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The seasonal development characteristic of different rhododendrons taxa and cultivars in Northern Lithuania.

1. Leafing peculiarities

Aurelija MALCIŪTĖ¹, Jonas Remigijus NAUJALIS², Ingrida ŠAULIENĖ³

¹Botanical Garden of Šiauliai University
Vilniaus 88, Šiauliai, Lithuania
E-mail: aurelija.malciute@gmail.com

²Vilnius University
M. K. Čiurlionio 21/27, Vilnius, Lithuania

³Šiauliai University
P. Višinskio 19, Šiauliai, Lithuania

Abstract

In scientific and educational collections, rhododendrons, like other introduced plants, are most often, although certainly not always, grouped considering the geographical factor, i.e. on the basis of their distribution ranges or places of origin. But rhododendrons could be very successfully grouped by particular phenorhythmotypic features. The rhododendron groups formed according to these criteria would be much longer attractive to the visitors of botanical gardens.

Based on long term research results, the rhododendrons grown in Northern Lithuania were grouped into specific phenorhythmotypes according to seasonal character of leaf unfolding, indexes of the end of leaf drop and average duration of leafing.

According to seasonal character of leafing, deciduous rhododendrons could be divided into phenorhythmotypes of 1) early leafing and 2) moderately early leafing. According to the indexes of the end of leaf drop deciduous rhododendrons could be divided into phenorhythmotypes of 1) early end of leaf drop, 2) moderately early end of leaf drop and 3) rather late end of leaf drop. According to the average leafing duration the deciduous rhododendrons could be divided into phenorhythmotypes of 1) short leafing duration, 2) moderate leafing duration and 3) long leafing duration.

Keywords: *Rhododendron*, seasonal development, leafing peculiarities, phenorhythmotype.

Introduction

Seasonal patterns of plant development are one of the key aspects of the plant-growing. This type of knowledge is increasing not only in the areas related to agriculture (Balčiūnas et al., 2008; Vilčinskas, Dabkevičienė, 2009). Intensive ornamental gardening development in Lithuania requires a new approach to phenological expression, giving a greater focus to introduced plants.

The most part of introduced plant phenological studies are made in the botanical gardens because there are databases where the influence of environmental conditions on plant development are

gathered (Harper et al., 2006; Primack, Miller-Rushing, 2009). Botanical gardens have long term observation data. According to the information from the Royal Botanic Garden in Edinburgh and the Royal Botanic Gardens at Kew they have data from the 19th century (Dosmann, 2006). Several factors affect woody plant phenology, including air temperature, soil moisture, daytime length, and plant water potential (Min, 2000; Dahlgren et al., 2007; Harper, Morris, 2007). As plants are transferred into new environment, their biological life cycle usually changes. This can even lead to the appearance of new mor-

phenological features or variations in the existing ones (Terzioğlu et al., 2001; Pérez-Latorre et al., 2010).

Timing of seasonal plant development can affect biotic interactions and plant fitness. Seasonal development of rhododendrons is closely dependent on climatic changes in the areas of their cultivation. A particularly reliable parameter for evaluation of the acclimatization of the plant is approximation of the development rhythm of the introduced plant to the naturally inherent rhythm in its natural environment (Александрова, 1989). Each species has a suite of adaptive traits. Adaptive traits can be identified in the behavioural, morphological, anatomical or physiological processes of plants (Nilsen, 2003).

A rhythm of seasonal development of rhododendrons, like that of other plants, could be evaluated employing classical phenological studies (Pérez-Latorre, Cabezudo, 2006; Crimmins, Crimmins, 2008). However, bearing in mind that in green plantations the introduced rhododendrons are grown for ornamental purposes, information about phenorhythmic features of these plants is much more important than traditional phenological data. Phenorhythmotype is a phenological group that combines plants of different species according to the similarity indexes of the beginning and end of their vegetative period as well as based on analogical succession of the main phenological phases during the vegetation period or the entire calendar year (Naujalis, 1992). In scientific and educational collections, rhododendrons, like other introduced plants, are most often, although certainly not always, grouped considering the geographical factor, i.e. on the basis of their distribution ranges or places of origin. But rhododendrons could be very successfully grouped by particular phenorhythmic features. The rhododendron groups formed according to these criteria would be much longer attractive to the visitors of botanical gardens.

Materials and methods

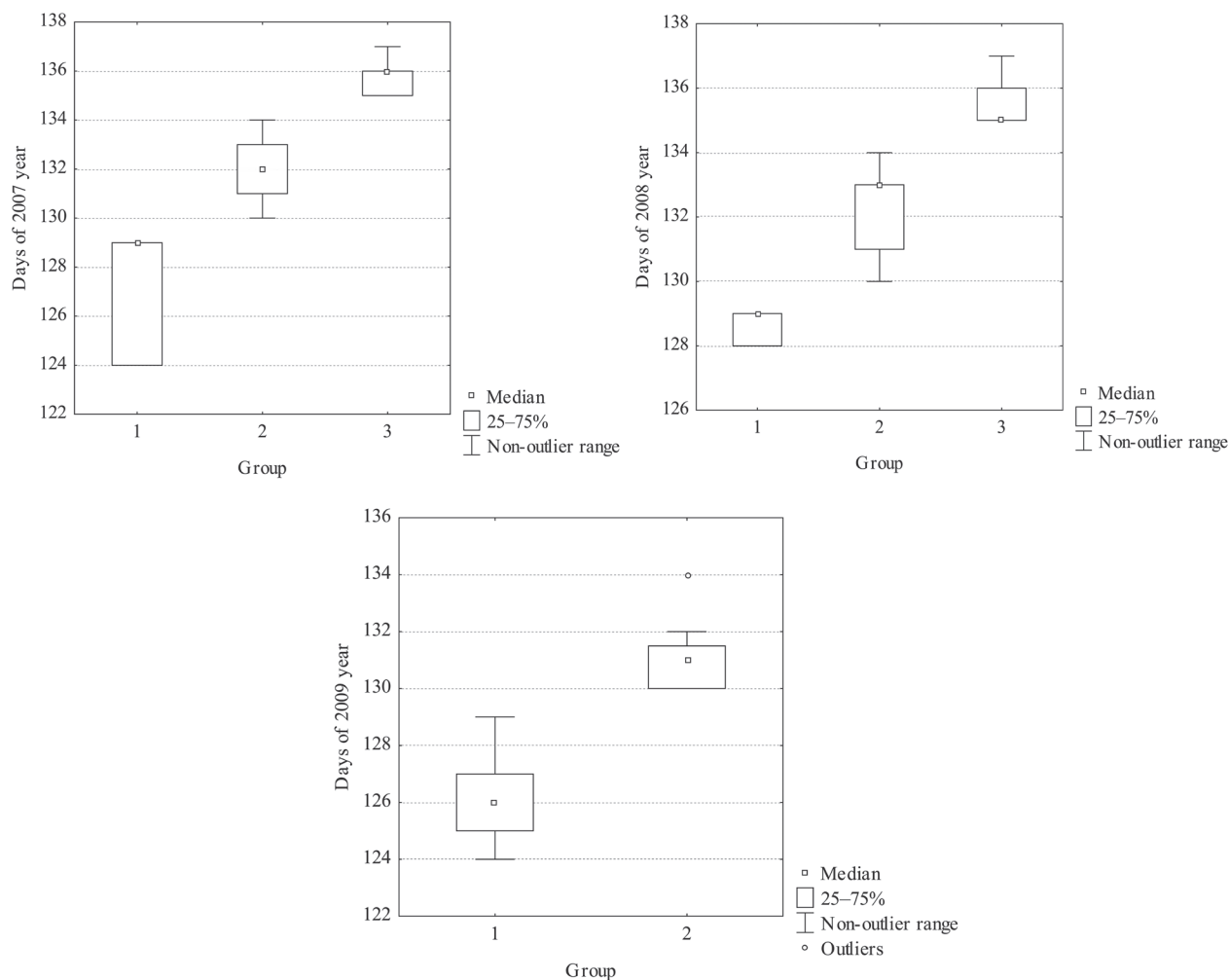
In 2007–2009, in the Botanical Garden of Šiauliai University (ŠU) specific studies on the seasonal development of rhododendrons were performed. In the course of the studies the features of leafing peculiarities of 37 deciduous taxa and cultivars of rhododendrons at generative maturity stage were assessed. From 1 to 5 individuals of each such taxon or cultivar were studied.

Beginning of the rhododendron leaf unfolding is the time in spring when leaves start to grow, their surface area becomes apparent and the leaf itself, although, still not reaching characteristic dimensions of the taxon or cultivar is already of typical shape. The moment for the end of leaf drop – seasonal loss of about 50% of leaves.

Based on long term research results, the rhododendrons grown in the Botanical Garden of Šiauliai University were divided into specific phenorhythmotypes according to seasonal character of leaf unfolding, indexes of the end of leaf drop and average duration of leafing.

Results and discussion

Phenological studies of deciduous rhododendrons suggest that in the Botanical Garden leafing of these plants usually starts during the first days of May (Malciūtė et al., 2009). However, each year the beginning of leafing differs among the rhododendrons. For example, on the 4th of May in 2007 the first to start leafing were *R. canadense* (L.) Torr. and *R. canadense* var. *album*. In 2008, the first to start leafing, on the 7th of May, were *R. canadense* var. *album* and *R. molle* (Blume) G. Don. In 2009, on the 4th of May the first to leaf were *R. luteum* (L.) Sweet., *R. luteum* ‘Gibraltar’, *R. luteum* ‘Persil’ *Rhododendron* ‘Alina’ and *Rhododendron* ‘Hotspur Red’. Summarized data of 2007–2009 show that in the Botanical Garden of Šiauliai University *R. canadense* var. *album* is the earliest to begin leafing; it usually happens on the 127th day of the year. The variation among the earliest and latest leaf unfolding of rhododendrons in the collection is 9–13 days. Most deciduous rhododendrons fully unfold leaves in late May or early June. In 2007 and 2008, the day for the average beginning of rhododendron leafing was the 132nd, in 2009 – 126th day of the year. In 2007 and 2008, the beginning of massive rhododendron leafing was on the 133rd day, and in 2009 – 126th day of the year. The survey data of separate years show that, according to seasonal character of leafing, deciduous rhododendrons in the Botanical Garden could be divided into phenorhythmotypes of 1) early leafing (127th–129th day of the year) and 2) moderately early leafing (130th–134th day of the year) (Fig. 1). In some years even later beginning of leafing was observed among the deciduous rhododendrons, but the long



Note. Phenorhythmotypes of rhododendrons: 1 – early leafing, 2 – moderately early leafing, 3 – rather late leafing.

Figure 1. Distribution of deciduous rhododendrons according to the beginning of leaf unfolding in separate years

term research results show that it was probably a coincidence, but not a consistent pattern.

In 2007, the beginning of leafing of rhododendrons of the first phenorhythmotype (*R. albrechtii* Maxim., *Rhododendron* ‘Inga’, etc.) was early – on 124th–129th day of the year. About 16% of deciduous rhododendrons in the collection belong to this group. Leafing of the rhododendrons of the second phenorhythmotype (*R. schlippenbachii* Maxim. *R. luteum* ‘Royal Command’, etc.) began moderately early – on 130th–134th day of the year. In the Botanical Garden about 49% of deciduous rhododendrons belong to this group. Leaf unfolding of the rhododendrons of the third phenorhythmotype (*R. luteum*, *Rhododendron* ‘Līva’, etc.) started rather late – on 135th–137th day of the year (Fig. 1). About 35% of deciduous rhododendrons of the collection belong to this group.

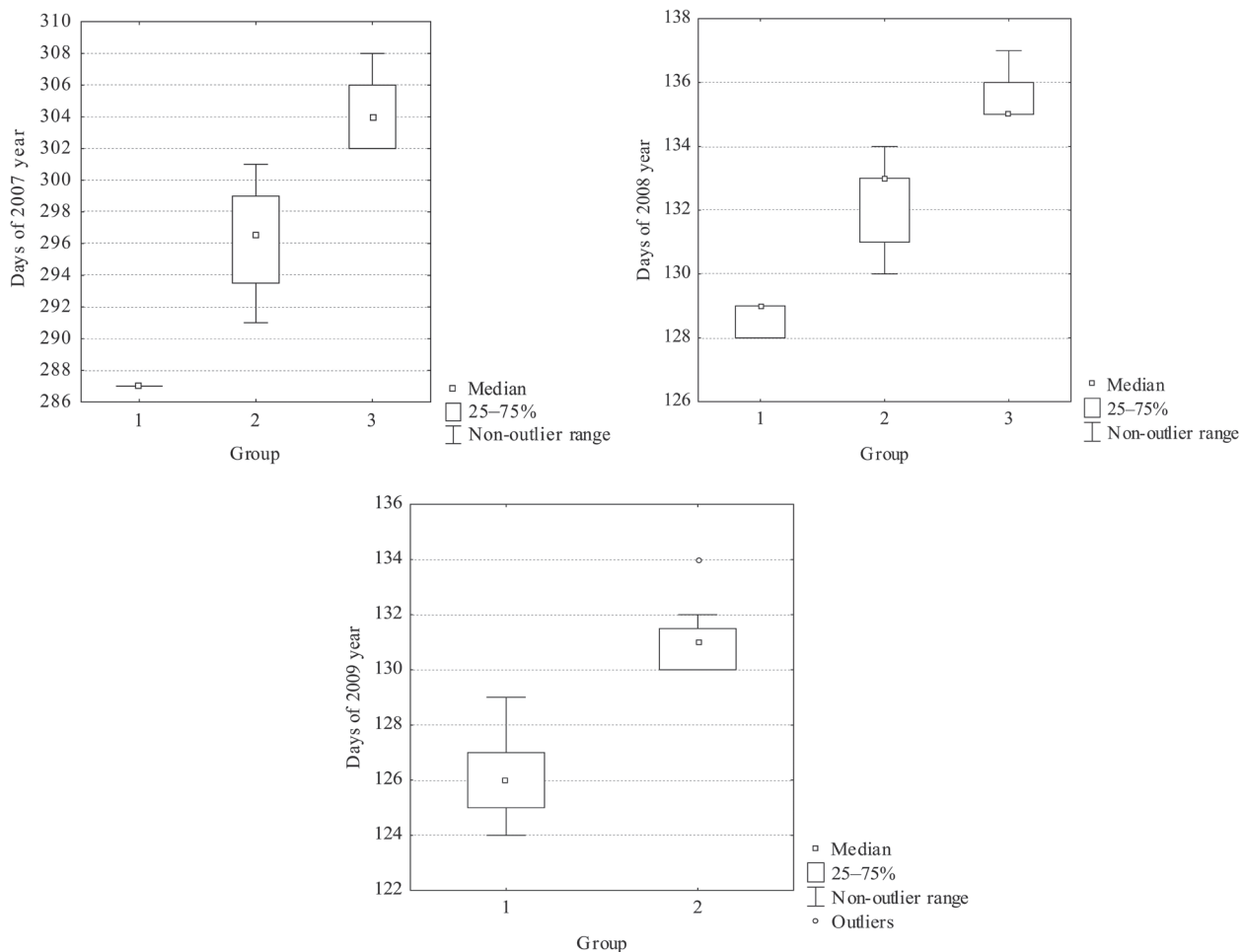
In 2008, rhododendrons of the first phenorhythmotype (*R. molle*, *R. luteum* ‘Canon’s Double’, etc.) were characterized by early leafing – 128th–129th day of the year. This group consists of 16% of deciduous rhododendrons in the collection. Rhododendrons of the second phenorhythmotype (*R. camtschaticum*, *R. japonicum* ‘Album’, etc.) started leafing moderately early – on 130th–134th day of the year. This group comprises about 57% of deciduous rhododendrons of the collection. The rhododendrons of the third phenorhythmotype (*R. calendulaceum* (Michx.) Torr. var. *croceum*, *R. luteum* ‘Gibraltar’, etc.) were characterized by late leafing – 135th–137th day of the year. About 27% of deciduous rhododendrons of the collection belong to this group.

In 2009, rhododendrons of the first phenorhythmotype (*R. viscosum* (L.) Torr., *R. luteum*

‘Canon’s Double’, etc.) started leafing early – on 124th–128th day of the year. This group accounted for about 81% of deciduous rhododendrons. Rhododendrons of the second phenorhythmotype (*R. albrechtii*, *R. canadense* var. *album*, etc.) began to leaf moderately early – on 130th–134th day of the year. In the Botanical Garden about 19% of deciduous rhododendrons belonged to this group. In 2009, no rather late leafing deciduous rhododendrons were recorded in the collection.

The indexes of the end of leaf drop show that the latest leaf fall of these plants occurs in the first ten-day period of November. Meanwhile the earliest rhododendron leaf fall occurs in mid-October. In 2007, leaf fall of most rhododendrons began on the 300th day of the year, in 2008 – on the 299th day, and in 2009 slightly earlier – on the 295th day of the year. The average date of the beginning of rhododendron leaf fall is the 298th day of the year. However, every year, this time index strong-

ly varies among the rhododendrons. For example, in 2007 the latest date of this phenological phase, on the 3rd–4th of November was characteristic of *R. japonicum* (A. Gray) J. V. Suring., *R. luteum* ‘Persil’, *Rhododendron* ‘Narcissiflora’. The earliest occurrence of the leaf fall, on the 14th October was recorded for *R. austrinum* Rehder and *Rhododendron* ‘Skaidrīte’. In 2008, the latest leaf fall for some rhododendrons (*Rhododendron* ‘Alina’ and *Rhododendron* ‘Anita’) was recorded on the 8th of November. Meanwhile in 2007, the dates of the occurrence of this phenophase were on the 18th and 28th of October, respectively. In 2008, the earliest leaf fall of some rhododendrons (*R. austrinum*) was observed on the 3rd of October. In 2009, the latest date of the leaf fall of certain rhododendrons (*R. camtschaticum*) was on the 6th of November. The earliest leaf fall, on the 11th of October, was recorded for *R. austrinum*.



Note. Phenorhythmotypes of rhododendrons: 1 – early end of leaf drop, 2 – moderately early end of leaf drop, 3 – rather late end of leaf drop.

Figure 2. Distribution of deciduous rhododendrons according to the end of leaf drop in separate years

According to the studies of separate years, in 2007 the average time of the beginning of rhododendron leaf fall was the 299th day of the year, in 2008 – 298th, and in 2009 – 295th day of the year. In 2007, the massive end of leaf drop coincided with the 302nd and in 2009 – with 292nd days of the year.

Based on the studies of several years, according to the indexes of the end of leaf drop, deciduous rhododendrons of the Botanical Garden could be divided into phenorhythmotypes of 1) early end of leaf drop (284th–289th day of the year), 2) moderately early end of leaf drop (290th–300th day of the year) and 3) rather late end of leaf drop (302nd–310th day of the year) (Fig. 2).

In 2007, rhododendrons of the first phenorhythmotype (*R. austrinum* and *Rhododendron* ‘Skaidrīte’) ended drop of leaf early – on the 287th day of the year. About 5% of the deciduous rhododendrons in the collection belong to this group. Rhododendrons of the second phenorhythmotype (*R. viscosum*, *Rhododendron* ‘Ilze’, etc.) ended drop of leaf early moderately early – on the 291st–301st day of the year. In the Botanical Garden this group comprises about 54% of deciduous rhododendrons. Rhododendrons of the third phenorhythmotype (*R. molle*, *R. viscosum* ‘Soir de Paris’, etc.) ended their drop of leaf rather late – on 302nd–308th day

of the year. This group comprises about 41% of deciduous rhododendrons in the collection.

In 2008, rhododendrons of the first phenorhythmotype (*R. schlippenbachii*, *R. japonicum* ‘Album’, etc.) ended drop of leaf early – on 277th–289th day of the year. This group comprises about 19% of deciduous rhododendrons in the collection. Rhododendrons of the second phenorhythmotype (*R. vaseyi*, *R. luteum* ‘Persil’, etc.) ended their drop of leaf moderately early – on 290th–300th day of the year. In the Botanical Garden of Šiauliai University this phenorhythmotype comprises about 39% of deciduous rhododendrons. Rhododendrons of the third phenorhythmotype (*R. japonicum*, *Rhododendron* ‘Līva’, etc.) ended drop of leaf rather late – on 302nd–313th day of the year. This group consists of 42% of deciduous rhododendrons of the collection.

In 2009, rhododendrons of the first phenorhythmotype (*R. albrechtii*, *R. austrinum*, *R. vaseyi*) ended their drop of leaf early – on 284th–289th day of the year. About 8% of the deciduous rhododendrons belong to this group. Rhododendrons of the second phenorhythmotype (*R. canadense*, *Rhododendron* ‘Laura’, etc.) ended their drop of leaf moderately early – on 290th–300th day of the year. About 73% of deciduous rhododendrons in the Botanical Garden

Table. Phenorhythmotypes of deciduous rhododendrons according to the leafing duration

Phenorhythmotype	Description	Typical representatives
1	Short leafing duration (151–160 days)	<i>R. albrechtii</i> , <i>R. austrinum</i> , <i>R. vaseyi</i> , <i>Rhododendron</i> ‘Polārzuvaigzne’, <i>Rhododendron</i> ‘Skaidrīte’
2	Moderate leafing duration (161–170 days)	<i>R. canadense</i> , <i>R. japonicum</i> , <i>R. luteum</i> , <i>R. schlippenbachii</i> , <i>R. viscosum</i> , <i>R. calendulaceum</i> var. <i>croceum</i> , <i>R. canadense</i> var. <i>album</i> , <i>R. gandavense</i> ‘Unigue’, <i>R. japonicum</i> ‘Album’, <i>R. luteum</i> ‘Gibraltar’, <i>R. viscosum</i> ‘Soir de Paris’, <i>Rhododendron</i> ‘Alina’, <i>Rhododendron</i> ‘Francisa’, <i>Rhododendron</i> ‘Ilze’, <i>Rhododendron</i> ‘Indra’, <i>Rhododendron</i> ‘Laura’, <i>Rhododendron</i> ‘Līva’, <i>Rhododendron</i> ‘Mazais Jefinš’, <i>Rhododendron</i> ‘Madame Debene’, <i>Rhododendron</i> ‘Narcissiflora’, <i>Rhododendron</i> ‘Pasacina’, <i>Rhododendron</i> ‘Rīgas Rhododendr’s
3	Long leafing duration (171–177 days)	<i>R. camtschaticum</i> , <i>R. molle</i> , <i>R. luteum</i> ‘Canon’s Double’, <i>R. luteum</i> ‘Persil’, <i>R. luteum</i> ‘Royal Command’, <i>R. molle</i> ‘Satan’, <i>Rhododendron</i> ‘Anita’, <i>Rhododendron</i> ‘Hotspur Red’, <i>Rhododendron</i> ‘Inga’, <i>Rhododendron</i> ‘Lidija’

belong to this group. Rhododendrons of the third phenorhythmotype (*R. camtschaticum*, *R. luteum* 'Royal Command', etc.) ended their drop of leaf rather late – on 302nd–310th day of the year. This group consists of 19% of the deciduous rhododendrons in the collection.

The analysis of the data of separate years shows that according to the indexes of average leafing duration the deciduous rhododendrons in the Botanical Garden could be divided into phenorhythmotypes of 1) short leafing duration (151–160 days), 2) moderate leafing duration (161–170 days) and 3) long leafing duration (171–177 days) (Table). Rhododendrons of the first group usually start leafing in the first ten-day period of May, and their end of leaf drop is before the middle of October.

Rhododendrons of the second group begin leafing on the 10th–13th of May; and their end of leaf drop is on the 18th–28th October. Rhododendrons ascribed to the third group start leafing on the 14th–17th of May, and the time when their end of leaf drop is on the 29th of October to 8th of November. These results are useful in grouping different types of rhododendrons for green areas in urban territories.

Conclusions

1. In Northern Lithuania, the rhododendron leafing usually begins on the first days of May, in most cases on the 127th day of the year. *R. canadense* var. *album* is the first to unfold leaves. The variation among the earliest and latest leaf unfolding of rhododendrons in the collection is 9–13 days. Most deciduous rhododendrons fully leaf out by late May or early June.

2. According to seasonal character of leafing, deciduous rhododendrons in the Botanical Garden could be divided into phenorhythmotypes of 1) early leafing (127th–129th day of the year) and 2) moderately early leafing (130th–134th day of the year). In some years, even later beginning of leafing was observed among the deciduous rhododendrons, but the long term research results show that it was probably a coincidence, but not a consistent pattern.

3. The indexes of the end of leaf drop show that the latest leaf fall of these plants occurs in the first ten-day period of November. Meanwhile

the earliest rhododendron leaf fall occurs in mid-October. According to the indexes of the end of leaf drop deciduous rhododendrons of the Botanical Garden could be divided into phenorhythmotypes of 1) early end of leaf drop (284th–289th day of the year), 2) moderately early end of leaf drop (290th–300th day of the year) and 3) rather late end of leaf drop (302nd–310th day of the year).

4. According to the average leafing duration the deciduous rhododendrons in the Botanical Garden could be divided into phenorhythmotypes of 1) short leafing duration (151–160 days), 2) moderate leafing duration (161–170 days) and 3) long leafing duration (171–177 days).

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References

- Balčiūnas M., Jankauskienė Z., Brazaitytė A., Duchovskis P. Lapų indekso ir fotosintezės pigmentų dinamika įvairaus tankumo pluoštinių linų pasėlyje [The effect of plant stand density on flax leaf area index and content of photosynthetic pigments (summary)] // *Žemdirbystė=Agriculture*. – 2008, vol. 95, No. 4, p. 97–109 (in Lithuanian)
- Crimmins M. A., Crimmins T. M. Monitoring plant phenology using digital repeat photography // *Environmental Management*. – 2008, vol. 41, p. 949–958
- Dahlgren J. P., Zeipel H., Ehrlén J. Variation in vegetative and flowering phenology in a forest herb caused by environmental heterogeneity // *American Journal of Botany*. – 2007, vol. 94, p. 1570–1576
- Dosmann M. S. Research in the garden: averting the collections crisis // *Botanical Review*. – 2006, vol. 72, p. 207–234
- Harper G. H., Mann D. G., Thompson R. Phenological monitoring at Royal Botanic Garden Edinburgh // *Sibbaldia*. – 2006, vol. 2, p. 33–45
- Harper G., Morris L. Flowering and climate change. Part II // *Sibbaldia*. – 2007, vol. 5, p. 25–42
- Malciūtė A., Naujalis J. R., Šaulienė I. The seasonal development peculiarities of some deciduous rhododendrons in Botanical Garden of Šiauliai University: 5th international conference “Research and conservation of biological diversity in Baltic region”. – Daugavpils, Latvia, 2009, p. 85
- Min B. M. Comparison of phenological characteristics for several woody plants in urban climates // *Journal of Plant Biology*. – 2000, vol. 43, iss. 1, p. 10–17
- Naujalis J. Augalų populiacinė ekologija. – Vilnius, 1992, p. 107–115 (in Lithuanian)
- Nilsen E. T. Unique anatomical traits in leaves of *Rhododendron* section *Vireya*: a discussion of functional significance / *Rhododendrons in Horticulture and Science*. – Edinburg, Scotland, 2003, p. 20–36
- Pérez-Latorre A. V., Cabezudo B. Phenomorphology and ecomorphological characters of *Rhododendron lauroid* forests in the Western Mediterranean (Iberian Peninsula, Spain) // *Plant Ecology*. – 2006, vol. 187, p. 227–247
- Pérez-Latorre A. V., Gaviraa O., Cabezudo B. Phenomorphology and ecomorphological characters of *Maytenus senegalensis* L. Shrublands in the Iberian Peninsula: a comparison with other Mediterranean plant communities // *Flora – Morphology, Distribution, Functional Ecology of Plants*. – 2010, vol. 205, iss. 3, p. 200–210
- Primack R. B., Miller-Rushing A. J. The role of botanical gardens in climate change research // *New Phytologist*. – 2009, vol. 182, iss. 2, p. 303–313
- Terzioğlu S., Merev N., Anşın R. A study on Turkish *Rhododendron* L. (*Ericaceae*) // *Turkish Journal of Agriculture and Forestry*. – 2001, vol. 25, p. 311–317
- Vilčinskas E., Dabkevičienė G. Pirmųjų auginimo metų dobilų (*Trifolium* spp.) rūšių kiekybiniai ir kokybiniai požymiai [Qualitative and quantitative characteristic of clover (*Trifolium* spp.) species in the first year of growing (summary)] // *Žemdirbystė=Agriculture*. – 2009, vol. 96, No. 4, p. 170–180
- Александрова М. С. Рододендрон. – Москва, 1989, с. 29–38 (in Russian)

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Rododendrų skirtingų taksonų ir veislių sezoninės raidos rodikliai Šiaurės Lietuvoje. 1. Lapojimo ypatumai

A. Malciūtė¹, J. R. Naujalis², I. Šaulienė³

¹Šiaulių universiteto Botanikos sodas

²Vilniaus universitetas

³Šiaulių universitetas

Santrauka

Botanikos soduose gana plačiai atliekami introdukuotų augalų fenologiniai tyrimai, nes būtent tokio pobūdžio tyrimų metu gauti duomenys padeda įvertinti aplinkos sąlygų tinkamumą augalams.

Žinant, kad introdukuoti rododendrai želdynuose auginami kaip dekoratyvūs augalai, už tradicinius fenologinius rodiklius kur kas svarbesnė gali būti informacija apie šių augalų fenoritmotipinius požymius. Mokslinėse arba pažintinėse kolekcijose rododendrai galėtų būti sėkmingai grupuojami pagal vienokius ar kitokius fenoritmotipinius rodiklius. Taip sudarytos rododendrų grupės botanikos sodų lankytojams turėtų tapti patrauklesnės kur kas ilgesnį laiką nei dažnokai yra dabar.

Pagal sezoninio sulapojimo pobūdį Šiaurės Lietuvoje išskiriami 1) anksti sulapojančių (127–129 metų dieną) ir 2) vėliau sulapojančių (130–134 metų dieną) rododendrų fenoritmotipai. Kai kuriais tyrimų metais pasitaikydavo ir gerokai vėlesnis vasaržalių rododendrų sulapojimas, tačiau keliamečių tyrimų duomenys parodė, kad tai veikia atsitiktinumas, o ne dėsningumas.

Pagal lapojimo pabaigos rodiklius išskiriami 1) anksti baigiančių lapoti (284–289 metų dieną), 2) vėliau baigiančių lapoti (290–300 metų dieną) ir 3) vėliausiai baigiančių lapoti (302–310 metų dieną) vasaržalių rododendrų fenoritmotipai.

Pagal vidutinės lapojimo trukmės rodiklius išskiriami 1) trumpai lapojančių (151–160 dienų), 2) vidutinės lapojimo trukmės (161–170 dienų) ir 3) ilgai lapojančių (171–177 dienų) rododendrų fenoritmotipai.

Reikšminiai žodžiai: rododendrai, sezoninė raida, lapojimo ypatumai, fenoritmotipas.