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PHENOLOGICAL OBSERVATIONS OF SELECTED SPECIES FROM THE GENUS *SYRINGA* L. (OLEACEAE) IN THE BOTANICAL GARDEN OF THE ADAM MICKIEWICZ UNIVERSITY IN POZNAŃ

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Abstract. Phenological observations at the Botanical Garden of the Adam Mickiewicz University in Poznań were conducted on *Syringa komarowii*, *S. meyeri*, *S. microphylla*, *S. oblata*, *S. reticulata*, *S. tomentella* and *S. wolfii*. These observations showed the longest foliation phase in the case of *S. oblata* and *S. meyeri*, while the longest flowering phase was recorded in *S. reticulata*, *S. microphylla* and *S. wolfii*. Additionally, the longest period of anthesis (i.e. the period from the moment when 25% flowers bloomed to the time when 75% were out of bloom) was observed in *S. oblata* and *S. microphylla*. All examined shrubs, except for *S. oblata*, set fruits, which dispersal was extended to the next year (except for *S. komarowii*). In terms of decorative value suitable for green areas the most valuable species were *S. komarowii*, *S. reticulata*, *S. meyeri*, *S. microphylla* and *S. oblata*, with the three latter being the most showy shrubs in terms of autumn foliage. Moreover, *S. komarowii* was exceptional among the analysed species due to its large, attractive leaf blades. This lilac, together with *S. meyeri*, was also characterised by the most decorative inflorescences. Thanks to their stronger growth in comparison to the other species, *S. komarowii*, *S. oblata* and *S. reticulata* are best suited for large gardens, whereas *S. meyeri* and *S. microphylla* will prove most suitable for small gardens. All the recommended shrubs show good drought resistance.

Key words: seasonal rhythm, climate factors

INTRODUCTION

Among approximately 30 lilac species only a few are known and common in green areas. This is evidenced e.g. by the offer of plants provided by the Polish Nurserymen Association (http://www.zszp.pl/), predominantly common lilac (*Syringa vulgaris*) with its cultivars, while other species: *S. ×chinensis, S. ×hyacinthifolia, S. meyeri, S. microphylla, S. oblata, S. patula* and *S. protolancinata*, are represented in small numbers. Most species from that genus exhibit adequate frost resistance to be grown throughout Poland (Białobok & Hellwig 1955, Bugała 2000). However, before they may be used more extensively sufficient information needs to be gathered on those species and it may be provided e.g. by phenological observations (Łukasiewicz 1984). Reliable observations yield detailed data on the duration of specific elements of decorative value, such as flowering or foliation, including leaf autumn colour change (Bielawska et al. 1964, Białobok 1971). It is particularly important when selecting plants and designing multispecies arrangements characterised by a sequence of flowering of used taxa. Additionally, according to Chylarecki & Straus (1968) and Witkowska (1984) it is crucial to gain information on the complete generative cycle of a given plant, as it is an indicator of vigour and the degree of adaptation to specific environmental conditions at a given locality.

The use of lilacs in green areas may vary and be dependent on the species, since they differ, among other things, in their habit and growth. They are suitable for parks, squares and roadside belts, home gardens or allotment plots. They work very well when used singly, e.g. *S. komarowi* or *S. wolfii*, and in clusters – bot single- and multi-species. In turn, *S. meyeri* and *S. microphylla* are better suited for home gardens and allotment plots (Białobok & Hellwig 1955, Łukasiewicz 1995, Nawrocka-Grześkowiak

1997, Bugała 2000, Bąbelewski 2009, Seneta & Dolatowski 2012, Czekalski 2014).

The aim of this study was to conduct phenological observations on selected lilac species from the collection of lilacs from the Botanical Garden of the Adam Mickiewicz University in Poznań and on this basis propose taxa best suited for urban conditions and of greatest value in terms of their use in green areas.

THE STUDY AREA, MATERIAL AND METHODS

Phenological observations were performed at the Botanical Garden of the Adam Mickiewicz University in Poznań from March to December 2015. Analyses were conducted on seven lilac species: *Syringa komarowii* C.K. Schneid. (register no. 691), *S. meyeri* C.K. Schneid. (no. 2939), *S. microphylla* Diels (7517), *S. oblata* Lindl. (3766), *S. reticulata* (Blume) H. Hara (835), *S. tomentella* Bureau & Franch. (2376) and *S. wolfii* C.K. Schneid. (439). According to Bugała (2000) and Takhtajan (2009), they belong to the subgenus *Ligustriana* (*S. reticulata*) and *Syringa*, within which the analysed lilacs may be allocated to sections *Villosae* (*S. komarowii, S. wolfii*) and *Syringa* (*S. meyeri, S. microphylla, S. oblata, S. tomentella*).

Observations were conducted on one shrub from each species, except for *S. reticulata*, which register number is allocated to two shrubs planted at a very small distance from each other, as a result of which they form one common crown. Dates of phenological parameters were recorded with varying frequency, depending on the developmental phase of plants. Flower development was examined four times a week. Observations of the individual phases of vegetative development and fruits were conducted with a minimum frequency of twice a week.

The distribution of examined plants in the Botanical Garden is given in Figure 1.

Research methods were adopted after Łukasiewicz (1984). In order to illustrate the results phenological spectra were prepared using the method developed by Schennikov (1928) as modified by Łukasiewicz (1984). The following **leaf development phases** were observed:

1. onset of leaf bud break
2. onset of leaf blade opening (the first leaves unfold their blades and their adaxial surface is visible)
3. onset of autumn leaf colour change (marked change in approx. 10% leaves)
4. onset of full autumn leaf colour change (approx. 50% autumn foliage)
5. end of full autumn leaf colour change (approx. 90% autumn foliage)
6. loss of decorative autumn foliage
7. onset of leaf fall
8. end of leaf fall (all leaves have been shed or only single leaves are left).

Flower development phases:

9. appearance of first flower or inflorescence buds
10. blooming of first flowers (several first flowers fully open)

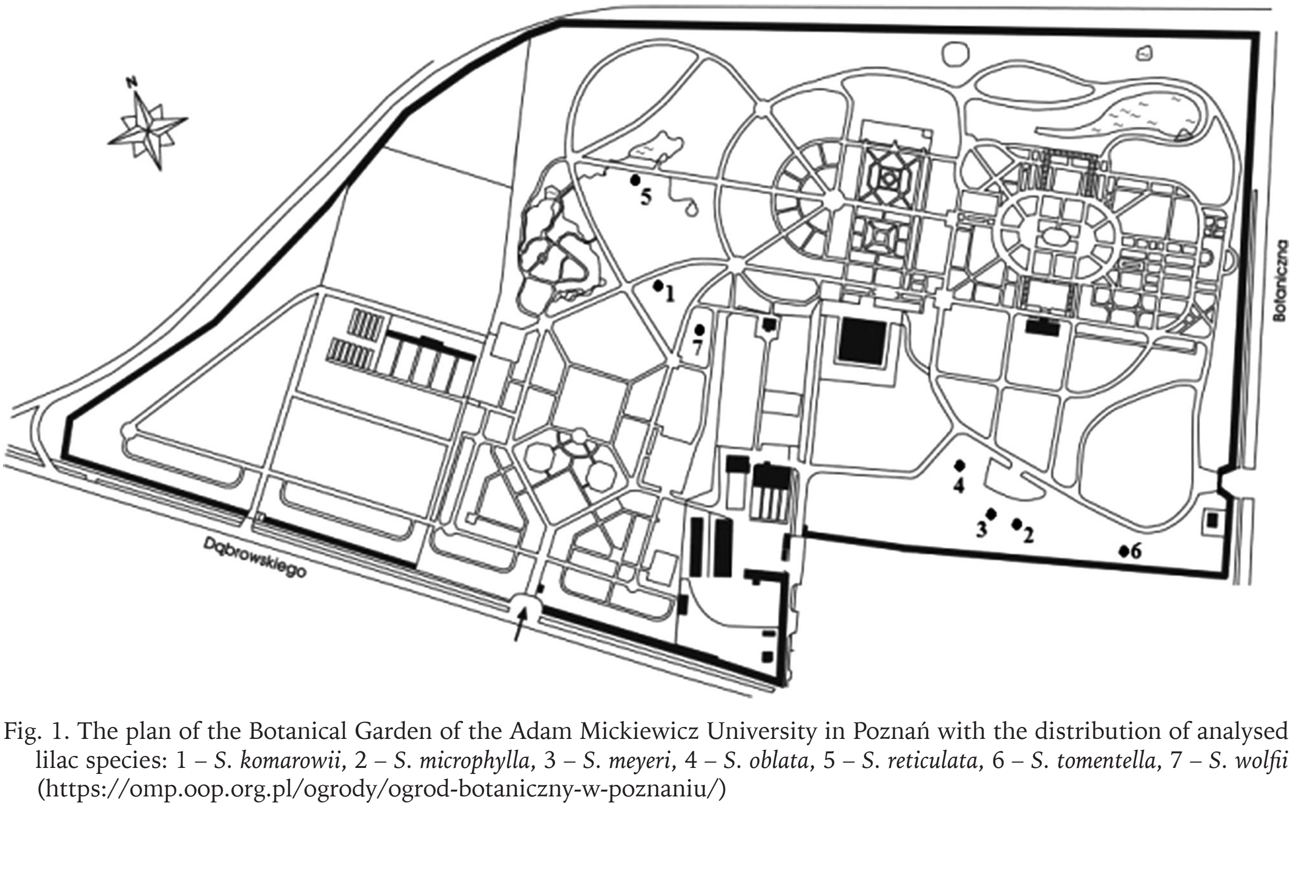

Fig. 1. The plan of the Botanical Garden of the Adam Mickiewicz University in Poznań with the distribution of analysed lilac species: 1 – *S. komarowii*, 2 – *S. microphylla*, 3 – *S. meyeri*, 4 – *S. oblata*, 5 – *S. reticulata*, 6 – *S. tomentella*, 7 – *S. wolfii* (https://omp.oop.org.pl/ogrody/ogrod-botaniczny-w-poznaniu/)

11. onset of anthesis (approx. 25% flowers in bloom; onset of mass flowering)
12. first flowers out of bloom (onset of first unripe fruits)
13. end of full anthesis (approx. 75% flowers out of bloom; end of the effect of mass flowering)
14. last flower buds
15. end of flowering (date when the last flowers are out of bloom).

Fruit development phases:

16. onset of fruit ripening (the first fruits change colour and texture)
17. onset of full fruit ripening (approx. 50% fruits take colour and texture characteristic of that phase)
18. end of fruit ripening (all fruits have ripened)
19. onset of fruit dispersal (the first fruits or seeds start to fall)
20. full fruit dispersal (approx. 50% fruits and seeds have been shed)
21. end of fruit dispersal (all or almost all fruits or seeds have been shed).

Climatic conditions

Meteorological data were collected from the Marcelin Experimental Station (Zgorzelecka 4 Street) of the Poznań University of Life Sciences. Measurements, on the basis of which ombrothermic diagrams according to Gaussen and Walter were prepared, are given in Tables 1 and 2. Dates for the onset of phenological seasons in Poznań from the Institute of Meteorology and Water Management, the National Research Institute, were collected from observations recorded at the Poznań Ławica station. Additionally, the winter period was identified after Łukasiewicz & Górska-Zajączkowska (1983), with its onset established at three successive days with maximum air temperatures below 0°C. These data are given in Table 3 and they were used as the background for the graphic presentation of research results.

Table 1. Weather data for the year of observations and the decade preceding the study

Month	Mean temperature (°C)		Precipitation total (mm)	
	2005–2014	2015	2005–2014	2015
I	–1.0	1.9	32.7	34.0
II	–0.2	1.2	22.0	7.6
III	3.6	5.5	31.6	43.2
IV	10.2	8.5	25.9	18.0
V	14.2	13.3	56.1	27.2
VI	17.5	15.9	54.9	93.6
VII	20.2	19.4	79.3	86.6
VIII	18.5	22.5	52.5	23.6
IX	14.7	14.7	34.6	21.8
X	9.2	8.0	23.8	19.2
XI	5.0	6.1	36.5	5.4
XII	0.7	5.7	31.5	22.6
Mean	9.4	10.2	–	–
Total	–	–	481.4	402.8

Table 2. Extreme and mean minimum and maximum temperatures in 2015 (°C)

Month	2005–2014				2015			
	absolute minimum	mean minimum temperature	absolute maximum	mean maximum temperature	absolute minimum	mean minimum temperature	absolute maximum	mean maximum temperature
I	–14.4	–3.4	8.2	1.2	–6.9	–0.1	12.2	4.0
II	–11.5	–2.9	10.2	2.4	–8.3	–2.0	10.0	4.4
III	–7.6	–0.4	16.1	7.5	–5.2	1.1	17.3	10.0
IV	–1.7	4.9	24.3	15.4	–2.8	2.9	24.9	13.8
V	1.2	8.7	28.1	19.2	0.3	6.9	25.0	18.7
VI	6.1	12.0	31.4	22.5	5.2	10.2	31.7	21.5
VII	10.1	15.1	33.1	25.6	8.1	13.5	34.4	25.2
VIII	7.6	13.5	31.1	23.6	6.7	15.9	36.5	28.8
IX	3.6	10.1	27.0	19.6	2.8	9.6	34.3	20.6
X	–1.9	5.5	20.8	13.6	–1.4	4.4	21.4	12.2
XI	–3.8	2.6	15.9	7.9	–4.4	2.9	15.7	9.4
XII	–8.8	–1.6	9.2	2.8	–5.7	3.3	13.9	8.0

Table 3. Phenological seasons in Poznań in 2015

Phenological season	Indicator plant/weather	Phase/temperature (°C)	Onset date
Beginning of spring	*Corylus avellana* L.	beginning of flowering	1.03
	Tussilago farfara L.		
Early spring	*Prunus padus* L.	beginning of flowering	18.04
	Taraxacum officinale F.H. Wigg.		
Full spring	*Syringa vulgaris* L.	beginning of flowering	30.04
	Aesculus hippocastanum L.		
Early summer	*Robinia pseudoacacia* L.	beginning of flowering	23.05
Summer	*Tilia cordata* Mill.	beginning of flowering	9.06
Early autumn	*Corylus avellana* L.	fruit ripening	6.09
	Aesculus hippocastanum L.	fruit ripening	
	Calluna vulgaris (L.) Hull	beginning of flowering	
Autumn	*Aesculus hippocastanum* L.	leaf yellowing	8.10
	Tilia cordata Mill.	leaf yellowing and leaf fall	
	Betula pendula Roth	leaf yellowing and leaf fall	
Winter	three consecutive days with maximum air temperature below 0°C	–2.8°C – 1.01.2016 –7.5°C – 2.01.2016 –9.9°C – 3.01.2016	3.01*

* Phenological winter started in 2016.

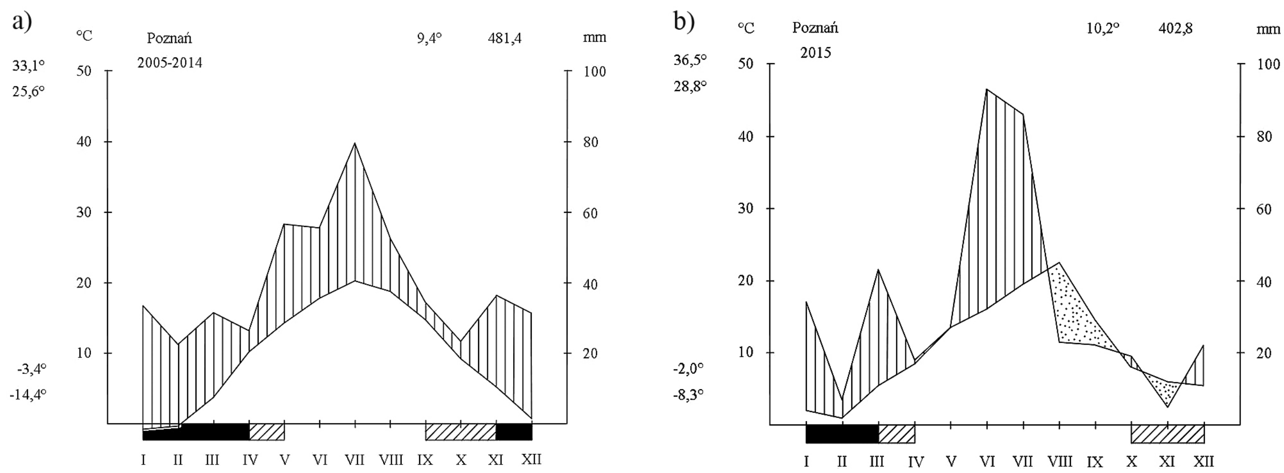

Fig. 2. The ombrothermic diagram according to Gaussen-Walter for the period of 2005–2014 (a) and for 2015 (b)

Analysis of climatic conditions indicates a warmer winter and summer, particularly in August, and a cooler spring of 2015 in relation to mean temperatures for the decade of 2005–2014. Drought lasted from August to the end of November, with only a short wet spell in October, i.e. the precipitation line is below the line plotted for temperature (Fig. 2b). The mean for the last decade (Fig. 2a) indicates solely a humid period. Thus the periodical drought is not a cyclic aspect and its occurrence provides an opportunity for additional observations of plants under stress conditions.

RESULTS

Results of phenological studies are given in Tables 4–6. Additionally, they were illustrated with phenological diagrams (Fig. 3).

DISCUSSION

Syringa oblata was the first of the observed lilacs to bloom, while *S. reticulata* was the last. Similar results were given in her study by Przybora (1980). Also Bugała (2000) indicated *S. oblata* as an early species and *S. reticulata* as a late species in terms of blooming in comparison to *S. vulgaris*. This aspect is of great value both for landscape architects and amateur gardeners. Planting arrangements may be designed comprising several lilac species, as a result being very attractive thanks to the considerably extended overall flowering period.

Among the observed species *S. oblata* was the only one not to undergo a complete generative cycle. That shrub flowered abundantly and extensively, but it did not set fruits. As it was stated by Chylarecki & Straus (1968), the incomplete generative development in shrubs of alien species is a result of their inadequate adaptation to Polish environmental conditions. However, a study by Przybora (1980) reported fruiting of another representative of that species in 1978 and 1979, thus *S. oblata* may not be classified as a species inadequately adapted to environmental conditions in Poland unless further studies are conducted to confirm that statement. The lack of seed setting may be caused by the different provenance of the analysed specimens.

As it was reported by Łukasiewicz (1989), during the catastrophically dry years of 1982 and 1983 with precipitation totals in Poznań amounting to 275 mm and 355 mm, respectively, and mean annual temperature of 8.9°C and 9.4°C, representatives of the genus *Syringa*, except for *S. yunnanensis*, did not suffer drastically enough to be classified to the group of plants with the lowest drought resistance. Among the species discussed in this study *S. komarowii*, *S. meyeri*, *S. oblata*, *S. reticulata*, *S. tomentella* and *S. wolfii* were included by Łukasiewicz in the group of trees and shrubs of medium drought resistance, i.e. such, in which as a result of adverse conditions leaves dry partly or even completely, while most shoots suffer no damage. In the course of investigations conducted in 2015 at the precipitation total of 402.8 mm and mean annual temperature of 10.2°C no premature leaf shedding or shoot die-back were observed. The dates for the onset of leaf shedding did not diverge considerably from the results given by Przybora (1980) and Mierniczak (1988), whose studies were conducted in cooler years and those with greater precipitation totals. As it was reported by Łabanowski et al. (2001), non-infectious leaf spot as a manifestation of soil water shortage was not observed. Thus the examined lilacs withstand (with no deterioration of foliage decorative value) such atmospheric conditions as those in 2015, in which precipitation (402.8 mm) was much lower than the mean from the last decade (481.4 mm) and the mean from the years 1971–2000

Table 4. Dates of phenological symptoms for phases of vegetative development in 2015

Species	Phases of leaf development							
	1	2	3	4	5	6	7	8
S. komarowii	24.03	24.04	16.09	30.09	12.10	*	23.09	23.10
S. meyeri	3.03	14.04	6.10	12.10	22.10	*	16.10	5.11
S. microphylla	3.03	14.04	9.09	23.09	2.10	*	6.10	27.10
S. oblata	6.03	17.04	2.10	12.10	22.10	*	22.10	11.11
S. reticulata	9.03	14.04	14.09	5.10	12.10	*	29.09	28.10
S. tomentella	24.03	24.04	6.10	16.10	20.10	*	6.10	27.10
S. wolfii	3.03	10.04	28.09	1.10	6.10	*	6.10	20.10

Numbers: 1–8 correspond to development phases described in *Study area, Material and Methods*; *phase not found in analysed lilacs.

Table 5. Dates of phenological symptoms for phases of flower development in 2015

Species	Phases of flower development						
	9	10	11	12	13	14	15
S. komarowii	28.04	21.05	25.05	1.06	6.06	2.06	11.06
S. meyeri	10.03	6.05	11.05	20.05	25.05	14.05	29.05
S. microphylla	27.03	14.05	19.05	29.05	3.06	20.05	8.06
S. oblata	14.04	27.04	28.04	5.05	14.05	5.05	18.05
S. reticulata	21.04	11.06	15.06	16.06	29.06	25.06	9.07
S. tomentella	24.04	20.05	25.05	1.06	6.06	2.06	10.06
S. wolfii	14.04	14.05	20.05	29.05	3.06	6.06	8.06

Numbers: 9–15 correspond to development phases described in *Study area, Material and Methods*.

Table 6. Dates of phenological symptoms for phases of fruit development in 2015

Species	Phases of fruit development					
	16	17	18	19	20	21
S. komarowii	12.08	17.08	23.09	20.08	16.09	30.09
S. meyeri	24.07	28.07	7.08	6.08	11.08	**
S. microphylla	1.09	12.10	1.11	19.10	22.10	**
S. oblata	*	*	*	*	*	*
S. reticulata	27.10	11.11	25.11	19.11	25.11	**
S. tomentella	6.08	1.09	21.09	25.08	20.10	**
S. wolfii	6.08	14.08	10.09	14.08	23.09	**

Numbers: 16–21 correspond to development phases described in *Study area, Material and Methods*; *lilac did not set fruits; **dispersal was extended to the following year.

of 507 mm (Pułyk 2009). Thus the analysed species may be successfully used in various garden designs in Poznań and the entire Wielkopolska region with no need for irrigation systems.

The species of high decorative value thanks to autumn foliage include *S. meyeri* (Fig. 5), *S. microphylla* (Fig. 6) and *S. oblata* (Fig. 7). They may be recommended for home gardens and urban green areas as elements of colourful vegetation compositions. It also needs to be stressed here that the above-mentioned lilacs do not lose their decorative foliage colour before leaf shedding. As it was reported by Górka (2003), in the United States considerable interest is observed in species of attractive autumn foliage and this trend is also reaching Poland. This is reflected in the tables of trees and shrubs of decorative value in autumn, presented in the plant catalogue recommended by the Polish Nurserymen Association (Filipczak 2011).

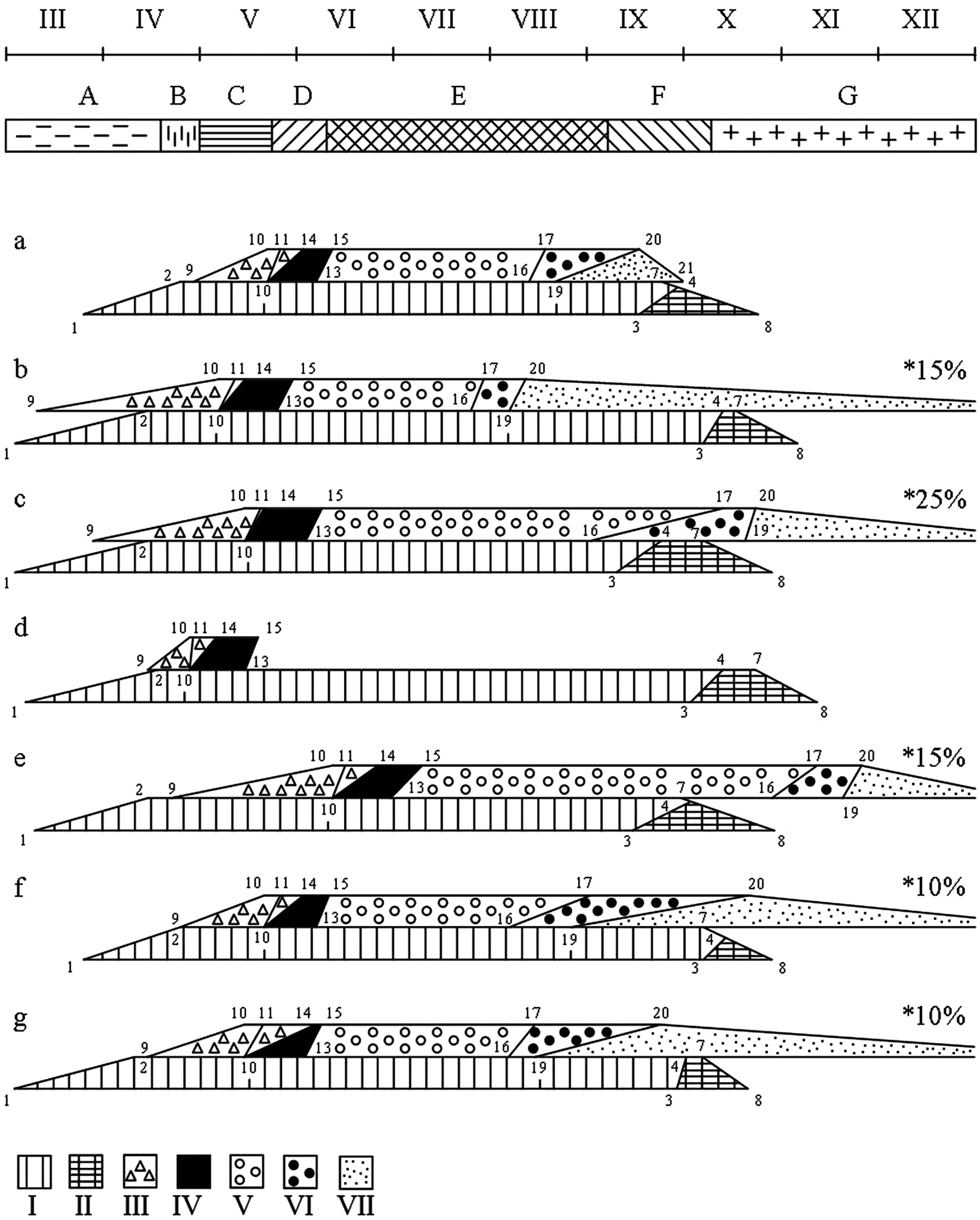

Fig. 3. Phenological spectra: *Syringa komarowii* (a), *S. meyeri* (b), *S. microphylla* (c), *S. oblata* (d), *S. reticulata* (e), *S. tomentella* (f) and *S. wolfii* (g). Numbers: 1–21 correspond to development phases described in *Study area, Material and Methods* and the numbers of development phases given in Tables 4, 5 and 6. A – beginning of spring, B – early spring, C – full spring, D – early summer, E – summer, F – early autumn, G – autumn; stages: I – foliation, II – autumn leaf coloration and leaf-fall, III – inflorescence buds, IV – flowering, V – immature fruits, VI – mature fruits, VII – seed dispersion; * – percentage of the seeds left on the bush

Fig. 4. Habit, leaves, buds, outer bark and inflorescences of *Syringa komarowii*

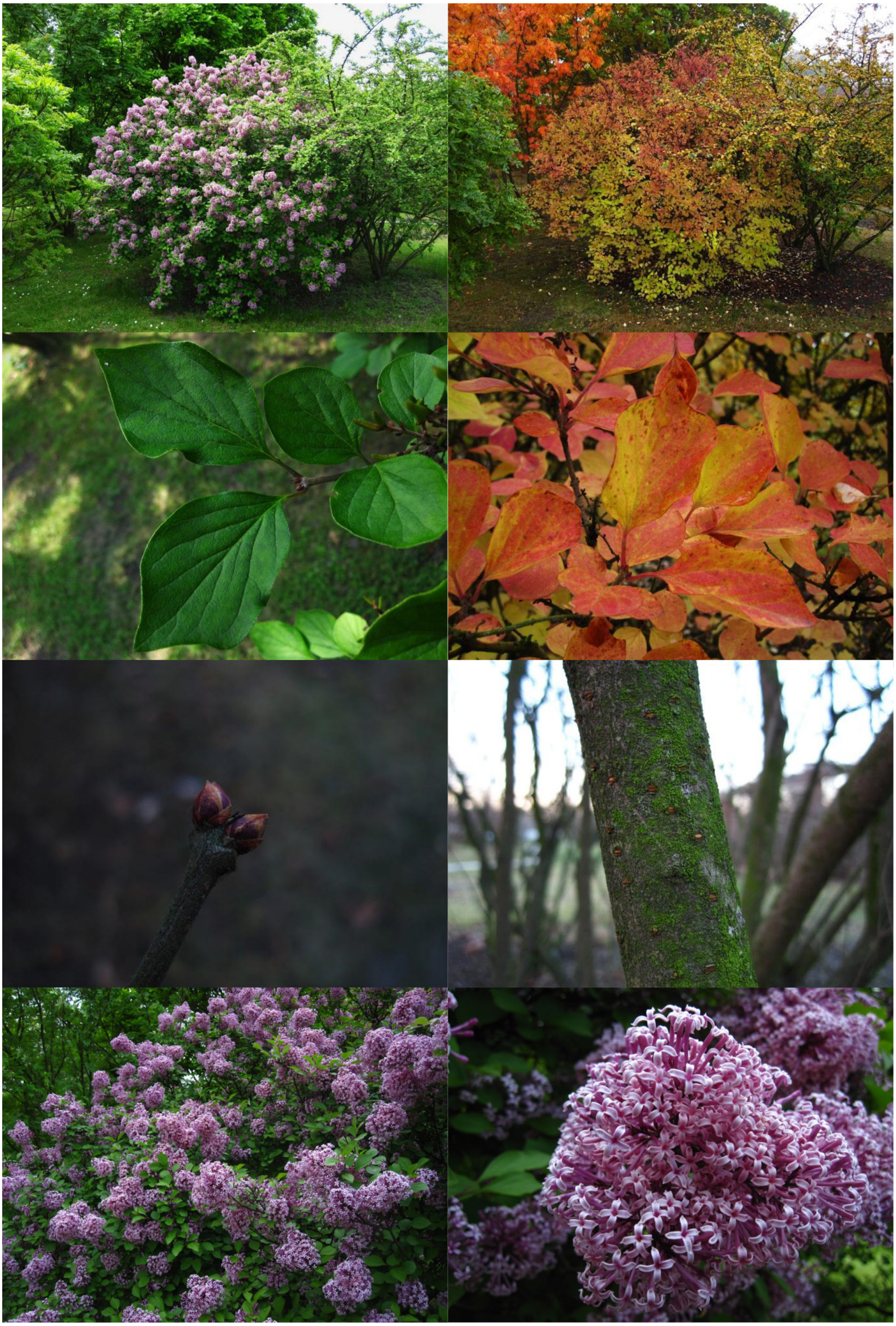

Fig. 5. Habit, leaves, buds, outer bark and inflorescences of *Syringa meyeri*

Fig. 6. Habit, leaves, buds, outer bark and inflorescences of *Syringa microphylla*

Fig. 7. Habit, leaves, buds, outer bark and inflorescences of *Syringa oblata*

Fig. 8. Habit, leaves, buds, outer bark and inflorescences of *Syringa reticulata*

Fig. 9. Habit, leaves, buds, outer bark and inflorescences of *Syringa tomentella*

Fig. 10. Habit, leaves, buds, outer bark and inflorescences of *Syringa wolfii*

Among the analysed species *S. wolfii* was the only one, on which European mistletoe *Viscum album* was found. The shrub was a host for four mistletoe specimens, of which two largest had eight branches and a diameter of 70 cm and nine branches and a 50 cm diameter, respectively. Both Bojarczuk (1971) and Stypiński (1997) in their studies mentioned *S. reticulata* subsp. *amurensis* as the only host for mistletoe in the genus *Syringa*. Susceptibility of *S. wolfii* may result from the weakening of the shrub, growing in the collection of the Botanical Garden already since 1949. Classification of the species as a host of mistletoe is a negative trait in the case of plant selection for urban green areas, where trees and shrubs very often grow under stress conditions.

Syringa oblata was the only one among the observed species, which in the vegetation season produced suckers. As it was reported by Białobok & Hellwig (1955) and Bugała (2000), it is a species similar to *S. vulgaris*, capable of forming dense thickets. Depending on the plant use, this property may be a disadvantageous or advantageous characteristic. In the case of home gardens and allotment plots the use of *S. oblata* will require additional tending operations connected with appropriate management of the shrubs. When plants are selected to reinforce escarpments, production of suckers by trees and shrubs is desirable. *Syringa vulgaris* is one of the many species recommended for that purpose by Zajączkowski (2001), while these observations indicate that a similar function may also be served by *S. oblata*.

CONCLUDING REMARKS

1. The longest foliation phase was observed in *Syringa oblata* (251 days) and *S. meyeri* (248 days).
2. Lilacs which bloomed for the longest time were *S. reticulata* (29 days), as well as *S. microphylla* and *S. wolfii* (26 days).
3. Species characterised by the longest period in bloom included *S. oblata* (21 days) and *S. microphylla* (16 days).
4. *Syringa komarowii, S. meyeri, S. microphylla, S. oblata* and *S. reticulata* were considered to be the most valuable and recommendable for green areas. Among the above-mentioned the most attractive in terms of autumn foliage were *S. meyeri, S. microphylla* and *S. oblata*.
5. *Syringa komarowii* is the lilac with exceptionally large and attractive leaf blades in comparison to the others.
6. *Syringa microphylla, S. oblata* and *S. reticulata* are recommendable thanks to their long flowering period. Moreover, the species characterised by especially decorative inflorescences include *S. komarowii* (with particularly decorative, pendulous panicles) and *S. meyeri* (with very dense and fine panicles).
7. In large garden planting compositions *S. komarowii, S. oblata* and *S. reticulata* are most suitable thanks to their stronger growth in comparison to the other species. In turn, *S. meyeri* and *S. microphylla* are better suited for smaller spaces.

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