species of annual, biennial and perennial, bulbous and corm, rhizome and tuber flowers of 62 families and 172 genera. Almost two thirds of these plants have been grown from seeds, received by seed interchange from world botanic gardens. The rest was purchased from Lithuania's botanic gardens, neighbouring states

and Lithuania's florists. The biggest attention is paid to the species and genera of decorative perennial flowers, such as Iris (there are 90 species in the collection), Lilium (64 species) and Hemerocallis (90 species). The aims of this department are to make and maintain a valuable collection of decorative herby plants, research ecology and decorative features of introduced plants and estimate the species that are fit to grow in our conditions. At present a collection of potherbs is being developed adjoining the Floriculture department; it takes an area of just 0.01 ha. In this collection there are about 60 perennial and annual potherbs and medicinal plants. It is mostly used for educational and cognitive purposes, though observations are carried out there as well.

The biggest part of the botanic garden territory belongs to the **Plant taxonomy and geography** department: 0.3 ha. The plant system proposed by A.L. Takhtadjan is used. Specimens of living plants are alphabetically arranged and grown in lawn beds. In 2006 there were 570 species, in 2007 – about 700. The planned number is 1500 taxa of vascular plants, including Lithuanian vanishing flora species (91 species, 61 included in the Lithuania Red Book). Seeds for collection supplement are received from 111 world botanic gardens. This department complements the collection with plants considering their exclusive morphological, systematic and decorative features of species and geographical subordination.

For **Phenology** observation presently 14 plant species phenology phases are observed. There is a study of the seasonal timing of life circle events in relation to environmental factors. In all areas genetically identical trees and shrubs are planted in order to make large-scale comparisons among the timing of different developmental stages of plants (Malciūtė, 2007).

Perspectives

The Action Plan for Botanic Gardens in the European Union should serve as a guideline in creating the mission of Šiauliai Botanic Garden on a large scale and helping to define its goals and prioritize activities for implementation (Tamutytė, 2007).

Since 2011, the area of the Botanic Garden of Šiauliai University expanded, now covering a territory of 6.5 ha. The new space will provide a possibility to develop the existing collections and establish new ones. The vision of the Botanic Garden is to identify an original feature of the Garden and explore possibilities to take part in the activities of Botanic Gardens of Lithuania, the Baltic States and Europe, to investigate the possibilities of adjusting and growing introduced plants in the northern area of Lithuania, to preserve, grow and research the flora of Lithuania, especially the plant collection of Lithuanian vanishing species – for this purpose the department of Lithuanian Flora has been established. In this department a

niche for each plant will be created, considering the specific features of their growing location (soil, humidity, sunlit or shaded, etc.). The focus of this department is going to be the collection of vanishing species of Lithuania, with a Red Book Path laid out there. It is considered to be useful not just for cognitive purposes, but also for research: these plants in the Botanic Garden are reproducing, so their comparison with the growing and vanishing plants in natural locations will be valuable for scientific research.

The Botanic Garden has also an educative function. For this purpose it has many cooperation contracts with education institutions, communities, etc. The activity and development of Šiauliai University Botanic Garden is hardly possible without collaboration with the city, so the Garden takes part in various projects and events as a partner or an organizer. The Botanic Garden has plans for future to become a place for florists' and other artists' exhibitions.

The Botanic Garden is an area that cannot be isolated or closed for public. This is a place where science, education and recreation can and should co-exist.

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