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ANEMOPHILOUS PLANT POLLEN IN SPRING SPECIFIC HONEYS FROM THE RZESZÓW AREA

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S u m m a r y

The present study comprises pollen analyses of 23 samples of spring specific honeys collected from apiaries situated in 12 communes in the Rzeszów area during the 2005 -2006 apicultural season. Forty two pollen taxa were identified in the examined material, of which 31 nectariferous and 11 non-nectariferous anemophilous plants. Among the nectariferous plants, the highest pollen frequency was found for Brassicaceae (others) (95.7%), Rubus type (91.3%) and Prunus type (86.9%). The presence of anemophilous pollen grains was recorded in all the samples, with Poaceae reaching the highest frequency (69.8%). The frequency of over 50% was characteristic of Quercus and Rumex, while the lowest frequency (less than 10%) was recorded for Cerealia, Corylus avellana and Humulus lupulus. The highest participation was found for Quercus, whose pollen grains constituted as much as 80% of anemophilous pollen grains in a single sample. The lowest participation (below 3%) was found for Rumex, Pinus and Artemisia. Among all the taxa of pollen grains found in a single sample, Poaceae pollen reached the highest share of anemophilous pollen in a sample of honey from fruit trees (10%), whereas Quercus pollen in one honey from Brassica napus (7.8%) and in one honey from Acer (4.5%). The pollen share of the remaining anemophilous taxa in the examined honeys ranged between 0.2% and 2.9%. The identified anemophilous taxa belong to 10 botanical families. In 19 out of 23 examined samples of honeys, small indicators of honeydew were discovered.

Key words: pollen analysis of honeys, anemophilous plants, Rzeszów

INTRODUCTION

The specific flower structure of some anemophilous plants makes pollination possible both by means of wind and insects. Pollen grains of these plants are produced in an enormous quantity and they are small, dry and light, sometimes with outgrowths aiding in wind dispersal. Pollen of anemophilous plants is of considerable importance for bees, mainly because it occurs abundantly in early spring, the time of intensive development of bee colonies. Microscopic analysis often shows the presence of anemophilous plant pollen in bee products, which reflects honeybees' interest in such pollen. The presence of pollen of such plants in the honeys is mainly due to some accidental contamination.

Since the 1930's, pollen analysis of honeys was a reliable method of describing their specific variety, as well as their biological and geographical origin. In 1939 M a u r i z i o elaborated a quantitative method of pollen analysis of honeys. In Poland, microscopic examination of honeys was initiated by Demianowiczowie (1955) and was continued by various scientists, among others by Warakomska (1985, 1997, 1999), W a r a k o m s k a and J a r o s z y ń s k a (1992); W r ó b l e w s k a (2002).

MATERIALS AND METHODS

The object of this study consists of 23 samples of spring specific honeys obtained from the Rzeszów area in the years 2005-2006. The material was collected from apiaries situated in 12 communes (Tab. 1). Pollen analysis of honeys was conducted in accordance with the recommendations of the International Commission for Bee Botany (L o u v e a u x et al. 1978) and the Polish standard for bee-honey, Polska Norma PN-88/A-77626 Miód Pszczeli (1988). From each honey sample, a glycerogelatine preparation was made in two repetitions. In each of the preparations, at least 300 grains of pollen were counted in consecutive visual fields (Moar, 1985) in order to identify the bee plants and to confirm the specific variety of honeys declared by beekeepers. In case of doubt, while identifying the grains of pollen, comparative preparations and keys were used (Z a n d e r, 1935, 1937; S a w y e r, 1981, 1988; R i c c i a r d e l l i d' A l b o r e, 1998). The presence of honeydew indicators, i.e. fungi spores and fungi and algae hyphae, was also registered. The pollen ratios of nectariferous and non-nectariferous plants, including anemophilous plants, were counted for each honey sample. The pollen share of particular plant taxa was calculated for each sample, separately for the groups of nectariferous and non-nectariferous plants. Four quota groups were distinguished: dominant pollen >45%, secondary pollen 45-16%, important minor pollen 16-3% and minor pollen <3%.

RESULTS

Among the studied samples of specific honeys, 12 were from *Brassica napus*, 3 from *Acer*, 2 from *Rubus* type, 2 from *Salix*, 1 from *Robinia pseudacacia,* 1 from *Trifolium repens,* 1 from *Anthriscus* type and 1 from fruit trees. The analysis of the material identified a total of 42 pollen taxa, of which 31 from nectariferous and 11 from non-nectariferous plants. The number of nectariferous taxa found in a particular sample ranged from 5 to 23, while the number of non-nectariferous taxa ranged from 1 to 11. The highest frequency of occurrence among nectariferous pollen was detected for Brassicaceae (others) (95.7%), *Rubus* type (91.3% and *Prunus* type (86.9%). The frequency in the range of 78.3% – 70% was characteristic of pollen grains of *Trifolium repens, Aesculus* and *Brassica napus* (Tab. 2). The following shares of the dominant taxon pollen grains were found: honeys from *Brassica napus* 56.6%-90.3%, from *Acer* 46.1%-77.4%, from *Salix* 79.6%-89.0%, from *Rubus* type 74.1%-76.6%, from *Robinia pseudacacia*, *Anthriscus* type and fruit trees 48.4%-79.3%.

Pollen grains from anemophilous plants were found in all samples of honeys. The highest frequency in this group (69.8%) was recorded for Poaceae (Fig. 1). This pollen taxon was detected in 16 samples. While analyzing the share of particular anemophilous taxa, Poaceae pollen was found to have reached a dominant status in 2 samples constituting 46.1% and 56.2% of total pollen grains of anemophilous plants found in the samples. The presence of Poaceae pollen was found to be minor in only one examined sample. A frequency within the range of 56.5% – 52.2% was found for *Quercus* and *Rumex* pollen grains. *Quercus* was dominant in 6 samples reaching from 51.4% to 80%, the highest fraction among all anemophilous pollen grains present in the examined honeys. The dominant pollen status was also reached by *Pinus* pollen grains in two samples and Chenopodiaceae pollen in one sample. The lowest frequency, less than 10%, was found for *Cerealia, Corylus avellana* and *Humulus lupulus* (Fig. 1). Apart from a minor contribution of Poaceae pollen in one sample, a similar contribution level was noted for *Rumex* (2.8% in 1 sample), *Pinus* (1.8% in 1 sample) and *Artemisia* (1.5% in 2 samples) (Fig. 1).

Table 3 illustrates the spectrum of pollen taxa of anemophilous plants in the examined specific honeys. The highest contribution in a sample was reached by Poaceae pollen grains in honey from fruit trees (10%), *Quercus* in one honey from *Brassica napus* (7.8%) and one honey from *Acer* (4.5%). The pollen shares of the remaining anemophilous taxa ranged from 0.2% to 2.9% (Tab. 3). In honeys from *Brassica napus*, the highest

Table 1
Localities and communes of honey samples collection.

Locality (sample no)	District
Bircza (1)	Bircza
Boguchwała (6)	Boguchwała
Poręby Dymarskie (1)	Cmolas
Wilcza Wola (1)	Dzikowiec
Grębów (1)	Grębów
Olszany (1)	Krasiczyn
Majdan Królewski (3)	Majdan Królewski
Nowa Dęba (4)	Nowa Dęba
Przemyśl (1)	Przemyśl
Trzebuska (1)	Sokołów Małopolski
Ustrzyki Dolne (2)	Ustrzyki Dolne
Zbydniów (1)	Zaleszany

Table 2
Pollen taxa identified in examined honeys from the Rzeszów area.

Taxa (in declining frequency order)	Frequency (%)	Pollen participation in samples (%)
Brassicaceae (others), *Rubus* type, *Prunus* type	95.7 – 86.9	0.2 – 76.6
Trifolium repens, Aesculus, Brassica napus, Poaceae (others)*	78.3 – 70.0	0.2 – 90.3
Anthriscus type*, Frangula alnus, Salix, Quercus*, Rumex*,* Caryophyllaceae, *Malus* type	56.5 – 43.5	0.2 – 89.2
Achillea type*, Lotus, Phacelia, Tilia, Centaurea cyanus, Taraxacum* type*, Trifolium pratense, Artemisia*, Cirsium* type*, Fagopyrum, Robinia pseudacacia, Solidago* type*, Pinus**	39.1 – 30.0	0.2 – 79.3
Acer, Aster type*, Medicago, Viola tricolor* type*, Betula*, Calluna, Heracleum* type*, Impatiens, Polygonum bistorta, Cyperaceae*, Crataegus, Lamium* type*, Melilotus, Chenopodiaceae**	21.7 – 13.0	0.2 – 77.4
Acer platanoides, Allium type, Cynoglossum, Galeopsis, Phaseolus, Sedum, Verbascum, Boraginaceae, *Centaurea jacea* type, *Cornus, Galium, Helianthus* type, Malvaceae, *Myosotis, Polygonum persicaria* type, *Symphytum, Syringa, Vicia* type, *Cerealia*, Corylus avellana*, Humulus lupulus**	8.7 – 4.3	0.2 – 5.7

* non-nectariferous anemophilous plants

Tabele 3
Share of anemophilous pollen (%) in the microscopic image of specific honeys.

Taxon	Type of honey (no. of samples)							
	Brassica napus (12)	*Acer* (3)	*Rubus* type (2)	*Salix* (2)	*Robinia pseudacacia* (1)	*Trifolium repens* (1)	From fruit trees (1)	*Anthriscus* type (1)
Poaceae (others)	0.2-2.9	–	0.5	0.8	1.6	1.1	10.0	0.9
Quercus	0.2-7.8	1.9-4.5	–	2.8	–	0.9	1.1	–
Rumex	0.2-1.7	0.2	0.8	–	1.9	–	–	2.5
Artemisia	0.2-0.7	0.3	–	–	0.8	–	–	0.2
Pinus	0.2-1.4	3.2	–	–	–	–	–	–
Betula	0.2-0.3	1.6	–	0.3	–	–	–	–
Cyperaceae	0.3-1.6	–	–	0.3	–	–	–	–
Chenopodiaceae	–	–	–	0.6	1.6	–	2.2	–
Cerealia	–	–	–	–	0.3	–	–	–
Corylus avellana	0.9	0.2	–	–	–	–	–	–
Humulus lupulus	0.7	–	–	–	–	–	–	–
No. of taxa in the samples	9	6	2	5	5	2	3	3

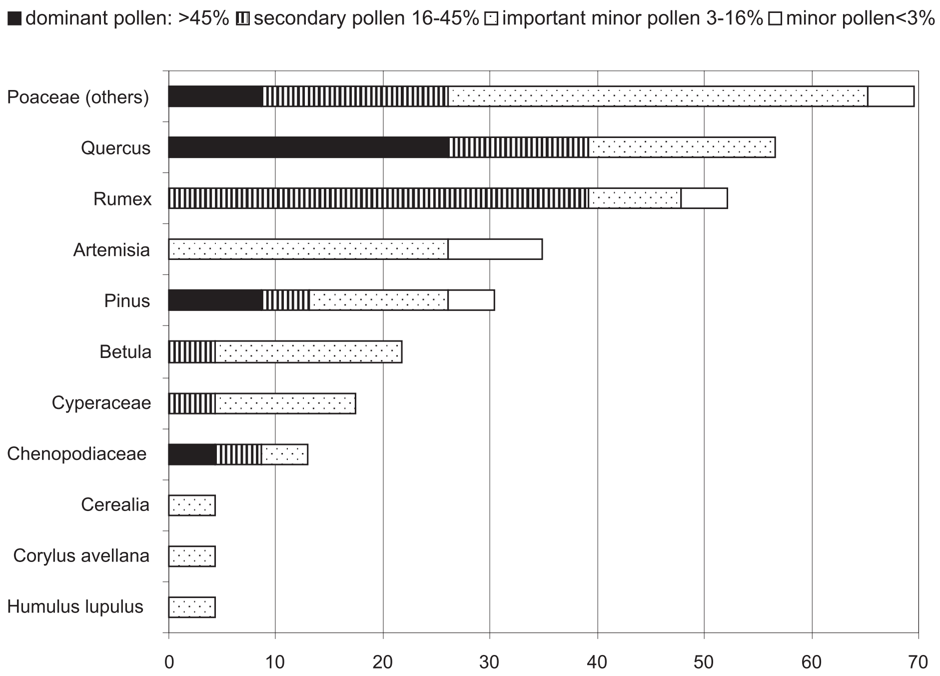

Fig. 1. Anemophilous pollen frequency and its share in non-nectariferous pollen spectrum (%).

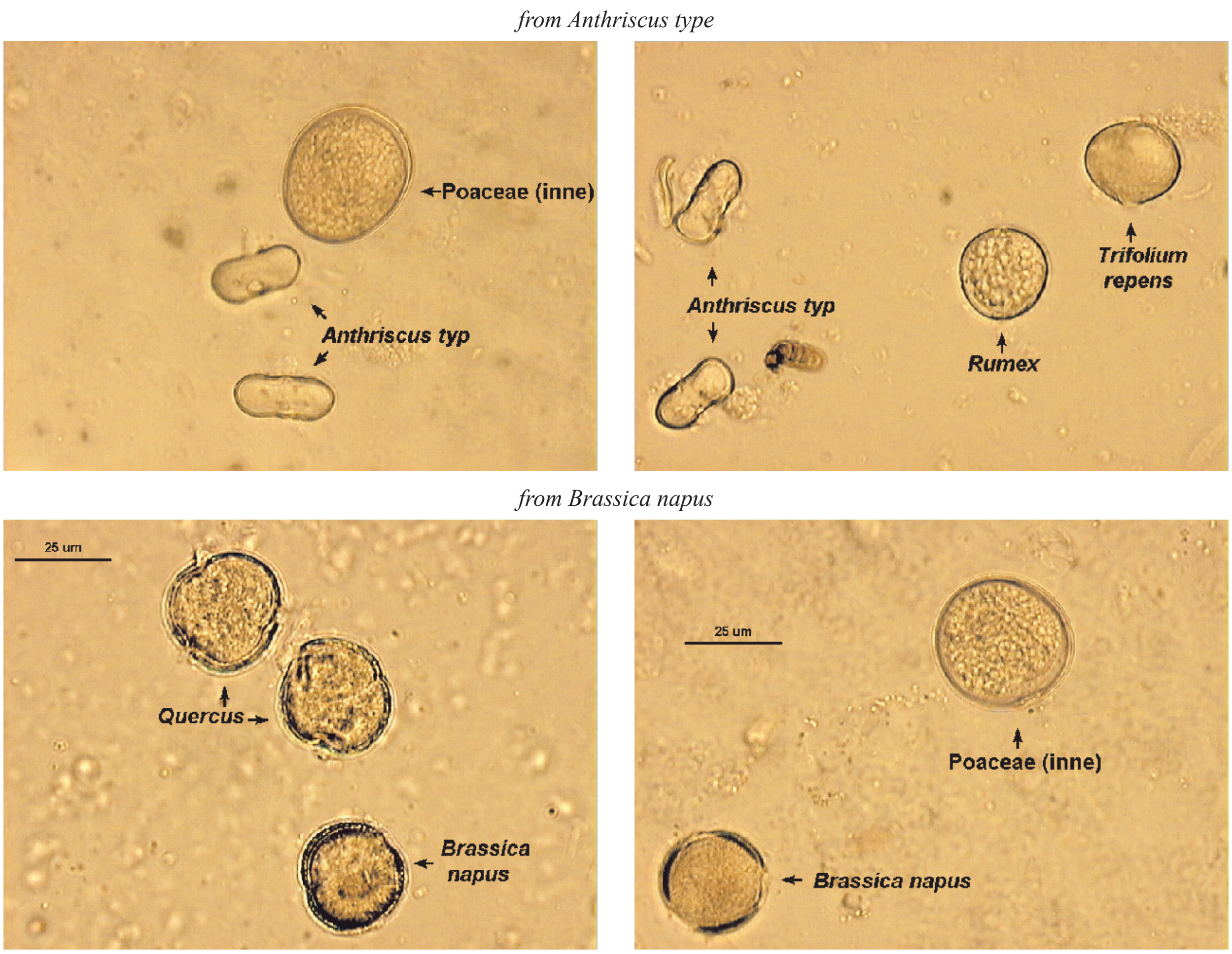

Fig. 2. Microscope image of some chosen honeys.

frequency was shown by Poaceae pollen (83.3%) and *Quercus* (75%), while in honeys from *Acer* – *Quercus* pollen (66.7%). The widest diversity of anemophilous pollen grains was found in honeys from *Brassica napus* and *Acer*. Fragments of microscope images of some chosen honeys are presented in Fig. 2.

Anemophilous pollen grains identified in the examined samples of honeys belong to 10 botanical families: Asteraceae, Betulaceae, Cannabaceae, Chenopodiaceae, Corylaceae, Cyperaceae, Fagaceae, Pinaceae, Poaceae, Polygonaceae. Only within the family Poaceae, 2 taxa were distinguished, namely *Cerealia* and Poaceae (others). On the other hand, pollen grains of nectariferous plants found in the examined honeys belong to 27 botanical families, with Asteraceae and Fabaceae being the most frequently represented.

Indicators of honeydew were found in 19 out of 23 samples of honeys. The honeydew indicator level was small in most samples ranging from 0.01 to 0.21 in honeys from *Brassica napus*, and in the remaining honeys between 0.01 and 1.34. Only in the honey from fruit trees, this indicator reached an average level of 2.2.

DISCUSSION

Pollen analysis revealed the presence of anemophilous pollen grains in all honey samples. One characteristic of anemophilous plants is that they produce huge quantities of pollen and that explains its presence in honeys, particularly when bees use it in case of scarcity of better flow. The nutritive value of anemophilous pollen is smaller in comparison with entomophilous plants, as noted by Maurizio (1951). Among anemophilous plants, the author included pollen of *Populus*, *Fagus*, *Acer*, *Ulmus* and *Zea mays* in an average value group, while pollen of *Corylus avellana*, *Betula*, *Alnus*, *Carpinus*, *Pinus*, *Abies* and *Picea* in a low value group. The role of anemophilous pollen for bees was also studied by Stawiarz (2005).

The present study has shown that Poaceae pollen has the highest frequency in comparison with other anemophilous pollen found in the examined samples. Similar results were obtained by other authors, e.g. Warakomska (1985), when analyzing bee products from Jeleniogórska Valley, Wróblewska (2002) in honeys from Biała Podlaska, Stawiarz (2006) in honeys from Świętokrzyskie Voivodship. Pollen loads with Poaceae gathered and formed by honeybees are light yellow and weigh 6.9 – 7.3 mg. During the high season of grass flowering, the amount of grass pollen in daily pollen loads may reach even 80% (Maurizio and Grafl, 1969). Pollen analysis of spring specific honeys from the Rzeszów area revealed a frequency of over 50% for *Quercus* and *Rumex* pollen grains. These plants are also frequently visited by bees collecting pollen. *Rumex* pollen was abundantly represented in the pollen spectrum of honeys from the Podlasie Region, reaching even over 45 % in one sample (Wróblewska, 2002). A high frequency of Poaceae, *Quercus* and *Rumex* pollen grains in examined honeys was noted by Wróblewska and Stawiarz (2004). Additionally, pollen of *Artemisia*, Chenopodiaceae and *Betula* recorded in specific honeys of the Rzeszów area was also found present in honeys and pollen loads studied by Warakomska (1999). The same author found a high frequency of *Artemisia* and the presence of Chenopodiaceae in multifloral honeys of Lubelskie Voivodship as well as a high share of *Artemisia* pollen in pollen loads gathered in the Puławy town area. Pollen grains of *Artemisia,* whose flowering season is in summer, found in the examined spring honeys must have come from previous year's supplies of bee bread. Warakomska (1997) recorded *Betula* pollen in honeys from Lubelskie Voivodship and from Jeleniogórska Valley (1985). Wróblewska (2002) recorded *Betula* pollen in honeys from Podlasie region. Maurizio (1951) reported a very beneficial influence of *Betula* pollen on bee health and longevity. The flowering period for *Betula* lasts from the end of March till May and one stamen can release as much as ten thousand of pollen grains. Pollen loads with *Betula* are of yellow colour (Maurizio and Grafl, 1969). The majority of anemophilous pollen grains examined in the present paper have also been observed in honeys described by other authors in this country and abroad. The results of the present study of spring specific honeys have confirmed bees' interest in anemophilous pollen, among which Poaceae, *Quercus* and *Rumex* have been found to be of particular importance. Pollen grains of *Cerealia*, *Corylus* and *Humulus lupulus* have been much less frequent in the examined honeys, which may be explained by the bees paying less interest in pollen of these plants. The present study, as well as the results obtained by other authors, confirms that pollen of anemophilous plants constitutes an important source of pollen flow for bees.

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Pyłek roślin wiatropylnych w wiosennych miodach odmianowych okolic Rzeszowa

Streszczenie

Analizie pyłkowej poddano 23 próbki wiosennych miodów odmianowych okolic Rzeszowa, zebranych w latach 2005-2006 z pasiek zlokalizowanych na terenie 12 gmin. W badanym materiale wyróżniono ziarna pyłku 42 taksonów, w tym 31 z roślin nektarodajnych i 11 z nienektarodajnych wiatropylnych. Wśród roślin nektarodajnych najwyższą frekwencję osiągnęły Brassicaceae (inne) (95,7%), *Rubus* typ (91,3%) i *Prunus* typ (86,9%). We wszystkich próbkach obecne były ziarna pyłku roślin wiatropylnych, wśród których najwyższą frekwencję (69,8%) osiągnęły Poaceae. Ponad 50% frekwencją charakteryzowały się ziarna pyłku *Quercus* i *Rumex*, zaś najniższą (poniżej 10%) uzyskały *Cerealia, Corylus avellana* i *Humulus lupulus*. Najwyższy udział wykazały ziarna pyłku *Quercus*, które w jednej próbce osiągnęły aż 80% udziału wśród roślin wiatropylnych. Najniższy udział poniżej 3% uzyskały *Rumex*, *Pinus* i *Artemisia.* Natomiast najwyższy udział pyłku roślin wiatropylnych wśród wszystkich taksonów w całej próbce osiągnęły Poaceae w miodzie z drzew owocowych (10%), oraz Quercus w jednym miodzie z *Brassica napus* (7,8%) i w jednym miodzie z *Acer* (4,5%). Udział pyłku pozostałych taksonów wiatropylnych w badanych miodach zawierał się w granicach 0,2%-2,9%. Zidentyfikowane taksony roślin wiatropylnych należały do 10 rodzin botanicznych. W 19 z 23 próbek miodów obecne były nieliczne wskaźniki spadzi.