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FLOWERING DYNAMICS AND POLLEN PRODUCTION OF *LABURNUM ANAGYROIDES* MED. UNDER THE CONDITIONS OF SOUTH-EASTERN POLAND

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Abstract

A study on the flowering biology and pollen production of the common laburnum (*Laburnum anagyroides* Med.) was conducted under the conditions of Lublin during the period 2004 - 2006. The flowering of this species began in the second 10-day period of May and lasted for 2.5 - 4 weeks. The flowers of common laburnum are borne in showy golden-yellow pendulous racemes. They develop successively, starting from the base and moving to the tip of an inflorescence. During the growing season, one shrub produces 800 to 3200 racemes, with 14 to 35 flowers in a single raceme. On average, the flowering duration for a raceme was 12.8 days and 8.7 days for a single flower. Throughout the study years, the shrubs proved to be most attractive in the third 10-day period of May when they reached full bloom.

The average weight of pollen produced was 6.08 mg per 10 flowers of *Laburnum anagyroides*, 14.02 mg per raceme, and 26.0 g per shrub. Pollen grains reached average dimensions of 24.01 μm × 24.26 μm.

Keywords: flowering, *Laburnum anagyroides*, pollen forage, pollen grain morphology.

INTRODUCTION

The genus *Laburnum* comprises four species of low trees or shrubs of the family Fabaceae, subfamily Faboideae, tribe Genisteae (Lewis and Schrire, 2003; Wojciechowski, 2003). In the wild, they are found in western Poland as well as in central and south-western Europe, and in Central Asia (Scheller, 1974; Krüssmann, 1984; Pritsch, 2007; Johnson and More, 2009; Seneta and Dolatowski, 2012; Tokarska-Guzik et al. 2012).

The common laburnum (*Laburnum anagyroides* Med. also known as *Cytisus laburnum* L.) is often planted in many European countries as an attractive ornamental species intended for park plantings as well as for gardens and slopes (Bodnarčuk et al. 1993; Wasson, 2001; Pritsch, 2007; Tokarska-Guzik et al. 2012). In the British Isles, this species was also grown in the past for wood fuel and was commonly used as a hedge plant (Chater, 1992; Johnson and More, 2009).

Numerous studies conducted in different countries relate to the poisonous and medicinal properties of this taxon (Greinwald et al. 1990; Szentesi and Wink, 1991).

In a few papers, *Laburnum anagyroides* is mentioned as a species that can be used in beekeeping (Bodnarčuk et al. 1993; Pritsch, 2007; Kozłowski et al. 2011). Its entomophilous flowers, devoid of nectaries, only provide floral pollen to bees (Szklanowska and Dąbska, 1993; Lipiński, 2010). This raw material is a source of protein food for insects, and its abundance near an apiary is necessary in the spring during the development of bee families.

The aim of the present study was first, to determine the time, dynamics and abundance of flowering of *Laburnum anagyroides* under the conditions of Lublin; second, to estimate the weight of floral pollen as a source of forage for insects; and third, to determine the morphological characteristics of pollen grains, which can be useful for their identification in bee products.

MATERIAL AND METHODS

Flowering observations

The study on flowering and flower production of the common laburnum (*Laburnum anagyroides* Med.) was conducted in urban plantings in Lublin (51°14' N and 22°34' E), Poland, during the period 2004 - 2006. The flowering duration of this taxon as well as its inflorescences and flowers was determined. Flowering time was defined as the number of days from the beginning of flowering to the end of flowering, and was measured on the same several-year-old shrubs in the successive years. Detailed observations of the flowering dynamics of this species were carried out over two growing seasons (in the period 2004 - 2005). They were started when the first flower appeared on the shrubs and were continued until the last flowers faded. Observations of the flowering pattern were recorded every day according to the recommendations of Łukasiewicz (1984). The following flower development stages were recorded: beginning of flowering, that is, when the first flowers open; full flowering when 50 - 75% of the flowers are in bloom; and the end of flowering when nearly 100% of the flowers had faded.

The flowering of inflorescences was observed at full bloom of the taxon in each year of the study on 10 randomly selected racemes located on different shrubs. Each day, the number of open flowers on the flowering racemes was determined on individual days of bloom.

The flowering duration of single flowers was investigated several times during the successive seasons under varying weather conditions. The observations were started at bud burst, and bud development was observed until petal fall. The particular stages of flower development were recorded using the phenological signs of Krotoska (1958). These were as follows: bud stage, beginning of flowering, full flowering, and end of flowering.

Measurements of the inflorescence rachis length were made and the number of flowers per inflorescence was determined. At full flowering stage, morphological measurements of the flowers were made, including their length and width, the dimensions of petals measured from the base to the tip of the corolla, and the dimensions of the banner.

Investigation of the rate of pollen release and pollen morphological characters

Pollen production of this species was studied using ether extraction and weight measurement following the modified method described by Warakomska (1972). Mature stamens, just before anther dehiscence, were sampled separately for the flowers located at the base, in the middle part, and in the apical part of the inflorescence. Anther heads from 10 flowers (100 stamens) were placed on individual watch glasses in 6 replications for each region of the inflorescence. Anthers on the glasses were dried in a drying oven at a temperature of 30°C. The pollen released from the anthers was first washed with 70% alcohol then washed several times with ether until the pollen grains were completely washed out of the anthers, which was carefully checked with a MSZ 200T stereoscopic microscope. After the pollen grains were completely washed out and the anther walls were removed, the glasses with pollen were weighed and pollen production per flower, raceme, and shrub were calculated.

The extracted pollen was used to prepare glycerol-gelatin coated microscope slides. The pollen sampled from the flowers located at the base, the middle part, and the apical parts of the inflorescence were fixed on separate slides. Two replications for each region of the inflorescence were done. Subsequently, measurements of the pollen grains were taken to determine the length of their polar and equatorial axes using a Nikon Eclipse E 600 light microscope at a magnification of 40 × 15. Fifty pollen grains were measured on each slide.

Statistical analysis of the study results was performed based on analysis of variance (ANOVA) and Tukey's multiple t-tests at a significance level of $\alpha = 0.05$. Calculations were done using Statistica 6.0 software.

RESULTS

Flowering biology

Under the conditions of Lublin, the flowering of *Laburnum anagyroides* started during the second 10-day period of May and lasted for 2.5 - 4 weeks. In the first year of the study, the shrubs blossomed the earliest (10 May). During this season, the flowering period was the longest, lasting 29 days. In the next years, the flowering time was shorter, with a duration of 19 days in 2005 and 24 days in 2006 (Tab. 1). The shrubs reached full bloom during the third 10-day period of May and the end of flowering occurred during the first 10-day period of June (Fig. 1).

The flowers of the common laburnum are borne in golden-yellow, loose, very delicate, pendulous

Table 1.

Flowering of *Laburnum anagyroides* under the conditions in Lublin

Year	Flowering time (days)	Inflorescence length (cm)		Number of flowers in inflorescence		Length of flowering (days)			
						Flower		Inflorescence	
		Mean ± SD	Range	Mean ± SD	Range	Mean ± SD	Range	Mean ± SD	Range
2004	10.05 - 07.06 (29)	13.9 ± 2.86ᵃ	9 - 18	27.8 ± 5.14ᵇ	18 - 35	10.8 ± 2.66ᶜ	7 - 13	16.2 ± 1.93ᶜ	14 - 20
2005	15.05 - 02.06 (19)	16.7 ± 4.22ᵃ	9 - 23	21.7 ± 4.45ᵃ	14 - 28	6.4 ± 0.97ᵃ	5 - 8	8.5 ± 0.71ᵃ	7 - 9
2006	19.05 - 11.06 (24)	16.3 ± 2.36ᵃ	13 - 19	22.9 ± 6.15ᵃᵇ	14 - 33	8.8 ± 1.03ᵇ	8 - 10	13.8 ± 1.13ᵇ	12 - 16
Mean	-	15.6	-	24.1	-	8.7	-	12.8	-

Abbreviations: SD - standard deviation.
Mean values in column followed by the same letter do not differ significantly at $\alpha \leq 0.05$.

Table 2.

Mean air temperatures and total rainfall during the decade of the study period relative to the long-term means

| Meteorological factor	Month	2004				2005				2006				1951 - 2005
		Decade			Mean	Decade			Mean	Decade			Mean	Mean
		I	II	III		I	II	III		I	II	III		
Temperature (°C)	April	5.2	8.8	9.8	7.9	9.0	10.9	7.4	9.1	6.2	7.7	12.3	8.7	7.4
	May	13.6	10.8	11.4	11.9	10.8	10.5	18.0	13.1	13.5	14.6	12.8	13.6	13.0
	June	15.7	15.8	16.1	15.8	13.4	17.2	17.4	16.0	11.6	17.9	21.1	16.9	16.2
Precipitation (mm)	April	24.6	10.4	3.1	38.1	0.2	4.0	14.4	18.6	19.4	10.5	0.4	30.3	40.2
	May	10.1	11.3	16.6	38.0	32.8	65.0	0.2	98.0	9.0	18.4	32.2	59.5	57.7
	June	3.7	25.9	20.3	49.9	47.1	7.4	1.4	55.9	28.4	0.0	9.5	37.9	65.7
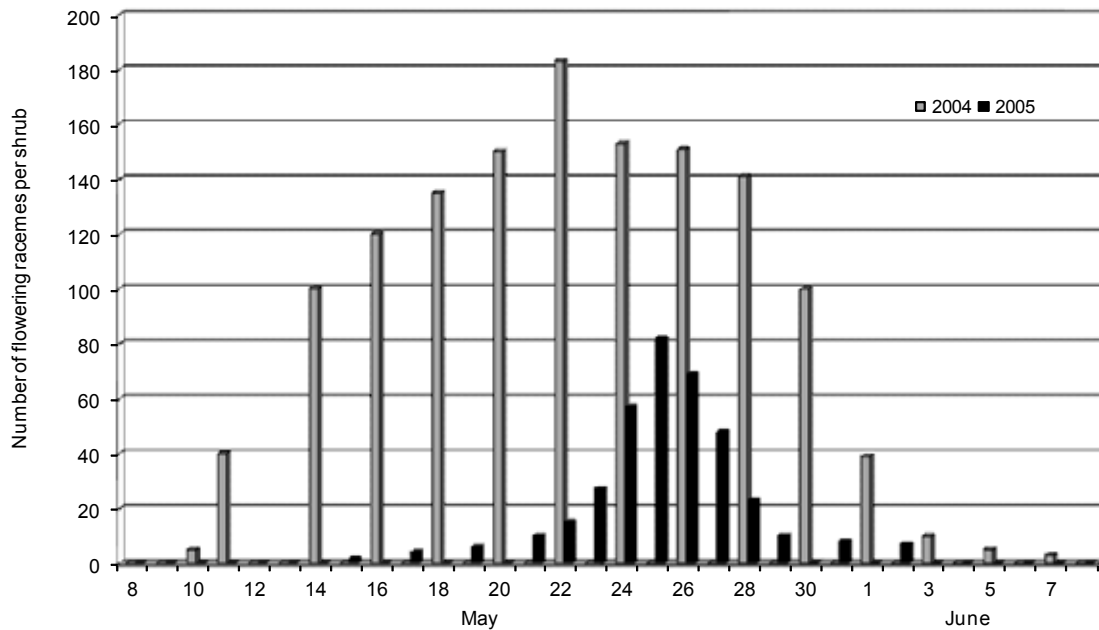
Fig. 1. Flowering of *Laburnum anagyroides* in 2004 - 2005 seasons.

racemes (Fig. 4A, 4B) with a length ranging from 9 cm to 23 cm (on average, 15.6 cm). Raceme length differed between years. In 2005, the largest differences in their dimensions were observed with raceme length ranging from 9 cm to 23 cm (Tab. 1).

During the growing season, one shrub produced between 800 and 3200 racemes (on average, 1735.2). The number of flowers per inflorescence ranged from 14 to 35 (on average, 24.1). The racemes flowered particularly abundantly during the first year of the study, in spite of this being the year that their length was the shortest (Tab. 1). In that year, there were from 1.3 to 2.6 flowers per 1 cm of the inflorescence rachis (on average, 2.1). During the other years of the study, the density of flowers in the racemes was much lower.

The flowers of *Laburnum anagyroides* have a structure characteristic of members of the Fabaceae family (Fig. 4C, 4D). They have zygomorphic symmetry and are bisexual. The sepals, numbering 5, are fused with each other. The separate petals of the corolla, also numbering 5, are differentiated into a raised banner, two lateral wings, and two lower petals fused into a keel that encloses the pistil and 10 stamens. The stamens are fused with each other by the filaments forming a tube (Fig. 4D) that adheres tightly to the ovary of the superior pistil. On the banner petal, there are brownish markings

extending from the base of the banner petal to two-thirds of its length. This clearly contrasts with the bright yellow colour of the flower (Fig. 4C). The other petals do not have such markings. The flower length ranged from 1.6 cm to 1.9 cm (on average, 1.8 cm), whereas its width ranged from 1.2 cm to 1.4 cm (on average, 1.3 cm).

The flowering of *Laburnum* is strictly dependent on weather conditions. On warm and sunny days when the average air temperature exceeded 25°C, a flowers' flowering duration was only 5 days. At a temperature of 10 - 14°C, this period was extended for up to 13 days. The average flower life span was 8.7 days (Tab. 1). Depending on weather factors, the flowering duration for a raceme ranged from 7 to 20 days (on average, 12.8 days). The flowers bloomed successively, starting from the base then moving up to the tip of an inflorescence (Fig. 4B). The full bloom of the racemes lasted longest in the first year of the study in which the flowering period of the shrubs was exceptionally long (Tab. 1, Fig. 1). During this season, the golden chain shrubs produced inflorescences with a much larger number of flowers than in the years 2005 and 2006 (Tab. 1, Fig. 2). Moreover, the low air temperature and unequal rainfall also had an effect on extending the flowering period in 2004 (Tab. 2, Fig 1).
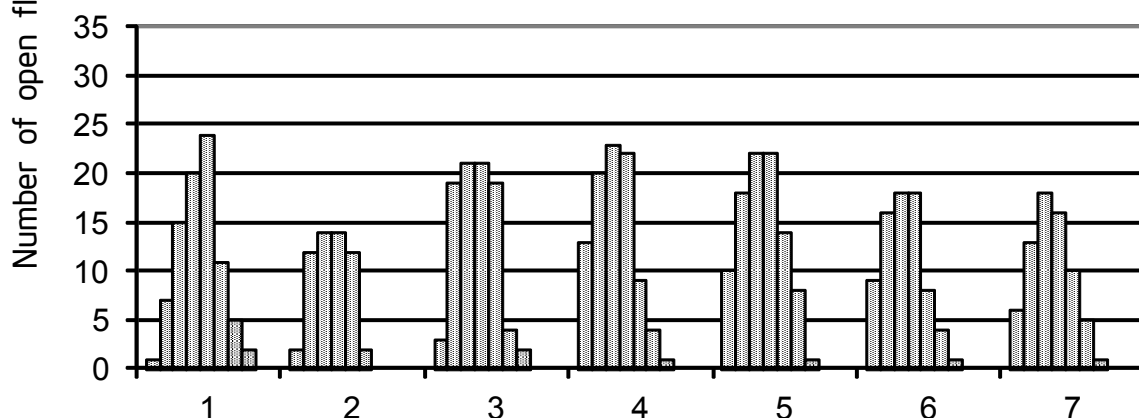
(2004)
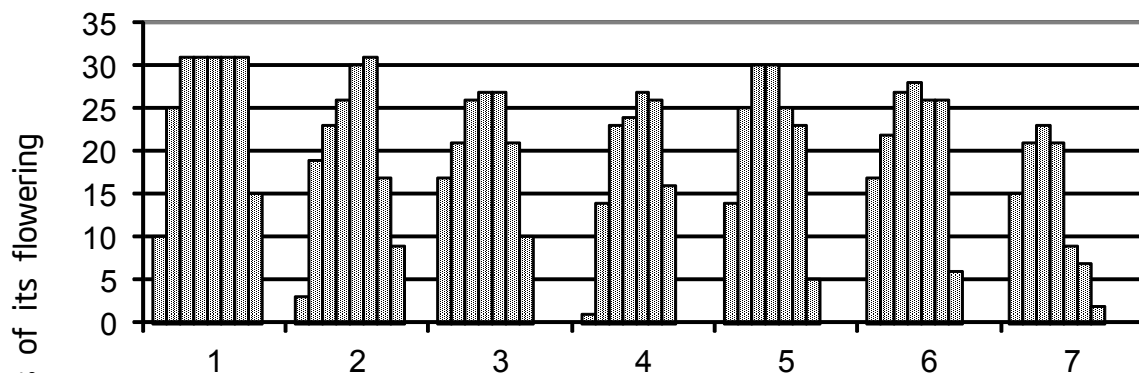
(2005)
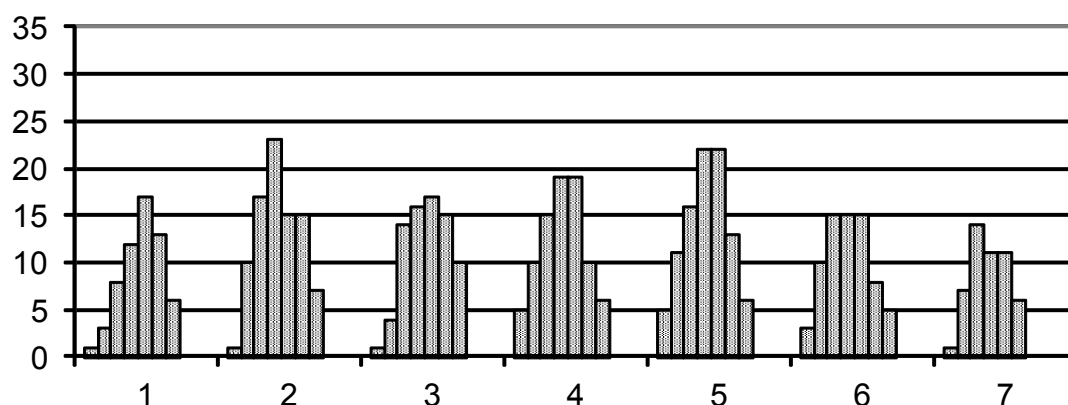
(2006)

Fig. 2. Flowering dynamics of some racemes during the study period.

Pollen production and morphological characteristics of pollen grains

The dehiscence of the anther walls in laburnum flowers begins at loose bud stage. Released pollen grains are hidden inside two petals forming the keel. The weight of pollen produced by 10 flowers ranged from 3.84 mg to 13.00 mg (on average, 6.08 mg) (Tab. 3). Flowers in the first year of the study, in which exceptionally low temperatures and heavy rainfalls were recorded during the period of flowering of the shrubs, were characterized by the lowest pollen production (Tab. 2 and 3). During this season, the average pollen production per 10 flowers was 5.22 mg.

Table 3.

Pollen production of *Laburnum anagyroides* Med.

Year	Location of flowers in a raceme	Mass of pollen from 10 flowers (mg)	
		Mean ± SD	Range
2004	At the base	5.09 ± 0.84 [a]	4.10 - 6.05
	In the middle	5.33 ± 0.56 [ab]	4.65 - 6.15
	In the apical part	5.25 ± 1.25 [ab]	3.84 - 6.99
	Mean	**5.22 [A]**	-
2005	At the base	7.14 ± 1.77 [ab]	4.90 - 9.02
	In the middle	7.68 ± 2.77 [b]	5.44 - 13.10
	In the apical part	5.77 ± 1.18 [ab]	4.76 - 7.99
	Mean	**6.86 [B]**	-
2006	At the base	6.67 ± 0.44 [ab]	6.20 - 7.38
	In the middle	5.48 ± 0.67 [ab]	4.70 - 6.63
	In the apical part	6.34 ± 0.50 [ab]	5.48 - 6.85
	Mean	**6.16 [AB]**	-
Mean	**At the base**	**6.30 [A]**	-
	In the middle	**6.16 [A]**	-
	In the apical part	**5.78 [A]**	-
	Mean	**6.08**	-

Abbreviations: SD - standard deviation.
Mean values followed by the same letter do not differ significantly at α≤0.05.
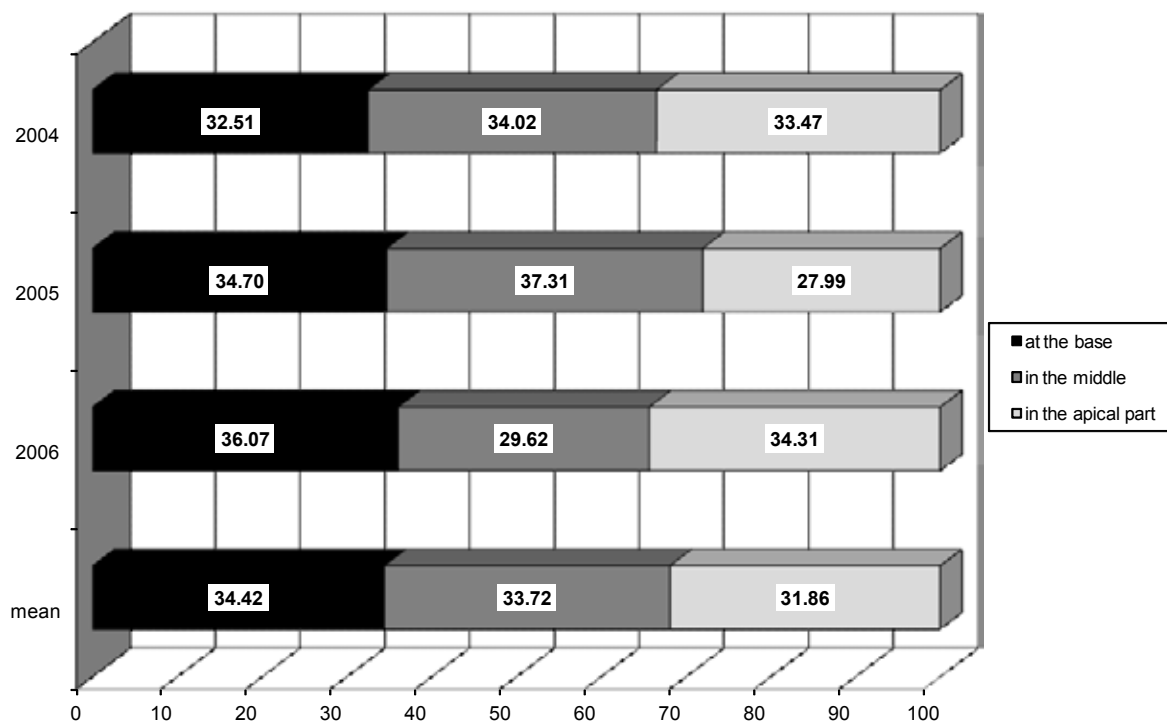

Fig. 3. Percentage of flowers from the respective regions of the inflorescence in pollen production.

Table 4.

Dimensions of the pollen grains of *Laburnum anagyroides* Med.

Year	Location of flowers in a raceme	Polar axis (P)		Equatorial axis (E)		Shape index P/E
		Mean ± SD	Range	Mean ± SD	Range	
2004	At the base	24.17 ± 1.10 [cd]	22.18 – 26.67	24.83 ± 1.48 [b]	22.17 – 28.28	0.97
	In the middle	23.06 ± 1.07 [a]	19.91 – 24.88	23.79 ± 1.13 [a]	20.85 – 26.03	0.97
	In the apical part	23.73 ± 1.05 [bc]	20.09 – 25.40	23.92 ± 0.97 [a]	21.79 – 26.72	0.99
	Mean	**23.65** [B]	-	**24.18** [B]	-	**0.98**
2005	At the base	23.20 ± 1.03 [ab]	21.01 – 25.67	23.87 ± 0.92 [a]	21.25 – 25.36	0.97
	In the middle	23.43 ± 0.81 [ab]	21.82 – 25.64	23.52 ± 0.96 [ac]	21.26 – 25.40	1.00
	In the apical part	23.18 ± 1.23 [ab]	20.49 – 25.53	22.98 ± 1.12 [c]	20.29 – 25.94	1.01
	Mean	**23.27** [A]	-	**23.46** [A]	-	**0.99**
2006	At the base	24.73 ± 1.14 [d]	22.09 – 26.70	25.14 ± 1.05 [bd]	22.11 – 27.31	0.98
	In the middle	24.32 ± 1.02 [cd]	22.33 – 26.37	24.69 ± 0.94 [b]	22.40 – 26.98	0.98
	In the apical part	26.24 ± 1.23 [e]	22.78 – 29.72	25.60 ± 1.40 [d]	23.97 – 28.82	1.02
	Mean	**25.10** [C]	-	**25.14** [C]	-	**1.00**
Mean	**At the base**	**24.03** [B]		**24.61** [B]		**0.97**
	In the middle	**23.60** [A]		**24.00** [A]		**0.98**
	In the apical part	**24.39** [C]		**24.16** [A]		**1.01**
	Mean	**24.01**		**24.26**		**0.99**

Abbreviations: SD - standard deviation.
Mean values in column followed by the same letter do not differ significantly at $\alpha \leq 0.05$

The highest pollen weight per 10 flowers (6.86 mg) was recorded in 2005. The weight of pollen produced by flowers from the particular regions of the raceme varied. Flowers at the base of the raceme produced the highest amount of pollen (on average, 6.30 mg per 10 flowers). For flowers in the middle part and at the apex of the inflorescence these values were 6.16 mg and 5.78 mg, respectively. The percentage of pollen production in the respective regions of the inflorescence differed between seasons (Fig. 3). Pollen production per raceme ranged from 10.1 mg to 18.1 mg (on average, 14.02 mg). Depending on the abundance of flowering, one shrub can provide from 11.6 g to 48.1 g of pollen (on average, 26.0 g).

Pollen grains of *Laburnum anagyroides* (Fig. 5) are tricolporate and roundish in outline (P/E = 0.99), with average axis dimensions of 24.01 µm × 24.26 µm (Tab. 4). Their exine is characterized by weak microreticulate sculpture.

During the period of flowering of the laburnum shrubs, various insects were observed on their flowers, with bumblebees predominating among the insect visitors. The presence of honey bees was also noted. Both bees and bumblebees visited the same laburnum flowers several times, gathering pollen that was gradually released into the keel. The insects formed yellow-orange pollen loads from this pollen (Fig. 6A, 6B). In all study years, the flowers of *Laburnum anagyroides* were the most attractive for insects, and insect visits to these flowers were most intense when the shrubs reached full bloom.

DISCUSSION

The flowering of *Laburnum anagyroides* in Lublin lasts for 2.5 to 4 weeks. The first flowers open on the shrubs in the second 10-day period of May. The end of flowering of this taxon occurs in the first half of June. Szklanowska
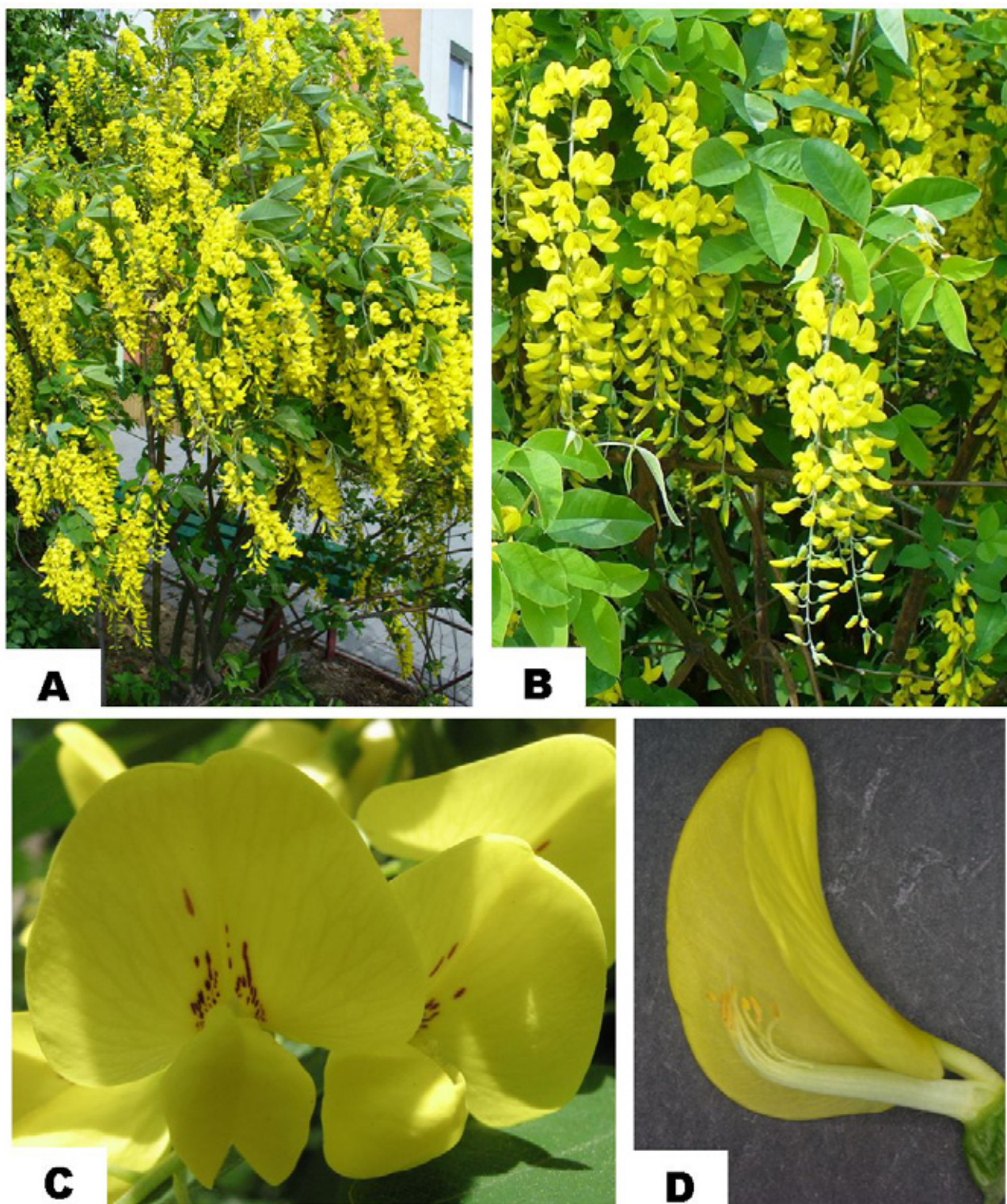
Fig. 5. *Laburnum anagyroides* Med. A - overall habit of the shrub; B - inflorescences; C - flower with visible markings on the banner petal; D - part of a flower with the staminal tube.

and Dąbska (1993), who studied the bee forage value of selected trees and shrubs of the family Fabaceae in the Lublin area, reported a later time of flowering for this species. According to these authors, *L. anagyroides* blooms at the turn of May and June and flowers for a shorter duration, ranging from 10 to 20 days. Demianowicz (1953) reported that in Poland shrubs of the taxon in question had already blossomed in April. A similar period of flowering was also observed under the conditions prevailing in other European countries, among other regions,
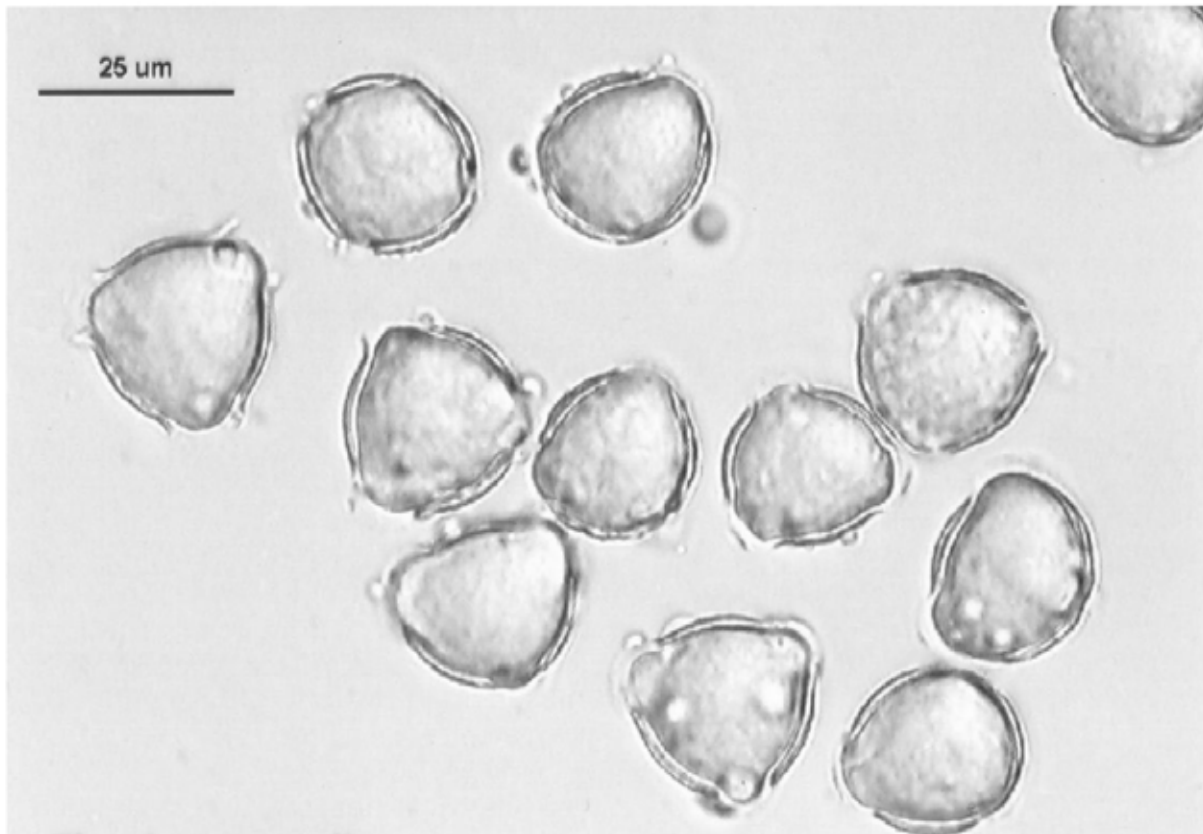
Fig. 6. Pollen grains of *Laburnum anagyroides* Med. viewed under a light microscope.

Pollen loads

Fig. 7. Bumblebees visiting flowers of *Laburnum anagyroides* (Phot. Jonas Ottos).

in the Ukraine (Bodnarčuk et al., 1993), and the United Kingdom (Sparks et al., 2000). In south-western Wales, full blooms occur at the beginning of June (Chater, 1992). In non-European countries with similar climate conditions, the flowering period of *L. anagyroides* starts at the end of April (Tütüncü et al., 2007) or at the turn of May and June (Krüssmann, 1984).

Common laburnum shrubs are characterized by showy drooping racemes with a slender rachis. Both their length and flower production changed throughout the study period and during particular growing seasons, which differed in weather conditions before and after flowering of the plants. In one raceme of *L. anagyroides* with a length ranging between 9 cm and 23 cm, 14 to 35 flowers were recorded (on average

24.1). These values are similar to those reported by Dirr (1990) and Seneta and Dolatowski (2012), according to whom *L. anagyroides* is characterized by loose and slender inflorescences reaching a length ranging from 10 - 15 cm to 20 - 25 cm. The dimensions obtained for the studied taxon are lower than those given for other species of the genus *Laburnum*; for example, *L. alpinum* produces racemes from 25 cm to 38 - 40 cm long, while *L.* x *watereri* 'Vossii' has racemes up to 60 cm in length (Dirr, 1990; Krüssmann, 1984; Johnson and More, 2009). Chater (1992) also stressed that *L. anagyroides* produces shorter inflorescences with more numerous and more intensely coloured flowers compared with *L. alpinum*. *Laburnum anagyroides* has racemes as densely packed as those in Voss's laburnum and even more densely than in the alpine laburnum (Chater, 1992; Johnson and More, 2009).

Under the conditions of Lublin, single flowers of *L. anagyroides* reach an average length of 1.8 cm and a width of 1.3 cm. On the banner petal, there is a clear dark marking whose length extended up to two thirds of the banner length. Dirr (1990) gives similar dimensions of the petal length (1.9 cm) for the species in question. According to Seneta and Dolatowski (2012), petal length in the common laburnum is 2 cm. However, according to Chater (1992), the petals of *L. anagyroides* reach larger dimensions, ranging from 2.2 cm to 2.3 cm, and the length of the marking is half the length of the standard (banner) petal. The above-mentioned author emphasises that in south-western Wales, *L. alpinum* produces petals ranging from 1.8 cm to 2.1 cm in length. The marking in this species is also shorter, since it reaches one third of the length of the standard petal.

The flowering duration of single *Laburnum* flowers was strictly dependent on weather conditions, lasting on average 8.7 days. This period was significantly extended in the case of lower daily air temperature, which was particularly noticeable in the first year of the study. On warm and sunny days, the flower life span was only 5 days. This value is close to the one estimated by Jabłoński and Kołtowski (1993) for *Robinia pseudacacia*, whose flower blooms for 4 - 5 days. At lower temperatures, the flower lifetime in *L. anagyroides* was extended up to 13 days.

In some trees and shrubs of the family Fabaceae among others Robinia and *Wisteria*, the morphological type of the inflorescence is similar to that of *L. anagyroides*. Compared to the inflorescences of *Robinia pseudacacia*, the inflorescences of common laburnum are showier and more attractive. During the growing season, one shrub of *L. anagyroides* produced from 800 to 3200 racemes, whereas a single *Robinia pseudacacia* tree at a similar age developed from 68 to 950 inflorescences (Jabłoński and Kołtowski, 1993). The number of flowers per raceme in *L. anagyroides* was similar to that obtained for *R. pseudacacia* (from 19.2 to 25.8) and *R. viscosa* (from 20 to 29 flowers) (Kim, 1987; Jabłoński and Kołtowski, 1993; 2000).

The study results on the flowering duration and abundance of *Laburnum* inflorescences were similar to or lower than those obtained for *Wisteria*. The inflorescences of common laburnum reached dimensions close to those recorded in the racemes of *Wisteria sinensis* (from 15 in 30 cm), which is very popular in cultivation, but were much shorter than the inflorescences of *Wisteria floribunda* (measuring from 20 to up to 121 cm) (Wyman, 1949; Seneta and Dolatowski, 2012). However, petal length in *Laburnum anagyroides* and both *Wisteria* species was comparable (in the range between 1.7 - 2.0 cm and 1.9 - 2.5 cm) (Seneta and Dolatowski, 2012).

The common laburnum is most frequently planted in groups of several shrubs, which additionally increases its attractiveness for visiting insects. This species flowers in the spring when there are very few equally attractive trees and shrubs.

Laburnum anagyroides is a non-nectar producing shrub that offers only pollen rewards to pollinating insects (López et al. 1999). The average pollen production per 10 flowers ranged from 5.09 mg to 7.68 mg. Depending on the abundance of flowering, one shrub can provide from 11.6 g to 48.1 g of pollen (on average 26.0 g of pollen) within the season. According to Szklanowska and Dąbska (1993), 10 flowers

of *L. anagyroides* produce on average 3.00 mg of pollen, whereas one inflorescence (raceme) produces from 8 mg to 14 mg.

The present study showed that the flowers at the base of the raceme were characterized by the highest pollen production, producing on average 6.30 mg per 10 flowers. The average weight of pollen in the successive regions of the inflorescence was lower. On the other hand, Szklanowska and Dąbska (1993) report that the flowers in the middle part of the inflorescence were marked by the highest pollen production (3.7 mg per 10 flowers), whereas the lowest amount was recorded for the flowers located at the apex of the raceme (2.9 mg). Among the several tree and shrub species of the family Fabaceae covered by their study, Szklanowska and Dąbska (1993) found laburnum to be one of the highest pollen-producing shrubs of this family. The results on pollen production per 10 flowers of *Laburnum anagyroides* (6.08 mg) obtained in the present study are higher than those reported by Szklanowska and Dąbska (1993) for this species, and also higher than the results for *Laburnum* alpinum (3.40 mg), *Robinia pseudacacia* (4.50 mg), and *Caragana arborescens* (3.60 mg). Comparable results for pollen weight per 10 flowers of herbaceous legume plants were obtained by Wróblewska (1991, 1997) for *Phaseolus coccineus* (4.60 - 7.70 mg), *Phaseolus vulgaris* (3.30 mg), and *Lathyrus sativus* (5.80 - 9.00 mg).

Pollen grains of *Laburnum anagyroides* are tricolporate and almost round, with average axis dimensions of 24.01 µm × 24.26 µm. Szklanowska and Dąbska (1993) give only the polar axis length of the pollen grain of this species, which was shorter and averaged 23.08 µm. Tütüncü et al. (2007) also demonstrated that these grains are tricolporate but oval (P/E = 0.94). Their colpi are long and wide and narrow towards the end, whereas the pores are very small. The exine is weakly sculptured and finely reticulate. According to the above-mentioned authors, pollen grains of *Laburnum anagyroides* reach average dimensions ranging from 23.08 µm to 24.40 µm. Halbritter (2011) also found similar morphological characters and dimensions of pollen grains of *Laburnum anagy-* *roides*; he classified them as tricolporate and small, in the class range from 10 µm to 25 µm. According to Zander (1935), *Laburnum* pollen grains are smaller and reach dimensions from 22.7 µm to 23.7 µm.

The common laburnum is a supplemental pollen source for insects at the turn of spring and summer. Bumblebees were predominant among the insects visiting *Laburnum anagyroides* flowers. These insects readily foraged on laburnum flowers to gather pollen from which they formed yellow-orange pollen loads. These observations are in agreement with those of Galloni and Cristofolini (2003) who stressed that bumblebees play a major role in the pollination of shrubs of the family Fabaceae. Insects harvesting pollen from flowers can gather it actively or passively (Thorp, 2000). In the case of *Laburnum anagyroides*, pollen gathering is active. According to López et al. (1999) and Galloni et al. (2007), the flowers of the studied species have created a pump mechanism of pollen presentation, which promotes several repeated visits to the same flower by insects.

Pollen harvesting from the flowers of members of the tribe Genisteae (to which, among others, *Laburnum* belongs) has been confirmed by microscopic investigations of pollen loads and bee bread conducted in Poland and other European countries (Díaz-Losada et al. 1998; Wróblewska, 2002; Sá-Otero et al. 2007). The presence of the pollen of plants from the above-mentioned tribe has also been recorded in Polish honeys (Wróblewska, 2002; Stawiarz and Wróblewska, 2010).

CONCLUSIONS

Flowering of *Laburnum anagyroides* under the conditions of Lublin lasts from the second 10-day period of May for 2.5 - 4 weeks.

Pollen production per raceme and per shrub is positively correlated with pollen yield of flowers and flower production.

Laburnum anagyroides can be recommended for urban plantings and home gardens as a highly decorative species enriching pollen flows for insects during the spring season.

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