

Kazimiera SZKLANOWSKA

The Influence of Conformation of Crabapple Flowers (*Malus Mill.*) on Their Nectar and Pollen Productivity

Wpływ budowy kwiatów jabłoni ozdobnych (*Malus Mill.*) na ich wydajność nektarową i pyłkową

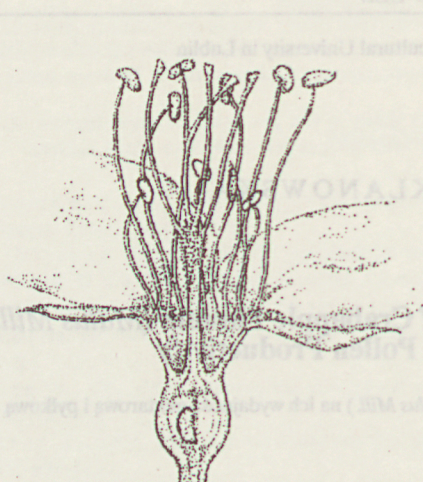
Ornamental apple trees have been investigated in Poland since 1983 in respect of their apicultural value and suitability as pollinators for fruit cultivars in production orchards (Szklanowska 1987).

Some previous experiments displayed serious morphological differences among flowers of particular cultivars. These problems were the object of studies discussed in the present paper and aimed at presentation of taxonomic data dealing with nectaries and anthers of the genus *Malus Mill.* Moreover the objective of undertaken researches was to test possible existence of any correlation between the amount of sugars secreted in nectar, abundance of pollinating and dimensions of these parts of flowers that provide insects with nectar and pollen.

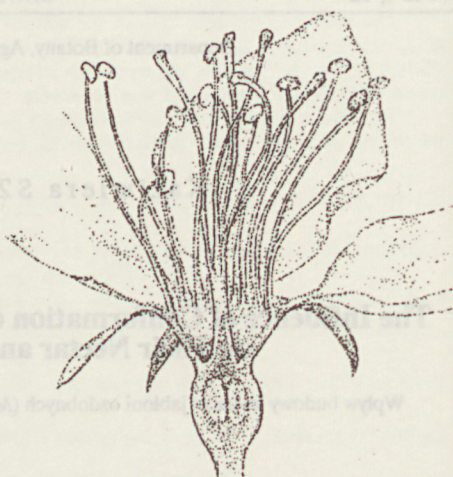
MATERIAL AND METHODS

The measurements of nectary surface were performed on the longitudinal cross-sections of fresh flowers that belong to nine ornamental cultivars of the genus *Malus* (Fig. 1a, b, c). The tissue pads the top part of torus that, in case of apple tree, is of a reversed truncated cone shape. The side surface of cone was calculated according to the formula $p = \pi \times L (r + R)$. The base of stamen was assumed a perimeter of top basis with a radius - R, a spot of styles pistils fusion a perimeter of bottom basis with radius -r and finally the length of side surface, that is a layer padding the torus - L.

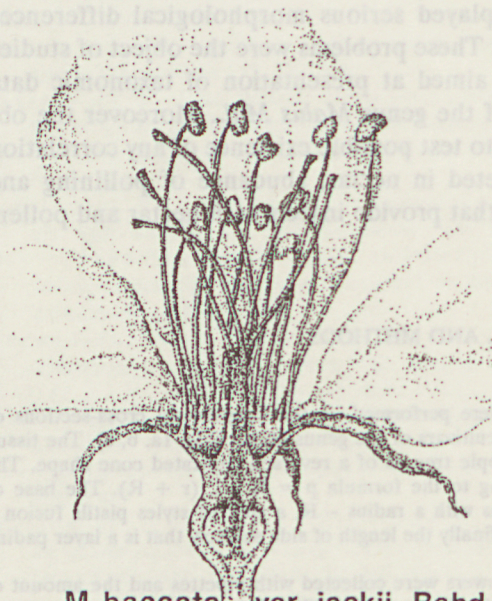
All the rations of nectar produced by flowers were collected with pipettes and the amount of sugars was stated with refractometer (Jabłoński, Szklanowska 1979). The anthers previously prepared from a fixed number of flowers were calculated, weighted in both fresh and dried state together with pollen. Afterwards pollen was rinsed away from anthers by means of ether (Warakomska 1972) and then its dry weight was established (Szklanowska 1984). The findings thus obtained were used to estimate the water content of fresh anthers and to determine mass fraction and percentage of pollen. Then sterility of pollen grains was verified by an acetocarmine - dyeing and their diameter measurements.



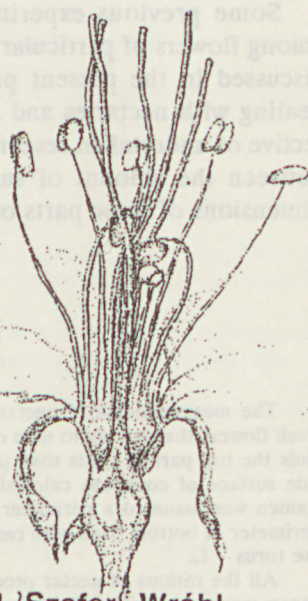
M. sieboldii
var. *arborescens* Rehd.



M. 'Wintergold' Dooren.

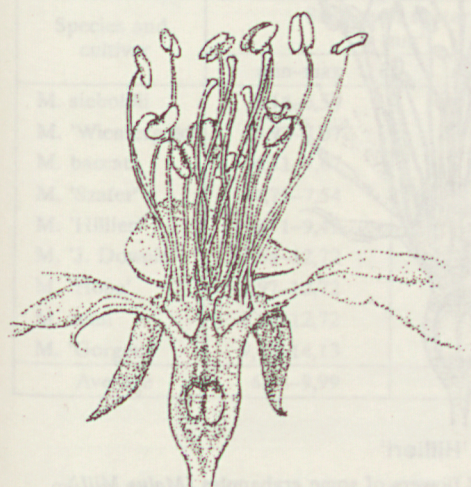


M. baccata var. *jackii* Rehd.

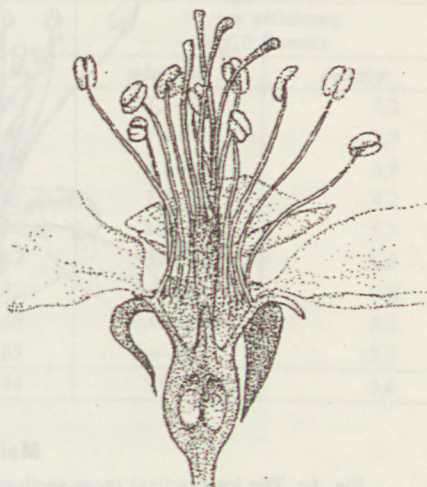


M. 'Szafer' Wróbl.

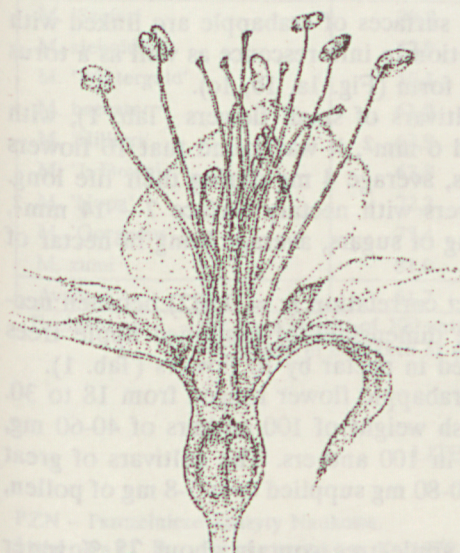
Fig. 1a. The longitudinal cross-sections of flowers of some crabapples (*Malus* Mill.)
The crabapple cultivars of flowers with the small nectary surface and small anthers weight



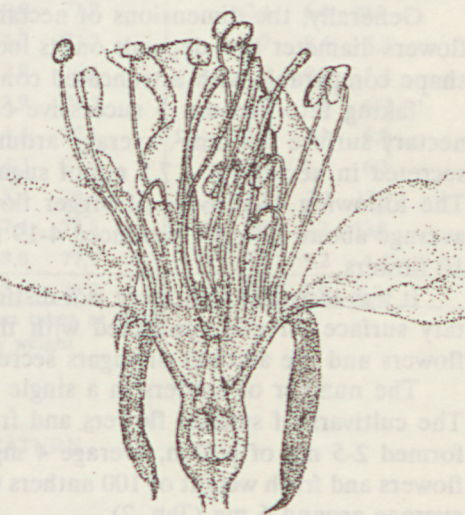
M. 'Hopa' Hansen.



M. 'Gorgeous' Boer.



M. 'John Downie'



M. zumi var. calocarpa Rehd.

Fig. 1b. The longitudinal cross-sections of flowers of some crabapples (*Malus* Mill.)
The flowers of bigger nectary surface and with the anthers of greater size



Malus 'Hillieri'

Fig. 1c. The longitudinal cross-sections of flowers of some crabapples (*Malus* Mill.)
The crabapple flower with numerous petals and anthers

RESULTS

Generally, the dimensions of nectary surfaces of crabapple are linked with flowers diameter that depends on its location in inflorescence as well as a torus shape comparable with a truncated cone form (Fig. 1a, 1b, 1c).

Taking into account 5 successive cultivars of small flowers (Tab. 1), with nectary surface 3-9 mm², average around 6 mm², it was found that 10 flowers secreted in nectar 1,4 – 7,5 mg of sugars, average 4 mg during their life long. The following 4 cultivars of bigger flowers with nectary surface 7 – 14 mm², average about 10 mm², produced 4-19 mg of sugars, average 8 mg in nectar of 10 flowers.

It was recorded that there is a distinct correlation ($r = 0,982$) between nectary surface directly connected with the dimensions of examined apple trees flowers and the amount of sugars secreted in nectar by 10 flowers (Tab. 1).

The number of anthers in a single crabapple flower ranged from 18 to 30. The cultivars of smaller flowers and fresh weight of 100 anthers of 40-60 mg, formed 2-5 mg of pollen, average 4 mg in 100 anthers. The cultivars of great flowers and fresh weight of 100 anthers 60-80 mg supplied over 5-8 mg of pollen, average around 6 mg (Tab. 2).

It was proved that fresh anthers of apple tree contain about 75 % water while dry weight of pollen reaches 8 % on the average. The percentage of sterile grains of pollen in their total numbers in anthers of the examined apple tree was rather low 5-19 %. The diameter of pollen grains runs from 30-33 μ m. The statistical analysis demonstrated a direct correlation ($r = 0,796$) between amount of pollen produced by anthers and the total weight of anthers (Fig. 2.).

Tab. 1. Dimension of the nectary surface in the flower of ornamental *Malus* and their sugars secretion (avarage from years 1988–1991)

Species and cultivar	Surface of nectary in mm ²		Sugars efficiency mg/10 flowers	
	min-max	average	min-max	average
M. sieboldii	3,14–6,59	5,38	1,7–4,8	3,2
M. 'Wientergold'	3,92–7,07	5,63	1,4–4,5	3,0
M. baccata	4,71–7,07	5,63	1,5–4,6	3,9
M. 'Szafer'	4,71–7,54	6,35	1,7–7,2	4,2
M. 'Hillieri'	4,71–9,42	7,07	1,8–7,5	5,3
M. 'J. Downie'	7,54–12,72	9,42	3,6–7,5	6,5
M. 'Hopa'	7,97–12,72	9,42	5,6–11,5	7,6
M. zumi	8,24–12,72	10,68	4,0–14,6	8,2
M. 'Gorgeus'	9,42–14,13	11,85	5,6–19,5	10,7
Average	6,04–9,99	7,94	3,0–9,1	5,8

Tab. 2. Weight of the anthers in a flower of some ornamental *Malus* and their abundance of pollening (average from years 1988 – 1991)

Species and cultivar	Weight of 100 anthers			Pollen from 100 anthers		
	Fresh mg	Dry mg	Water %	Weight mg	Share %	Sterile %
M. 'Szafer'	39,8	9,0	77,7	2,4	6,0	19,0
M. sieboldii	42,9	11,7	72,7	3,7	8,6	5,3
M. 'Wintergold'	55,1	12,9	76,6	4,9	9,0	5,2
M. baccata	61,0	13,9	77,2	5,3	8,6	6,7
M. 'Hillieri'	62,9	14,4	77,1	5,0	7,1	6,0
M. 'J. Downie'	63,8	14,3	77,6	5,4	8,5	6,1
M. 'Hopa'	72,2	15,4	78,6	5,1	7,1	13,8
M. 'Gorgeous'	77,4	17,4	77,5	5,6	7,2	13,8
M. zumi	81,0	18,0	77,7	7,5	9,2	4,4
Avarage	61,7	13,9	76,9	5,0	7,9	8,9

Explanation – the frsch weight of 100 anthers taken as 100%
 – the pollen in mg taken as dry weight

LITERATURE

PZN – Pszczelnicze Zeszyty Naukowe.

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Szklanowska K., 1984. Wydajność pyłkowa sadu wiśniowego odmian Kerezer, Nefris i Łutówka. PZN., 28: 163-174.

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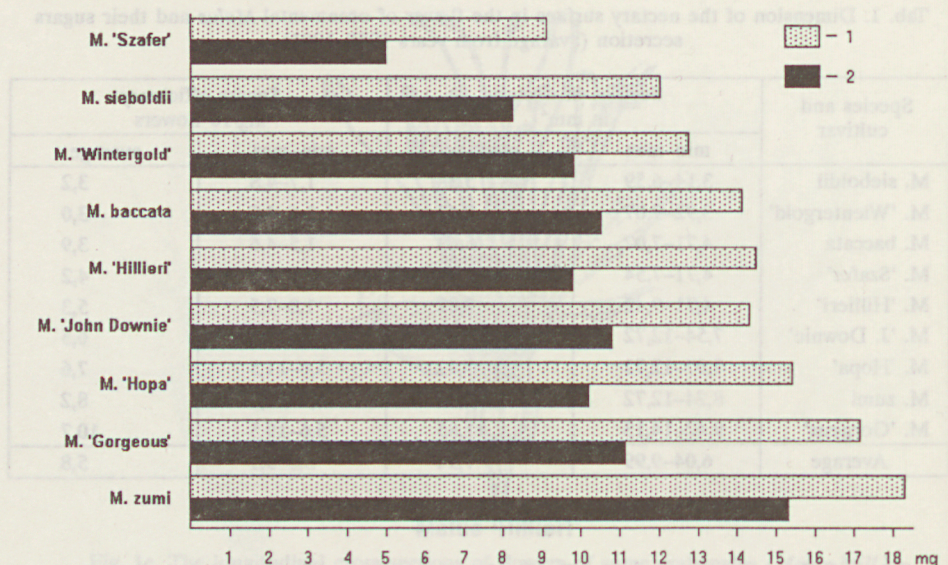


Fig. 2. The correlation between the dry weight of 100 anthers and the amount of pollen produced by 10 flowers; 1 – Weight of 100 dry anthers in mg, 2 – Yield of pollen from 10 flowers in mg

STRESZCZENIE

W latach 1989-1991 przeprowadzono badania na kwiatach 9 odmian jabłoni ozdobnych, rosnących w Ogrodzie Botanicznym UMCS w Lublinie. Na przekrojach podłużnych (ryc. 1a, b, c) wykonano wiele pomiarów powierzchni nektarnika wyścielającego górną część dna kwiatowego oraz ustalano wagowo masę 100 pylników i ilość pyłku w nich wytworzoną. Celem było zbadanie współzależności pomiędzy obfitością nektarowania i pylenia a wielkością tych części kwiatów.

Pomiary wykazały, że powierzchnia tkanki wydzielniczej u jabłoni ozdobnych zależała od wielkości i kształtu dna kwiatowego (ryc. 1). W małych kwiatach *M. sieboldii* i *M. Wintergold* nektarnik miał często powierzchnię nieco ponad 3 mm², a w dużych kwiatach odmiany "Gorgeous" sięgał 14 mm² (tab. 1). Z wielkością nektarnika skorelowana wprost ($r = 0,982$) była całkowita ilość cukru wydzielana w nektarze, która dla obu pierwszych odmian wynosiła 3 mg z 10 kwiatów, a dla ostatniej około 12 mg.

Ilość pyłku dostarczana przez kwiaty wykazała prostą korelację ($r = 0,796$) między masą produkowanego przez pylniki pyłku a ogólną masą pylników. Świeże pylniki zawierały średnio 77 % wody. Po wysuszeniu masa 100 pylników (tab. 2) wahała się od 9 mg (*M. "Szafer"*) do 18 mg (*M. zumi*), a ilość pyłku wynosiła odpowiednio 2,4 mg i 7,5 mg. Ogólnie sucha masa pyłku w pylnikach jabłoni ozdobnych stanowiła 8 % udziału.