

Department of Botany, Laboratory of Horticultural Plant Biology,  
Agricultural University, Lublin

BOŻENA DENISOW

### **Aspects of Flowering, Pollen Exposition and Insect Visits on some *Hydrangea* L. species**

---

Aspekty kwitnienia, pylenia i oblotu przez owady kilku gatunków  
z rodzaju *Hydrangea* L.

**Abstract.** In the years 2001–2004 the observations of blooming and the abundance of pollen flow delivered by *Hydrangea* shrubs were made. *Hydrangea heteromalla* D. Don, *H. arborescens* L., *H. arborescens* ssp. *discolor* (Raf.) McClintock, *H. paniculata* 'Grandiflora' grown in the Botanical Garden in Lublin were studied. The investigated species form inflorescences consisting of two types of flowers. Fertile flowers deliver pollen flow and sterile flowers attract pollinators optically. The following pollen efficiency values were measured: 0.6 g (*H. paniculata* 'Grandiflora'), 7–11 g (*H. arborescens*, *H. arborescens* ssp. *discolor*), 19.7 g (*H. heteromalla*) per one shrub, on average. The main pollinators were *Apis mellifera*, *Bombus* sp., *Andrena*, while *H. paniculata* attracted mainly *Diptera*.

**Key words:** *Hydrangea*, pollen efficiency, pollinators

#### INTRODUCTION

Trees and bushes constitute an important element of landscape. Their aesthetic value aside, they provide the source of food for pollinators at the time of blooming. In cities, the most valuable are all pollinating and nectar producing species. The improvement of flow may be achieved mainly by changes in the structure of tree and shrub planting (Jabłoński, 2000).

Recent years have witnessed the growing tendency for using non-native species – for example *Hydrangea*, which is very frequently planted in gardens. *Hydrangea* L. – the species belonging to the *Hydrangeaceae* family, which itself was part of a biological family of *Saxifragaceae* containing many honey and pollen producing species like *Ribes*, *Deutzia*, *Philadelphus* (Heywood, 1982; Masierowska, 1995).

All species grown in Poland are indigenous to Asia (Bugala, 1991). The available literature provides no information concerning the pollen flow value of *Hydrangea*. For this reason the present study aims at a detailed presentation of blooming and pollen value produced by flowers of *Hydrangea*.

#### MATERIAL AND METHODS

The experiments were conducted in 2001–2004 in the UMCS Botanical Garden in Lublin. The following species and cultivars were taken under consideration: *Hydrangea heteromalla* D.Don (= *H. bretschneideri* Dopp.), *H. arborescens* ssp. *discolor* (Raf.) McClintock, *H. arborescens* L., *H. paniculata* 'Grandiflora'. The investigated bushes were grown on loess originated soil, pH = 5. The time and length of blooming and diurnal dynamics of flowering were observed. Because the inflorescences consisted of different types of flowers, separate observations were made for each morph. Additionally, the average, life span of flowers and inflorescences was estimated. At the same time the number of insects visiting flowers was calculated. The average abundance of blooming was estimated by calculating the number of inflorescences per shrub and the number of flowers per inflorescence. The amount of pollen delivered was calculated for 100 anthers of a given number of flowers, inflorescences and bushes, and expressed per 1 ha. The method, modified by Szklanowska (1984, 1995) was applied. Four samples with 200 anthers each were taken for each investigated species in full blooming. Pollen viability was detected in acetocarmin. The length of polar axis and equatorial axis were measured in glycerin jelly slides under light microscope Nikon Eclips 200. The data concerning pollen efficiency were analysed statistically using Duncan's test at  $P = 95\%$ .

#### RESULTS

The blooming of the investigated species started in June and lasted till mid September (Fig.1). *H. heteromalla* was the first one to bloom in each years of study. *H. arborescens* and *H. arborescens* ssp. *discolor* bloomed simultaneously in July. The last one was *H. paniculata* 'Grandiflora' whose blooming period

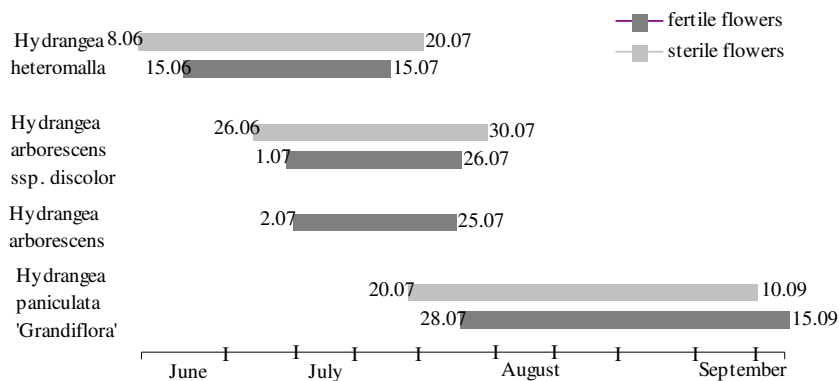


Fig. 1. The period and length of blooming of investigated *Hydrangea* species taking into consideration types of flowers (average from the years of study)

lasted till September. The inflorescences of *H. heteromalla* and *H. arborescens* ssp. *discolor* and *H. paniculata* 'Grandiflora' consist of both fertile and sterile flowers, while *H. arborescens* inflorescences were made of fertile flowers only (Fig. 2). The ratio of fertile to sterile flowers proved to be an individual feature and reached 1:1 in the case of *H. paniculata* 'Grandiflora', while the remaining species showed the majority of sterile flowers. Sterile flowers of investigated *Hydrangea* species bloomed approx. a week earlier than fertile ones.

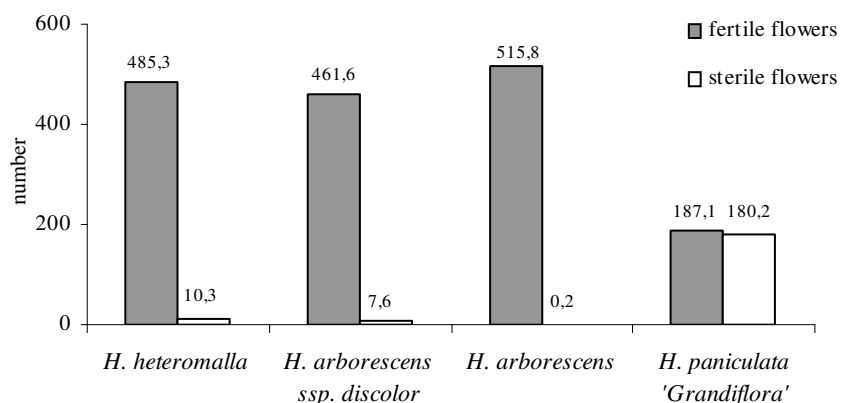


Fig. 2. Number of fertile and sterile flowers in *Hydrangea* L. inflorescences (average from the years of study)

The sterile *Hydrangea* flowers show the reduction of generative elements and contained a considerable size calyx. They are peripheral in inflorescences and attract pollinators optically. The life-span of these flowers was very long 3 weeks, on average. They remained on bushes even after sterile flowers had ceased blooming. Tiny, white fertile *Hydrangea* flowers had fragmented calyx and impressive well-developed corolla. The number of stamens varied from 9 to 11 in *H. macrophylla*, while it was constant (10) in the remaining species. A fragmented gynoecium was surrounded by androecium. The life span of sterile flowers depended on species and weather conditions – it varied from 1.3 to 3.5 days. The life-span of inflorescences was 1.5–2 weeks.

The diurnal dynamic of blooming depended on the type of flower (Fig. 3). The blooming peak for sterile flowers happened in the early morning and till 8.00 40% of flowers bloomed. The fertile flowers bloomed most intensively between 9 am and 1pm.

The abundance of blooming depended on the number of flowers per inflorescence and on the number of inflorescences per bush and it varied in different years of the experiment. Adverse weather conditions, mainly drought at the time of bud

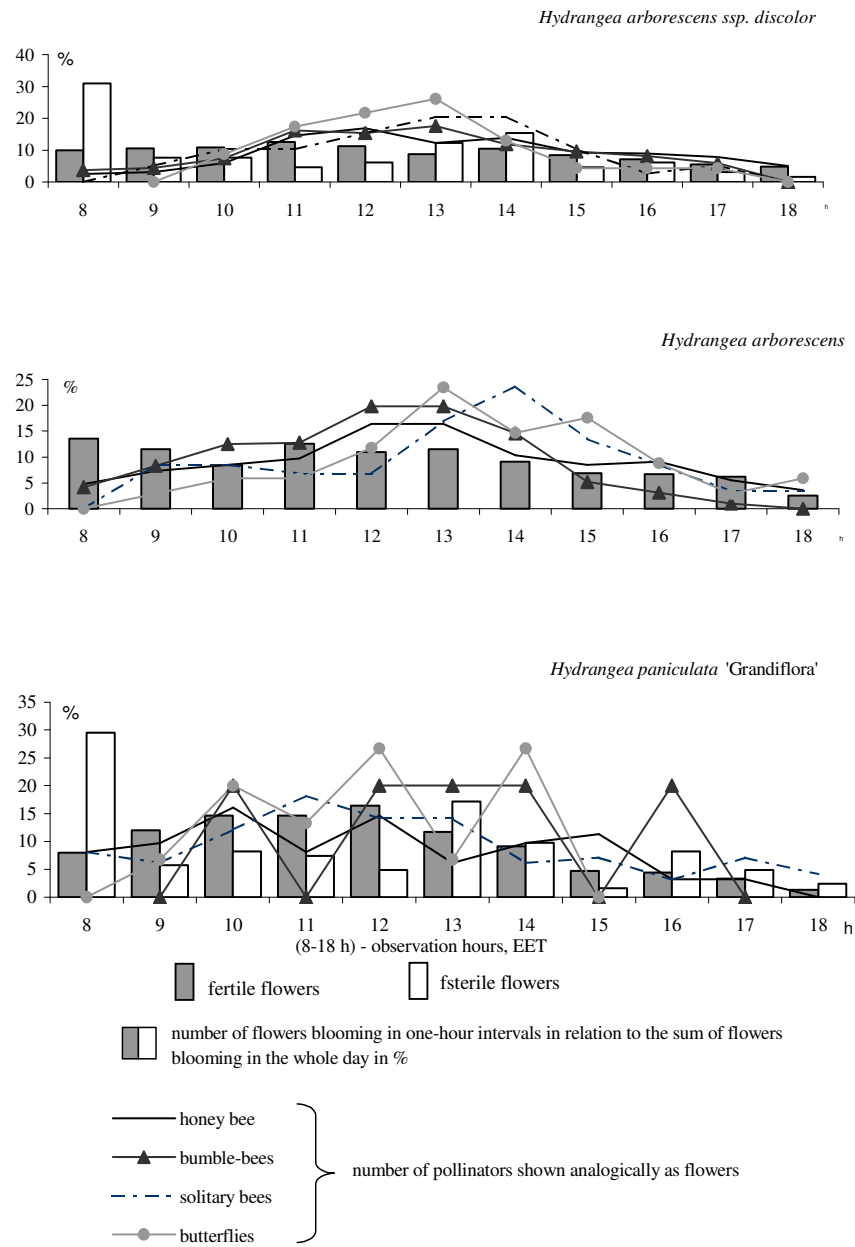


Fig. 3. Diurnal dynamic of fertile and sterile flowers blooming and pollinators foraging on three *Hydrangea* L. species

development and heavy cuttings of *H. arborescens* after spring frosts in 2003, resulted in the decrease of the abundance of blooming. *H. paniculata* 'Grandiflora' had the smallest average number of fertile flowers per inflorescence – only 180.2 (Fig. 2). Other investigated *Hydrangea* species had considerably more pollen exposing flowers per inflorescence 461.6–515.8 (487.5). The biggest number of fertile flowers were always produced by *H. heteromalla* and *H. arborescens* ssp. *discolor* – 102.5 thousand and 129.2 thousand pollinating flowers, on average (Tab. 1). Only 15.3 thousand of fertile flowers were found on *H. paniculata* 'Grandiflora'.

Table 1. The abundance of blooming and pollen efficiency of 4 *Hydrangea* species in the years of study

Species	Year	Inflorescences/shrub	Fertile flowers/shrub (thous.)	Mass of pollen			
				mg		g · shrub <sup>-1</sup>	kg · ha <sup>-1</sup> *
				100 flowers	inflorescence		
<i>Hydrangea heteromalla</i> D. Don	2003	218	111.4	17.7	90.44	19.72	23.6
	2004	204	93.7	21.1	96.95	19.78	23.8
	Mean	211	102.5 <sub>C</sub>	19.4 <sub>C</sub>	93.70 <sub>C</sub>	19.75 <sub>C</sub>	23.7
<i>Hydrangea arborescens</i> ssp. <i>discolor</i> (Raf.) Mc Clintock	2001	271	153.5	10.4	58.92	15.97	31.94
	2003	227	89.3	5.8	22.80	5.20	10.40
	2004	340	144.9	9.8	41.65	14.16	28.32
	Mean	279,3	129.2 <sub>C</sub>	8.7 <sub>B</sub>	41.12 <sub>B</sub>	11.78 <sub>BC</sub>	23.55
<i>Hydrangea arborescens</i> L.	2001	207	121.4	9.8	57.46	11.89	23.78
	2003	80	33.6	5.4	11.20	0.90	1.80
	2004	180	97.4	9.0	48.72	8.77	17.54
	Mean	155,7	84.1 <sub>B</sub>	8.1 <sub>B</sub>	39.12 <sub>B</sub>	7.19 <sub>B</sub>	14.37
<i>Hydrangea paniculata</i> Grandiflora Siebold	2003	72	11.5	5.8	9.20	0.66	0.79
	2004	89	19.1	3.7	7.94	0.71	0.85
	Mean	80.5	15.3 <sub>A</sub>	4.8 <sub>A</sub>	8.57 <sub>A</sub>	0.68 <sub>A</sub>	0.82

\*Calculated for 1200 shrubs · ha<sup>-1</sup> for *H. heteromalla* and *H. paniculata* 'Grandiflora' and 2000 shrubs · ha<sup>-1</sup> for *H. arborescens* ssp. *discolor* and *H. arborescens*

The amount of pollen delivered per 100 flowers of *H. paniculata* 'Grandiflora' was 4.8 mg, on average, and 8 mg for *H. arborescens* ssp. *discolor* and *H. arborescens*. The biggest amount of pollen was delivered by 100 flowers of *H. heteromalla* – 19.4 mg. The pollen efficiency of bushes depended strictly on the abundance of blooming and the mass of pollen delivered by anthers and it varied from 0.68 g (*H. paniculata* 'Grandiflora') to 19.7 g (*H. heteromalla*) per shrub. Pollen grains of all species are colourless and small (*minuta*). Their polar axis measures between 12.5–17.5 µm, while equatorial axis between 9.1–13.5 µm (Tab. 2). They are characterised by considerable viability – 85.8–91.1%, on average. The pollinating insects foraged on flowers willingly, with honey bee being the most frequent visitor on *H. heteromalla*, *H. arborescens* ssp. *discolor*,

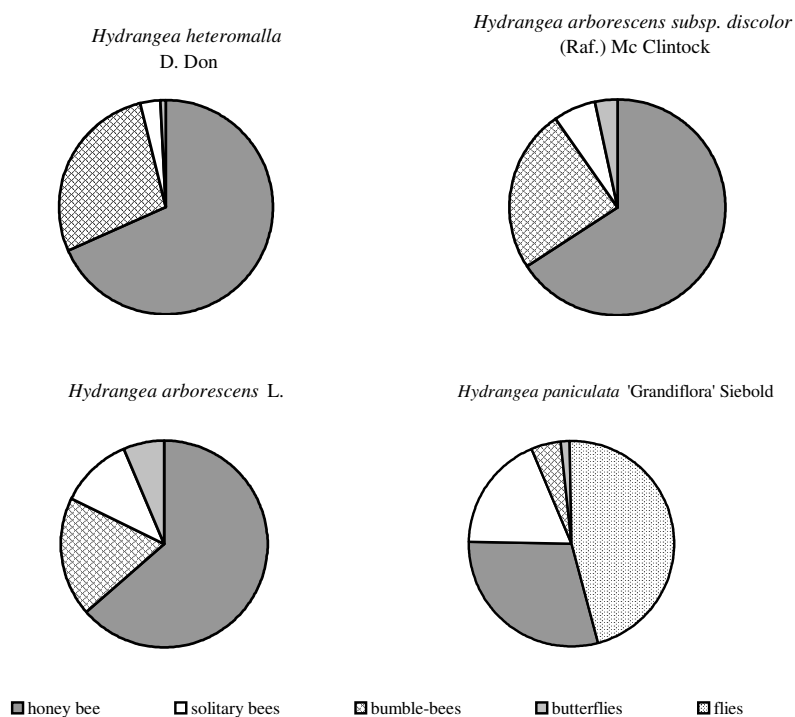


Fig. 4. The percentage participation of pollinators on flowers of investigated species of *Hydrangea* L. (average from the years of study)

Table 2. The features of pollen grains of 4 *Hydrangea* species

Species	Year	Viability %	Length of axis – $\mu\text{m}$		Shape P/E
			Polar	Equatorial	
<i>Hydrangea heteromalla</i> D. Don	2003	80.4	15.0	10.0	1.5
	2004	91.2	17.5	12.5	1.4
	Mean	85.8	16.3	11.3	1.4
<i>Hydrangea arborescens</i> ssp. <i>discolor</i> (Raf.) Mc Clintock	2001	91.4	15.0	10.0	1.5
	2003	82.7	13.3	9.1	1.5
	2004	90.5	12.5	10.0	1.3
Mean	88.2	13.6	9.7	1.4	
<i>Hydrangea arborescens</i> L.	2001	90.3	15.0	10.0	1.5
	2003	89.4	15.0	10.0	1.5
	2004	93.6	17.5	10.0	1.8
Mean	91.1	15.8	10.0	1.6	
<i>Hydrangea paniculata</i> 'Grandiflora' Siebold	2003	86.4	19.0	13.5	1.4
	2004	90.5	17.5	13.5	1.3
	Mean	88.5	18.3	13.5	1.4

*H. arborescens* accounting for more than 60% of pollinators (Fig. 4). The different *Bombus* species use mainly pollen forming big pollen loads, 24.2 mg, on average. The flowers of *H. paniculata* 'Grandiflora' were foraged mainly by *Diptera* attracted by strong ammonia scent.

#### DISCUSSION

The blooming of species under examination occurred in Lublin at the time most frequently quoted in the literature, e.g. Bugała (1991). Contrary to Zientarska and Kluza (1999), sterile flowers always bloomed before fertile ones. The data concerning the diurnal dynamics of blooming are not found in the available literature. The two types of flowers found in *Hydrangea* species were characterised by different daily rhythms of blooming, which is probably connected with their function. The same dependence between different diurnal dynamic of blooming and the morphological type of flowers was previously reported by Denisow (2002) for *Chaenomeles japonica*.

Frost damage influenced the abundance of blooming. After heavy cutting bushes produced fewer flowers, at the same time low temperatures caused damage of flower buds. This tendency was especially strong in the case of *H. arborescens* ssp. *discolor* i *H. arborescens*, whose pollen efficiency in 2003 was considerably lower when compared with the other years. Under good weather conditions one can get 7–19 g of pollen from one bush of *Hydrangeas*; the amount comparable to the results obtained by Masierowska (1995) for *Deutzia* and *Philadelphus* bushes.

#### CONCLUSIONS

1. Under Lublin weather conditions the investigated *Hydrangea* species bloomed in late spring (*H. heteromalla*), in summer (*H. arborescens*, *H. arborescens* ssp. *discolor*) and in late summer (*H. paniculata* 'Grandiflora').

2. The average pollen efficiency, which is correlated positively with the number of pollen delivering fertile flowers, reaches 0.6 mg per shrub for *Hydrangea paniculata* 'Grandiflora', 7–11 g per *H. arborescens* and *H. arborescens* ssp. *discolor* and 19.7 g *H. heteromalla*.

3. *H. heteromalla*, *H. arborescens*, *H. arborescens* ssp. *discolor* can constitute an additional source of pollen flow for pollinating insects. However, in the years of bad weather conditions the amount of pollen may be considerably smaller than in good weather years.

4. *H. paniculata* 'Grandiflora' flowers, producing the lowest amount of pollen and secrete strong ammonia scent, are more attractive for *Diptera* than for *Apoidea*.

## REFERENCES

- B u g a ł a W., 1991. Drzewa i krzewy dla terenów zieleni. PWRiL, Warszawa.
- D e n i s o w B., 2002. The blooming and melliferous value of tristilous flowers of Japanese quince (*Chaenomeles japonica* Lindl.). *J. Apic. Sci.* 46: 15–22.
- H e y w o o d V. H., 1985. Flowering plants of the world. Croom Helm Publishers Ltd.: 146–148
- J a b ł o Ń s k i B., 2000. O potrzebie i możliwości poprawy pożytków pszczelich. Oddział Pszczelnictwa ISK, Puławy.
- K l u z a M., Z i e n t a r s k a A., 1999. Obserwacje fenologicznej fazy kwitnienia wybranych gatunków krzewów w Ogrodzie Dendrologicznym Akademii Rolniczej w Poznaniu. *Bibl. Fragm. Agron.*, 6: 117–124.
- M a s i e r o w s k a M., 1995. Some ornamental shrubs as food source for pollinating insects. In: *Changes in Fauna of Wild Bees in Europe*. Pedagogical Univ., Bydgoszcz: 189–200.
- S z k ł a n o w s k a K., 1995. Pollen flows of crowfoot family (*Ranunculaceae* L.) from some natural plant communities. In: *Changes in Fauna of Wild Bees in Europe*. Pedagogical Univ., Bydgoszcz: 201–214.
- S z k ł a n o w s k a K., P l u t a S., 1984. Wydajność pyłkowa sadu wiśniowego odmian Kerezer, Nefris, Łutówka. *Pszczel. Zesz. Nauk.*, 28 (1): 63–70.

## STRESZCZENIE

W latach 2001–2004 prowadzono obserwacje kwitnienia i oblotu przez owady oraz badano obfitość pylenia 4 gatunków hortensji: *Hydrangea heteromall* D. Don, *H. arborescens* L., *H. arborescens* ssp. *discolor* (Raf.) McClintock, *H. paniculata* 'Grandiflora'. Krzewy rosły w kolekcji Ogrodu Botanicznego UMCS w Lublinie. W kwiatostanach występowały dwa rodzaje kwiatów: płodne dostarczające pyłku i płone stanowiące powabnię optyczną dla owadów. Jeden krzew dostarczał przeciętnie 0,6 g pyłku (*H. paniculata* 'Grandiflora'), 7–11 g (*H. arborescens*, *H. arborescens* ssp. *discolor*), 19,7 g (*H. heteromalla*). Owadami odwiedzającymi kwiaty hortensji były przede wszystkim pszczołowate, głównie pszczoła miodna oraz trzmielie i pszczoły samotnice, tylko w przypadku *H. paniculata* dominowały muchówki.