

## The occurrence of hoverflies (Syrphidae) on flowers in the Botanic Garden of the Jagiellonian University in Kraków

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### ABSTRACT

The study on the Syrphidae fauna was conducted in the years 2008-2009 in the Botanic Garden of the Jagiellonian University in Kraków. Hoverflies were collected from flowers with a sweeping net, using the method of hand collecting at a specific time, beginning to collect samples in the mid of May and finishing in the mid of August. In total, 545 hoverflies from the family Syrphidae were collected, belonging to 40 species which represented 5 trophic groups (predators, saprophages, phytophages, parasites and coprophages). Over 45% of the collected specimens, i.e. 247 individuals representing 24 species, were hoverflies whose larvae were predatory. Among the predatory species the most numerous was *Episyrphus balteatus* (De Geer, 1776) – 30%, followed by *Sphaerophoria scripta* (Linnaeus, 1758) – 22.3%, *Eupeodes corollae* (Fabricius, 1794) – 12.5%, *Syrphus ribesii* (Linnaeus, 1758) – 6.5% and *Sphaerophoria rueppelli* (Wiedemann, 1830) – 4.8%. The hoverflies were collected from 44 plant species, both shrubs and herbaceous plants. The most attractive shrub for the predatory Syrphidae was tamarisk *Tamarix* sp. Among herbaceous plants the most attractive were bitter candytuft (*Iberis amara* L.), creeping madwort (*Alyssum repens* Baumg.), and peppermint (*Mentha piperita* L.).

**KEY WORDS:** Syrphidae, attractiveness of flowers, urban greenery

## INTRODUCTION

According to many researchers, the significance of piercing and sucking insects, mainly Aphidoidea, is increasing in cities (BANASZAK & KASPRZAK, 1978; KAROLEWSKI, 1981; PISARSKI & TROJAN, 1976; CICHOCKA & GOSZCZYŃSKI, 2008; BOROWIAK-SOBKOWIAK & WILKANIEC, 2010). A crucial role in limiting their numbers is played by predatory larvae of hoverflies, especially considering the fact that, as has been discovered by GOSPODAREK (2007), the level of urban pollution does not directly affect the numerosity of these larvae. In the course of its development lasting 10-14 days, a hoverfly larva may eat from 200 to 1000 aphids, depending on a hoverfly species and an aphid species (WNUK, 1979; WNUK & FUSCH, 1977). Basic diet ingredients of adult hoverflies, which determine their fertility, are flower pollen and nectar (WNUK, 2005), thus the availability of flowering plants is a condition which has to be fulfilled in order to maintain a population of these useful insects in an urban ecosystem. A rational activity to undertake in the sphere of plant protection is to arrange their surroundings in a way which would encourage the presence of as large a number of entomophages as possible. Large parks, especially ones where old-growth forest is abundant, have a special ecological value in urban areas (TROJAN & WINIARSKA, 2001), since in these parks stable insect communities can develop, rich with regard to a number of species (including useful ones), which can penetrate various areas of a city.

The aim of the present study has been to specify the species composition of hoverflies in the Botanic Garden in Kraków and to discover which plants grow flowers that they visit the most willingly.

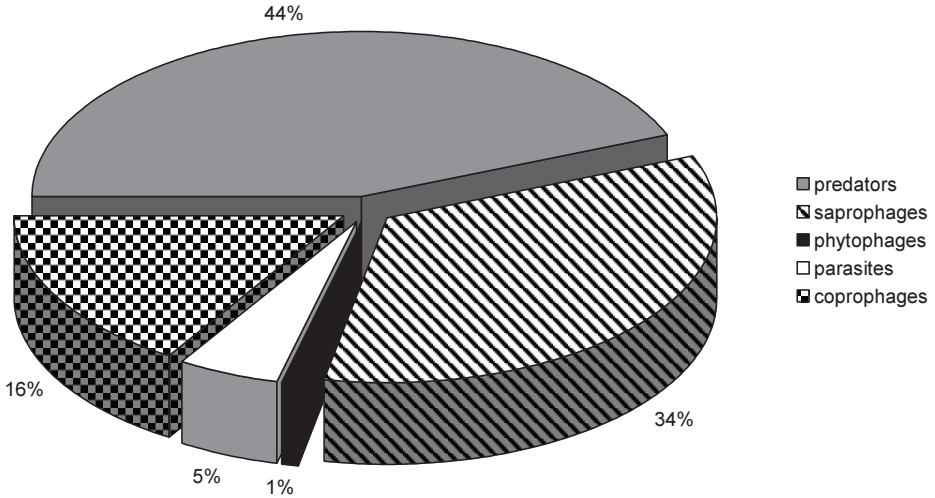
## MATERIAL AND METHODS

The study was conducted in the years 2008-2009 in the Botanic Garden of the Jagiellonian University in Kraków. In 2008 the observations were conducted from 14 May to 7 August (6 observations in total), and in 2009 they were conducted from 13 May to 14 August (7 observations), on days with good weather and no rain, between 10 a.m. and 3.30 p.m. The hoverflies were collected from flowers with a sweeping net, using the method of hand collecting at a specific time (WNUK *et al.*, 2009). Flowering plants were observed by the researchers in the Botanic Garden. If hoverflies were spotted on them, all specimens that appeared during the period of 20 minutes were collected. If no hoverflies were spotted on a plant for 10 minutes, the plant was not observed any longer. The hoverflies collected from the flowers were identified according to the key proposed by BAŃKOWSKA (1963), and the names of species were given after SOSZYŃSKI (1991).

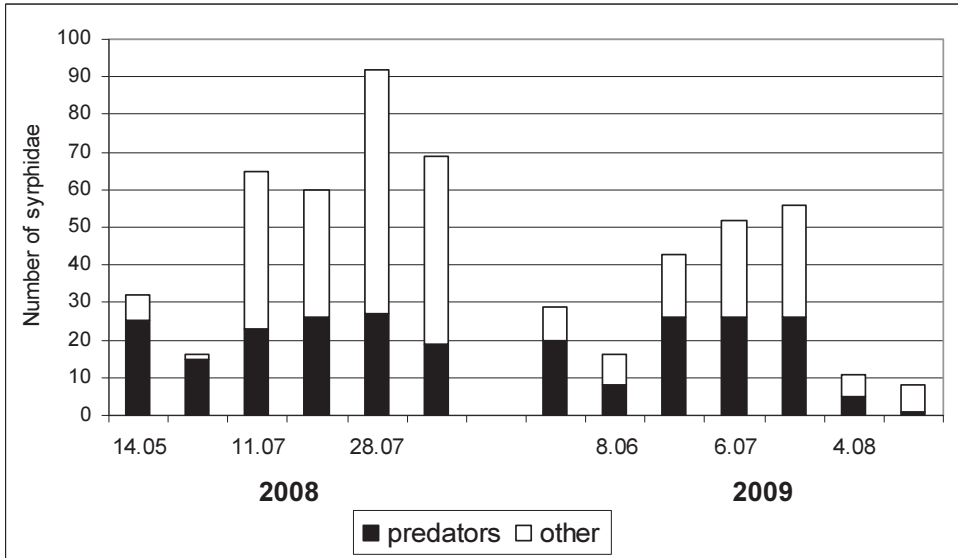
## RESULTS AND DISCUSSION

In the years 2008-2009, there were collected from flowers 545 hoverflies of the family Syrphidae, belonging to 40 species which represented 5 trophic groups (predators, saprophages, phytophages, parasites and coprophages) (Tab. 1). This constitutes 10% of 395 species which were recorded in Poland by SOSZYŃSKI (2007). About one third of this number comprises species feeding on aphids, scale insects and small caterpillars. Among the species recorded during the research conducted in the Botanic Garden, 24 species whose larvae were predatory comprised 60% of the total number of specimens. The numbers of representatives in particular groups are displayed in Figure 1. Apart from predatory species, 11 saprophagous species were recorded (among which *Eristalis tenax* (Linnaeus, 1758) was the most numerous one), 3 parasitic species representing the genus *Volucella*, one phytophagous species – *Merodon equestris* (Fabricius, 1794) and one coprophagous species – *Syritta pipiens* (Linnaeus, 1758). TRZCIŃSKI (2008), conducting the study on the Syrphidae fauna inhabiting urban greenery in the city of Poznań, recorded 51 predatory species. In the course of all observations both predatory species and other species were collected (Fig. 2). Among the predatory Syrphidae (247 individuals), the most numerously represented was *Episyrphus balteatus* (De Geer, 1776) – 30% of the total, followed by *Sphaerophoria scripta* (Linnaeus, 1758) – 22.3%, *Eupeodes corollae* (Fabricius, 1794) – 12.5%, *Syrphus ribesii* (Linnaeus, 1758) – 6.5% and *Sphaerophoria rueppelli* (Wiedemann, 1830) – 4.8% (Fig. 3.). These species play an enormously important role in limiting the number of aphids on vegetables, both in orchards and on ornamental plants. Information on aphidophagous hoverflies in aphids colonies on ornamental shrubs can be found in the studies by ZIARKIEWICZ & KOZŁOWSKA (1973), JAŚKIEWICZ (1996), CICHOCKA *et al.* (1998), WNUK & GOSPODAREK (1999), WNUK (2000, 2004), SŁAWIŃSKA & JAŚKIEWICZ (2004), WOJCIECHOWICZ-ŻYTKO (2004, 2009), GOSPODAREK (2008). In many of these studies *Episyrphus balteatus* was identified as a dominant species. According to WNUK (1979), its larvae, in the course of their life, eat from 200 to 566 aphids. Also studies conducted in other countries confirm the crucial significance of hoverflies (with the dominant species – *E. balteatus*) in limiting the population of aphids in an urban environment (MIZUNO *et al.*, 1997).

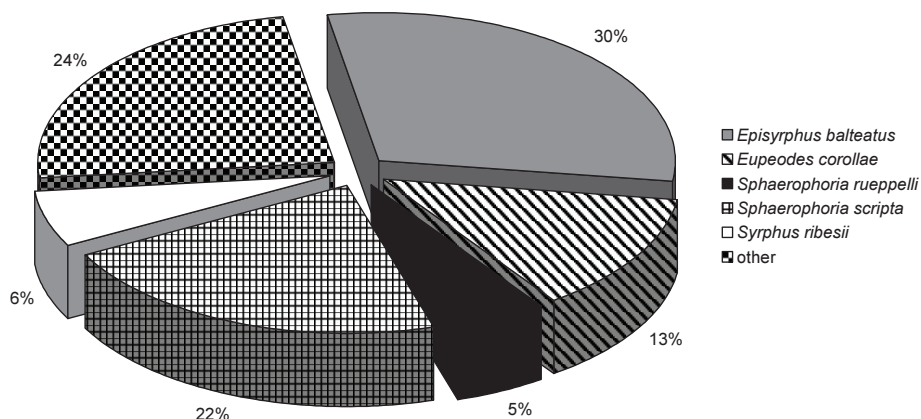
In the studies of a number of authors (KIENEGGER *et al.*, 2003; NAWROCKA, 2006; JANKOWSKA, 2007) can be found a confirmation that the effectiveness of predatory hoverflies may be increased by attracting adult hoverflies to agroecosystems. There have also been conducted studies attempting to discover which flowers are found the most attractive by hoverflies and might be used for this purpose (COLLEY & LUNA, 2000; AMBROSINO *et al.*, 2006; KELM *et al.*, 2009), as well as studies attempting to estimate the attractiveness of particular selected plant species (KELM *et al.*, 2007; WNUK *et al.*, 2009).



**Figure 1.** Share of particular trophic groups of hoverflies (Syrphidae) in the investigated habitat (2008-2009)



**Figure 2.** The occurrence of Syrphidae in the Botanic Garden of the Jagiellonian University (2008-2009)



**Figure 3.** Percentage share of the aphidophagous Syrphidae on flowers in the Botanic Garden of the Jagiellonian University (2008-2009)

In the Botanic Garden hoverflies were collected from 44 plant species: several shrubs and a number of herbaceous plants (Tab. 2.). In spring, shrubs were especially important: barberries, firethorn, *Spiraea* spp. and cherry laurel. On a majority of shrubs only predatory species were collected in May (Tab. 2). It was discovered that the most attractive plant for predatory Syrphidae was tamarisk *Tamarix* sp. On its flowers, apart from hoverflies (88 specimens in total, including 36 predatory ones) many other insects were observed, e.g. flies, beetles and representatives of the Hymenoptera, including Ichneumonidae. Among herbaceous plants the ones which were found the most attractive by hoverflies included bitter candytuft *Iberis amara*, creeping madwort *Alyssum repens*, and peppermint *Mentha piperita* (Tab. 2). In the study conducted by KELM *et al.* (2009), it was the peppermint which turned out to be the most attractive plant to hoverflies out of the total number of 13 studied herbs. Peppermint produces vast numbers of easily accessible flowers. Candytuft and alyssum are very suitable in the role of border plants and should be taken into account while planting flower beds or flower bowls within the city. The attractiveness of these plants can be further enhanced by the colour of their flowers. COWGILL (1989), studying many wildly growing plants drew a conclusion that those with yellow and white flowers were the most attractive.

**Table 1.** Species composition and number of hoverflies (Syrphidae) recorded in Botanic Garden in Kraków

Species	Trophic group*	2008		2009		Total	
		No	[%]	No	[%]	No	[%]
<i>Baccha elongata</i> (Fabricius, 1775)	D	1	0.3	0	0	1	0.2
<i>Chrysotoxum bicinctum</i> (Linnaeus, 1758)	D	5	1.5	3	1.4	8	1.5
<i>Chrysotoxum festivum</i> (Linnaeus, 1758)	D	1	0.3	0	0	1	0.2
<i>Chrysotoxum vernale</i> (Loew, 1841)	D	1	0.3	2	1	3	0.5
<i>Dasysyrphus albostrigatus</i> (Fallén, 1817)	D	3	0.9	1	0.4	4	0.7
<i>Epistrophe eligans</i> (Harris, 1780)	D	1	0.3	2	1	3	0.5
<i>Episyrphus balteatus</i> (De Geer, 1776)	D	38	11.6	36	16.6	74	13.6
<i>Eristalis alpina</i> (Panzer, 1798)	S	3	0.9	1	0.4	4	0.7
<i>Eristalis arbustorum</i> (Linnaeus, 1758)	S	11	3.5	3	1.4	14	2.6
<i>Eristalis cryptarum</i> (Fabricius, 1794)	S	0	0	7	3.3	7	1.3
<i>Eristalis horticola</i> (De Geer, 1776)	S	4	1.2	5	2.3	9	1.7
<i>Eristalis interrupta</i> (Poda, 1761)	S	1	0.3	1	0.4	2	0.4
<i>Eristalis rupium</i> Fabricius, 1805	S	1	0.3	1	0.4	2	0.4
<i>Eristalis tenax</i> (Linnaeus, 1758)	S	86	26.2	33	15.2	119	21.8
<i>Eupeodes corollae</i> (Fabricius, 1794)	D	15	4.6	16	7.4	31	5.7
<i>Eupeodes lapponicus</i> (Zetterstedt, 1838)	D	1	0.3	2	1	3	0.5
<i>Eupeodes latifasciatus</i> (Marcquart, 1829)	D	3	0.9	1	0.4	4	0.7
<i>Eupeodes luniger</i> (Meigen, 1822)	D	1	0.3	2	1	3	0.5
<i>Helophilus hybridus</i> (Loew, 1846)	S	5	1.5	1	0.4	6	1.1
<i>Helophilus pendulus</i> (Linnaeus, 1758)	S	1	0.3	1	0.4	2	0.4
<i>Helophilus trivittatus</i> (Fabricius, 1805)	S	1	0.3	1	0.4	2	0.4
<i>Melanostoma mellinum</i> (Linnaeus, 1758)	D	1	0.3	0	0	1	0.2
<i>Melanostoma scalare</i> (Fabricius, 1794)	D	1	0.3	1	0.4	2	0.4
<i>Merodon equestris</i> (Fabricius, 1794)	F	1	0.3	2	1	3	0.5
<i>Myathropa florea</i> (Linnaeus, 1758)	S	11	3.5	6	2.8	17	3.1
<i>Paragus bicolor</i> (Fabricius, 1794)	D	1	0.3	1	0.4	2	0.4
<i>Platycheirus albimanus</i> (Fabricius, 1781)	D	1	0.3	0	0	1	0.2
<i>Platycheirus discimanus</i> (Loew, 1871)	D	1	0.3	1	0.4	2	0.3
<i>Scaeva pyrastris</i> (Linnaeus, 1758)	D	4	1.2	1	0.4	5	1
<i>Scaeva selenitica</i> (Meigen, 1822)	D	1	0.3	1	0.4	2	0.4
<i>Sphaerophoria menthastri</i> (Linnaeus, 1758)	D	1	0.3	2	1	3	0.5
<i>Sphaerophoria rueppelli</i> (Wiedemann, 1830)	D	6	1.8	6	2.8	12	2.2
<i>Sphaerophoria scripta</i> (Linnaeus, 1758)	D	34	10.4	21	9.7	55	10
<i>Syrirta pipiens</i> (Linnaeus, 1758)	K	55	16.8	30	13.8	85	15.6
<i>Syrphus ribesii</i> (Linnaeus, 1758)	D	9	2.7	7	3.3	16	2.9
<i>Syrphus torvus</i> Osten-Sacken, 1875	D	2	0.6	3	1.4	5	1
<i>Syrphus vitripennis</i> Meigen, 1822	D	3	0.9	3	1.4	6	1.1
<i>Volucella inanis</i> (Linnaeus, 1758)	P	7	2.1	10	4.6	17	3.1
<i>Volucella pellucens</i> (Linnaeus, 1758)	P	4	1.2	1	0.4	5	1
<i>Volucella zonaria</i> (Poda, 1761)	P	2	0.6	2	1	4	0.7
Total		328	100	217	100	545	100

\* D - predators, S - saprophages, F - phytophages, P - parasites, K - coprophages

**Table 2.** Number of adult hoverflies (Syrphidae) visiting flowering plants in Botanic Garden in Kraków

Flower	Trophic group*										Total
	D		S		F		P		K		
	No	[%]	No	[%]	No	[%]	No	[%]	No	[%]	
<i>Achillea clypeolata</i> Sibth. et. Sm.	6	100	-	-	-	-	-	-	-	-	6
<i>Ageratum</i> sp.	8	72.7	3	27.3	-	-	-	-	-	-	11
<i>Allium montanum</i> F.W. Schmidt	2	6.7	18	60	1	3.3	8	26.7	1	3.3	30
<i>Allium pyrenaicum</i> Costa et Vayr.	2	33.3	1	16.7	-	-	3	50	-	-	6
<i>Allium ursinum</i> L.	-	-	8	88.9	-	-	1	11.1	-	-	9
<i>Alyssum repens</i> Baumg.	19	86.4	-	-	-	-	-	-	3	13.6	22
<i>Anthriscus sylvestris</i> (L.) Hoffm.	9	90	1	10	-	-	-	-	-	-	10
<i>Arnica montana</i> L.	3	100	-	-	-	-	-	-	-	-	3
<i>Aster pyrenaicus</i> Desf. ex. DC.	1	25	2	50	-	-	-	-	1	25	4
<i>Berberis</i> sp.	2	100	-	-	-	-	-	-	-	-	2
<i>Calendula officinalis</i> L.	1	9.1	10	90.9	-	-	-	-	-	-	11
<i>Cheiranthus cheiri</i> L.	3	60	2	40	-	-	-	-	-	-	5
<i>Chrysanthemum multicaule</i> Desf	2	26.6	5	71.4	-	-	-	-	-	-	7
<i>Convolvulus arvensis</i> L.	3	60	-	-	-	-	-	-	2	40	5
<i>Coreopsis verticillata</i> L.	4	13.3	23	76.7	2	6.7	1	3.3	-	-	30
<i>Dianthus praecox</i> W. et K.	3	100	-	-	-	-	-	-	-	-	3
<i>Eryngium maritimum</i> L.	3	75	1	25	-	-	-	-	-	-	4
<i>Eryngium planum</i> L.	-	-	6	46.2	-	-	4	30.8	3	23	13
<i>Euphorbia marginata</i> Pursh	6	42.9	8	57.1	-	-	-	-	-	-	14
<i>Foeniculum vulgare</i> Miller	6	75	-	-	-	-	-	-	2	25	8
<i>Gypsophila paniculata</i> L.	1	4.8	-	-	-	-	-	-	20	95.2	21
<i>Hosta lancifolia</i> Engl.	3	100	-	-	-	-	-	-	-	-	3
<i>Iberis amara</i> L.	24	68.6	2	5.7	-	-	2	5.7	7	20	35
<i>Iberis sempervirens</i> L.	8	50	5	31.3	-	-	-	-	3	18.7	16
<i>Lobularia maritima</i> (L.)Desv.	5	71.4	2	28.6	-	-	-	-	-	-	7
<i>Lonicera tatarica</i> L.	9	100	-	-	-	-	-	-	-	-	9
<i>Mentha xpiperita</i> L.	16	30.8	18	34.6	-	-	7	13.5	11	21.1	52
<i>Origanum vulgare</i> L.	8	61.5	5	38.5	-	-	-	-	-	-	13
<i>Pelargonium peltatum</i> hort.	-	-	7	100	-	-	-	-	-	-	7
<i>Paeonia suffruticosa</i> Andr.	-	-	3	100	-	-	-	-	-	-	3
<i>Potentilla atrosanguinea</i> Lodd.	5	100	-	-	-	-	-	-	-	-	5
<i>Primula farinosa</i> L.	1	100	-	-	-	-	-	-	-	-	1
<i>Prunus laurocerasus</i> L.	3	75	1	25	-	-	-	-	-	-	4
<i>Pyracantha coccinea</i> M. Roem.	3	100	-	-	-	-	-	-	-	-	3
<i>Rudbeckia fulgida</i> Aiton	3	27.3	8	72.7	-	-	-	-	-	-	11
<i>Scabiosa lucida</i> L.	-	-	5	100	-	-	-	-	-	-	5
<i>Solidago</i> sp.	8	80	2	20	-	-	-	-	-	-	10
<i>Spirea chamaedryfolia</i> L. emend. Jacq.	5	50	4	40	-	-	-	-	1	10	10
<i>Spirea</i> sp.	13	76.5	3	17.6	-	-	-	-	1	5.9	17
<i>Tagetes tanuifolia</i> Cav.	6	66.7	3	33.3	-	-	-	-	-	-	9
<i>Tamarix</i> sp.	36	40.9	24	27.3	-	-	-	-	28	31.8	88

Flower	Trophic group*										Total
	D		S		F		P		K		
	No	[%]	No	[%]	No	[%]	No	[%]	No	[%]	
<i>Thymus vulgaris</i> L.	3	50	1	16.7	-	-	-	-	2	33.3	6
<i>Vinca minor</i> L.	1	100	-	-	-	-	-	-	-	-	1
<i>Vitariana primuliflora</i> Bertol.	3	50	3	50	-	-	-	-	-	-	6
Total	247	45.3	184	33.8	3	0.5	26	4.8	85	15.6	545

\* D - predators, S - saprophages, F - phytophages, P - parasites, K - coprophages

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### Występowanie muchówek bzygowatych (*Syrphidae*) na kwiatach na terenie Ogrodu Botanicznego Uniwersytetu Jagiellońskiego w Krakowie

#### STRESZCZENIE

Obserwacje nad fauną *Syrphidae* na terenie Ogrodu Botanicznego UJ w Krakowie prowadzono w latach 2008-2009. Muchówki odławiano z kwiatów siatką entomologiczną metodą „na upatrzonego w określonym czasie” od połowy maja do połowy sierpnia. Z kwiatów odłowiono 545 muchówek z rodziny *Syrphidae* należących do 40 gatunków z 5 grup troficznych (drapieżce, saprofagi, fitofagi, pasożyty, koprofagi). Ponad 45% (247 sztuk) stanowiły muchówki, których larwy są drapieżne, należące do 24 gatunków. Wśród gatunków drapieżnych najliczniej występowały *Episyrphus balteatus* (De Geer, 1776) – 30%, *Sphaerophoria scripta* (Linnaeus, 1758) – 22.3%, *Eupeodes corollae* (Fabricius, 1794) – 12.5%, *Syrphus ribesii* (Linnaeus, 1758) – 6.5% i *Sphaerophoria rueppelli* (Wiedemann, 1830) – 4.8%. Muchówki odłowiono z 44 gatunków roślin – kilku krzewów i roślin zielnych. Najbardziej atrakcyjny dla drapieżnych *Syrphidae* okazał się tamaryszek (*Tamarix* sp.). Z roślin zielnych najbardziej atrakcyjne okazały się ubiorek gorzki (*Iberis amara* L.), smagliczka płózka (*Alyssum repens* Baumg.) i mięta pieprzowa (*Mentha piperita* L.).