

## Resistance to Low and Negative Temperatures of *Rhododendrons* (*Rhododendron*) in the Botanical Garden of Šiauliai University in 2002-2007

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### Abstract

Rhododendrons are not native to Lithuania, but are often cultivated in botanical gardens, various public and private green plantations. Resistance to low temperatures are among the most important criteria in evaluating the condition of the rhododendron collection in the Botanical Garden of ŠU. The research initiated in the ŠU Botanical Garden will help in the selection and propagation of ornamental and tolerant to low temperatures representatives of species and cultivars, suitable for cultivation in northern Lithuania.

**Keywords:** rhododendron, low temperature, ŠU Botanical Garden

### Introduction

Introduction of plants is one of the most important tasks of Botanical Garden of Šiauliai University (further referred as ŠU) which constantly expands the assortment of woody plants and that is the reason for the beginning of introduction of the *Rhododendrons* (*Rhododendron* L.) genus plants. Rhododendrons are not native to Lithuania, but are often cultivated in botanical gardens, various public and private green plantations (Malciūtė, Naujalis, 2005). They are among the most popular ornamental plants in the world. The rhododendrons are favoured among gardeners because of their extraordinary variety and ornamental features conditioned by rather large, brightly coloured, fragrant flowers clustered into multiflorous umbelliferous or peltate trusses.

Among the most important ecological factors limiting the introduction of rhododendrons are unfavourable wintering conditions which depend on the plant's geographical origin, climatic conditions and the biological characteristics of the plant. According to the degree of frost damage of alien ligneous plants and general ecological conditions, the territory of Lithuania is divided into 4 regions (Januškevičius, 1999). The Botanical garden of ŠU is in the region of Žemaitija uplands. This region is in the third place in Lithuania regarding the cultivation conditions for alien ligneous plants.

The research initiated at the ŠU Botanical Garden will help in selection and propagation of ornamental, tolerant to low temperatures representatives of species and cultivars, suitable for cultivation in northern Lithuania. No special

research on the plants of the *Rhododendron* genus in the region of Žemaitija uplands has been performed yet.

### Materials and methods

Resistance to low temperatures are among the most important criterion evaluated condition of rhododendrons collection in the Botanical Garden of ŠU (Malciūtė, Naujalis, 2005). The most appropriate time to evaluate the resistance of rhododendrons to low temperatures is when the plants germinate and start flowering. Tolerance of deciduous and evergreen rhododendrons to low temperatures was evaluated separately (Table 1) according to different scales. The research performed every year and in this article presented results in the period of 2002–2007.

Resistance of deciduous rhododendrons to low temperatures was evaluated basing on a 10 point scale (Navys, 1999): 1 – remain undamaged by frost; 2 – up to 70 % of flower buds are frost-damaged; 3 – up to 70 % of vegetative buds and up to 30 % of first-year shoots are frost-damaged; 4 – 30–100 % of annual shoots and up to 30 % of older branches are totally or partly frost-damaged; 5 – up to 70 % of two-year and older branches (or shrub stems) are frost-damaged; 6 – stems are badly frost-damaged (bark splits up to 3 cm wide) above a blanket of snow; 7 – stems are frost-damaged, in root collar splits up to 3 cm wide, at any height the bark is cracked and splits are wider than 3 cm; 8 – aboveground part is frozen (more than 70 %), but the plant can regenerate from viable phloem; 9 – the aboveground part of a plant is dead, but roots remain viable and the plant produces stub sprouts and root shoots;

Table 1 Resistance to low temperatures of evergreen rhododendrons in the Botanical Garden of ŠU (2002–2007)

| No. | <i>Rhododendron</i> taxa and cultivars   | Native range/cultural origin          | Resistance to low temperatures |
|-----|--|---------------------------------------|--------------------------------|
| 1.  | <i>R. aureum</i> Georgi  | Russia, Japan, North China            | 0                              |
| 2.  | <i>R. brachycarpum</i> G. Don. ex D. Don   | Japan, Korea                          | 0                              |
| 3.  | <i>R. brachycarpum</i> ssp. <i>tigerstedtii</i> 'Haaga'  | Finland                               | 0                              |
| 4.  | <i>R. brachycarpum</i> ssp. <i>tigerstedtii</i> 'Helsinki Yliopisto'                           | Finland                               | 0                              |
| 5.  | <i>R. brachycarpum</i> ssp. <i>tigerstedtii</i> 'P. M. A. Tigersted'                           | Finland                               | 0                              |
| 6.  | <i>R. calostrotum</i> Balf. f et Kingdon–Ward ssp. <i>keleticum</i> (Balf. f & Forrest) Cullen | China, Burma                          | 0                              |
| 7.  | <i>R. catawbiense</i> Michx.   | Eastern part of North America         | 0                              |
| 8.  | <i>R. catawbiense</i> 'Calsap'   | Origin unknown                        | 0, a, d                        |
| 9.  | <i>R. catawbiense</i> 'Gomer Waterer'  | Origin unknown                        | 0, a, d                        |
| 10. | <i>R. catawbiense</i> 'Humboldt'   | Origin unknown                        | 0, a, d                        |
| 11. | <i>R. catawbiense</i> 'Nova Zembla'  | Holland                               | 0, a, g, i                     |
| 12. | <i>R. catawbiense</i> 'Uldis'  | Latvia                                | 0, a                           |
| 13. | <i>R. caucasicum</i> 'Cunningham's White'  | England                               | 0, a                           |
| 14. | <i>R. caucasicum</i> 'Pohjolan Tytär'  | Finland                               | 0                              |
| 15. | <i>R. dauricum</i> L.  | Russia, Mongolia, Japan, North China  | 0                              |
| 16. | <i>R. degronianum</i> subsp. <i>yakushmanum</i> 'Blurettia'                                    | Origin unknown                        | 0, a, d                        |
| 17. | <i>R. degronianum</i> subsp. <i>yakushmanum</i> 'Bohlken's Juditha'                            | Origin unknown                        | 0, a                           |
| 18. | <i>R. degronianum</i> subsp. <i>yakushmanum</i> 'Fantastica'                                   | Origin unknown                        | 0, a                           |
| 19. | <i>R. degronianum</i> subsp. <i>yakushmanum</i> 'Flava'  | Origin unknown                        | 0, a                           |
| 20. | <i>R. degronianum</i> subsp. <i>yakushmanum</i> 'Kalinka'                                      | Origin unknown                        | 0, a                           |
| 21. | <i>R. degronianum</i> subsp. <i>yakushmanum</i> 'Koichiro Wada'                                | Origin unknown                        | 0, a                           |
| 22. | <i>R. degronianum</i> subsp. <i>yakushmanum</i> 'Kullervo'                                     | Finland                               | 0                              |
| 23. | <i>R. degronianum</i> subsp. <i>yakushmanum</i> 'Percy Wiseman'                                | Origin unknown                        | 0, a                           |
| 24. | <i>R. degronianum</i> subsp. <i>yakushmanum</i> 'Polaris'                                      | Origin unknown                        | 0, a                           |
| 25. | <i>R. ferrugineum</i> L.   | Central Europe                        | 0, a                           |
| 26. | <i>R. forrestii</i> 'Baden Baden'  | Origin unknown                        | 0                              |
| 27. | <i>R. forrestii</i> 'Bengal'   | Origin unknown                        | 0                              |
| 28. | <i>R. forrestii</i> var. <i>repens</i> 'Elviira'   | Finland                               | 0                              |
| 29. | <i>R. hirsutum</i> L.  | Central Europe                        | 0                              |
| 30. | <i>R. impeditum</i> Balf. f et W. W. Sm.   | China                                 | 0                              |
| 31. | <i>R. indicum</i> L.   | Japan                                 | 0, j                           |
| 32. | <i>R. maximum</i> L.   | North America, Canada                 | 0, a                           |
| 33. | <i>R. mucronulatum</i> Turcz.  | Russia, China, Mongolia, Korea, Japan | 0                              |
| 34. | <i>R. ponticum</i> 'Chionoides'  | Origin unknown                        | 0, a                           |
| 35. | <i>R. smirnowii</i> 'Dace'   | Latvia                                | 0, a                           |
| 36. | <i>R. smirnowii</i> 'Hellikki'   | Finland                               | 0, a, g                        |
| 37. | <i>R. wardii</i> 'Goldbukert'  | Origin unknown                        | 0, a, d                        |
| 38. | <i>R. wardii</i> 'Lachsgold'   | Origin unknown                        | 0, a, d                        |
| 39. | <i>R. williamsianum</i> Rehder & E. H. Wilson  | China                                 | 0, a                           |
| 40. | <i>R. williamsianum</i> 'Gartendirektor Rieger'  | Origin unknown                        | 0, a, d                        |
| 41. | <i>R. yunguingense</i> Balf. f.  | China                                 | 0                              |
| 42. | <i>Rhododendron</i> 'Blauw's Pink'   | Origin unknown                        | 0                              |
| 43. | <i>Rhododendron</i> 'Catawbiense Grandiflorum'   | England                               | 0                              |
| 44. | <i>Rhododendron</i> 'Emils'  | Latvia                                | 0, a                           |
| 45. | <i>Rhododendron</i> 'Erich'  | Origin unknown                        | 0, a                           |
| 46. | <i>Rhododendron</i> 'Eskimo'   | Origin unknown                        | 0, a                           |
| 47. | <i>Rhododendron</i> 'Germania'   | Origin unknown                        | 0, b, d                        |
| 48. | <i>Rhododendron</i> 'Ginta'  | Latvia                                | 0, a, d, g                     |
| 49. | <i>Rhododendron</i> 'Gold Crone'   | Origin unknown                        | 0, a, d                        |
| 50. | <i>Rhododendron</i> 'Irina'  | Latvia                                | 0                              |
| 51. | <i>Rhododendron</i> 'Jānis'  | Latvia                                | 0, a, g                        |
| 52. | <i>Rhododendron</i> 'Kārlis'   | Latvia                                | 0, a                           |
| 53. | <i>Rhododendron</i> 'Lavanda'  | Latvia                                | 0, a                           |
| 54. | <i>Rhododendron</i> 'Lita'   | Latvia                                | 0, a                           |
| 55. | <i>Rhododendron</i> 'Mikkeli'  | Finland                               | 0                              |
| 56. | <i>Rhododendron</i> 'P. J. Mezitt'   | USA                                   | 0                              |
| 57. | <i>Rhododendron</i> 'Schneekrone'  | Origin unknown                        | 0, a                           |
| 58. | <i>Rhododendron</i> 'Scintillation'  | USA                                   | 0, a, d                        |
| 59. | <i>Rhododendron</i> 'Spriditis'  | Latvia                                | 0, a                           |

Table 2 Resistance to low temperatures of deciduous rhododendrons in the Botanical Garden of ŠU (2002–2007)

| No. | <i>Rhododendron</i> taxa and cultivars                                  | Native range/cultural origin           | Resistance to low temperatures |
|-----|---|--|--------------------------------|
| 1.  | <i>R. calendulaceum</i> (Michx.) Torr. var. <i>croceum</i> Sweet.       | North America                          | 1                              |
| 2.  | <i>R. camtschaticum</i> Pallas  | North Japan, Far East, USA             | 1                              |
| 3.  | <i>R. canadense</i> (L.) Torr.  | North America                          | 1                              |
| 4.  | <i>R. canadense</i> (L.) Torr. var. <i>album</i>                        | North America                          | 1                              |
| 5.  | <i>R. luteum</i> Sweet.   | Ukraine, Byelorussia, Turkey, Caucasus | 1                              |
| 6.  | <i>R. luteum</i> 'Gibraltar'  | Origin unknown                         | 1                              |
| 7.  | <i>R. luteum</i> 'Klondyke'   | Origin unknown                         | 1–10                           |
| 8.  | <i>R. luteum</i> 'Parkfeuer'  | Origin unknown                         | 1                              |
| 9.  | <i>R. luteum</i> 'Persil'   | Origin unknown                         | 1                              |
| 10. | <i>R. luteum</i> 'Royal Command'  | Origin unknown                         | 1                              |
| 11. | <i>R. molle</i> (Blume) G. Don.   | China, Japan                           | 1                              |
| 12. | <i>R. molle</i> (Blume) G. Don ssp. <i>japonicum</i> (A. Gray) K. Kron. | Japan                                  | 1                              |
| 13. | <i>R. molle</i> 'Satan'   | Origin unknown                         | 1                              |
| 14. | <i>R. prinophyllum</i> (Small) Millais                                  | North America                          | 1                              |
| 15. | <i>R. schlippenbachii</i> Maxim.  | Korea, Far East                        | 1–3                            |
| 16. | <i>R. vaseyi</i> A. Gray  | Eastern part of North America          | 1                              |
| 17. | <i>R. viscosum</i> (L.) Torr.   | Eastern part of North America          | 1                              |
| 18. | <i>R. viscosum</i> 'Soir de Paris'                                      | Origin unknown                         | 1                              |
| 19. | <i>Rhododendron</i> 'Alina'   | Latvia                                 | 1–2                            |
| 20. | <i>Rhododendron</i> 'Anita'   | Latvia                                 | 1–2                            |
| 21. | <i>Rhododendron</i> 'Francisa'  | Latvia                                 | 1–2                            |
| 22. | <i>Rhododendron</i> 'Ilze'  | Latvia                                 | 1                              |
| 23. | <i>Rhododendron</i> 'Indra'   | Latvia                                 | 1–2                            |
| 24. | <i>Rhododendron</i> 'Inga'  | Latvia                                 | 1–2                            |
| 25. | <i>Rhododendron</i> 'Laura'   | Latvia                                 | 1–2                            |
| 26. | <i>Rhododendron</i> 'Lidija'  | Latvia                                 | 1                              |
| 27. | <i>Rhododendron</i> 'Līva'  | Latvia                                 | 1–2                            |
| 28. | <i>Rhododendron</i> 'Mazais Jefinš'                                     | Latvia                                 | 1–2                            |
| 29. | <i>Rhododendron</i> 'Madame Debene'                                     | Latvia                                 | 1–2                            |
| 30. | <i>Rhododendron</i> 'Narcissiflora'                                     | Origin unknown                         | 1                              |
| 31. | <i>Rhododendron</i> 'Pasacina'  | Latvia                                 | 1–2                            |
| 32. | <i>Rhododendron</i> 'Polārzvaigzne'                                     | Latvia                                 | 1                              |
| 33. | <i>Rhododendron</i> 'Rīgas Rhododendrs'                                 | Latvia                                 | 1–2                            |
| 34. | <i>Rhododendron</i> 'Skaidrīte'   | Latvia                                 | 1                              |
| 35. | <i>Rhododendron</i> 'Toucan'  | Poland                                 | 1–10                           |
| 36. | <i>Rhododendron</i> 'Uguns'   | Latvia                                 | 1                              |

10 – aboveground part of a plant and roots are completely frozen.

Resistance of evergreen rhododendrons to low temperatures was evaluated basing on a 10 point scale created in Poznan A. Mickiewicz University Botanical Garden (Lukasiewicz, 1992) with our amendments: 0 – plants undamaged; a – leaves partially frozen; b – leaves completely frozen; c – shoots do not grow through the whole period of vegetation; d – tips of first-year shoots are frozen; f – phloem of first-year shoots is frozen, only the basis remains

viable; g – older branches partially frozen; h – a plant is frozen till the snow (soil) surface, but its parts are still viable (new buds appear from shoot basis or root phloem); i – stump phloem is cracked; j – plants completely frozen (no possibilities to recover).

## Results and discussion

As it was already mentioned, among the most important ecological factors limiting the introduction of rho-

dodendrons are unfavourable wintering conditions. Our investigations show that majority of rhododendrons of the collection are can tolerate winter frosts or are just slightly damaged by them. Meanwhile their ornamental properties are fully regained during the vegetation period. Somewhat more frost-sensitive are evergreen rhododendrons and especially young plants.

Tolerance of deciduous and evergreen rhododendrons to low temperatures was evaluated separately (Table 1,2) according to different scales. During the period of observation, out of 59 taxa of evergreen rhododendrons 37 % were not frost-damaged (0 points) (*R. caucasicum* 'Pohjolan Tytär', *R. yungningense*, etc.). About 63 % of plants were with partly frozen foliage, apices of the first-year shoots and older branches, or with cracked stems (a, b, d, g, i points).

36 taxa of deciduous rhododendrons were also investigated for frost tolerance. During the observation period, 62 % of deciduous rhododendrons were not damaged by winter frosts (1 point), 30 % of plants were evaluated by 1–2 points (flower buds injured by frost), and 3 % of plants got evaluation of 1–3 points (vegetative buds and first-year shoots injured by frost). During the observation period, two rhododendrons taxa (*R. luteum* 'Klondyke' and *Rhododendron* 'Toucan') have not survived due to unfavourable wintering conditions. It should be mentioned that majority of them suffered not from winter frosts but from late spring frosts. Evergreen rhododendrons, comparing to those which are green in summertime, are more sensitive to low temperature. Considering all aspects, it can be stated that the evergreen rhododendrons, have been grown in SU Botanic Garden, have overtaken those which are green only in summertime.

The most successful rhododendrons which have acclimatized in the Botanical Garden cultivars were created in Latvia (*Rhododendron* 'Irina', *Rhododendron* 'Polārsvaigzne', etc.), Finland (*R. brachycarpum* subsp. *tigerstedtii* 'Haaga', *R. brachycarpum* subsp. *tigerstedtii* 'Helsinki Yliopisto'), England (*R. caucasicum* 'Cunningham's White', *Rhododendron* 'Catawbiense Grandiflorum'). These rhododendrons are tolerant up to -30 Celsius degree and are one of the most promising plants to grow in the regions of North Lithuania. Some rhododendron cultivars created in Holland, Poland, USA are intolerant to low temperatures (with partly frozen foliage, apices of the first-year shoots and older branches, or with cracked stems) and acquires special care. A rather large part of cultivars are of still unknown cultural origin that is why the conclusions could have been done only in future. While comparing different species and cultivars of rhododendrons (according to the same aspects), it is possible to state that species of rhododendrons are more adjusted to the climate conditions of North Lithuania and acclimatize better and faster.

## Conclusions

Reason for bad condition of rhododendron plants is low winter temperatures and especially late spring frosts. Therefore, climatic conditions undoubtedly have strong impact upon general condition of rhododendrons. Comparing different species and cultivars of rhododendrons (according to the same aspects), it is possible to state that species of rhododendron are more adjusted to the climate conditions of North Lithuania and acclimatize better and faster. The most successfully acclimatized rhododendrons in Botanic garden have been nurtured in Latvia, Finland and England. These types of rhododendrons are the most suitable to grow in the region of North Lithuania. Majority of the rhododendrons in the collection are tolerant to low temperatures or are just slightly frozen during winter, and their condition improves and they are able to return to their original condition during the vegetation period. Somewhat more frost-sensitive are evergreen rhododendrons and especially young plants.

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